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SOUTH AFRICAN NATIONAL STANDARD

The installation of pipes and appliances for use with natural gas

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Table of changes

Change No.	Date	Scope

Foreword

This South African standard was approved by National Committee SABS TC 1019, *Gas supply, handling and control (fuel, industrial and medical gases)*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in November 2011.

Reference is made in 3.4(a) to "relevant national legislation". In South Africa this means the Trade Metrology Act, 1973 (Act No. 77 of 1973).

Reference is made in 3.4(b) and 3.81 to "relevant national legislation". In South Africa this means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

Reference is made in 3.4(c) to "relevant national legislation". In South Africa this means the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

This document was written in order to support a specific South African Regulation and, of necessity, includes references to South African legislation. It therefore might not be suitable for direct application in other jurisdictions where conflicting legislation exists.

In South Africa control of pressure vessels and pressure systems is regulated in terms of the Pressure Equipment Regulations by the Chief Inspector of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) of the Department of Labour.

Annexes B, E and F form an integral part of this document. Annexes A, C and D are for information only.

Contents

Contents (*concluded*)

The installation of pipes and appliances for use with natural gas

1 Scope

1.1 This standard sets out requirements for the installation of consumer piping, flueing, ventilation and appliance installations which are associated with the use or intended use of fuel gases for natural gas (NG) and simulated natural gas (SNG).

1.2 The requirements cover piping systems from the outlet of the consumer billing meter installation through to the consumer piping from the property boundary.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

AS 4176, *Polyethylene/aluminium and cross-linked polyethylene/aluminium macro-composite pipe systems for pressure applications*.

AS 4267, *Pressure regulators for use with industrial compressed gas cylinders.*

AS/NZS 1734, *Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate.*

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

AS/NZS 4130, *Polyethylene (PE) pipes for pressure applications.*

BS 1600, *Specification for dimensions of steel pipe for the petroleum industry*.

EN 161, *Automatic shut-off valves for gas burners and gas appliances*.

EN 15266, *Stainless steel pliable corrugated tubing kits in buildings for gas with an operating pressure up to 0,5 bar.*

SANS 62-1, *Steel pipes – Part 1: Pipes suitable for threading and of nominal size not exceeding 150 mm.*

SANS 62-2, *Steel pipes – Part 2: Screwed pieces and pipe fittings of nominal size not exceeding 150 mm*.

SANS 460, *Plain-ended solid drawn copper tubes for potable water.*

SANS 1067-2, *Copper-based fittings for copper tubes – Part 2: Capillary solder fittings.*

SANS 1109-1/ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation*.

SANS 1123, *Pipe flanges.*

SANS 1306-1/ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation*.

SANS 1539, *Appliances operating on liquefied petroleum gas – Safety aspects.*

SANS 4437/ISO 4437, *Buried polyethylene (PE) pipes for the supply of gaseous fuels – Metric series – Specifications.*

SANS 10087-1, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation*.

SANS 10140-3, *Identification colour markings – Part 3: Contents of pipelines.*

SANS 10141, *The processing, testing and storage of silver-gelatin microfilm for archival purposes.*

SANS 10268-2, *Welding of thermoplastics – Welding processes – Part 2: Electrofusion welding.*

SANS 10400 (SABS 0400), *The application of the National Building Regulations*.

SANS 10400-T, *The application of the National Building Regulations – Part T: Fire protection*.

SANS 10400-V, *The application of the National Building Regulations – Part V: Space heating*.

SANS 50331/EN 331, *Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings*.

3 Definitions

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

3.1
acceptable
acceptable to the approving authority

3.2
accessible
access can be gained without hazard or undue difficulty for inspection, repair, renewal, or operational purposes

3.3
approved
approved by the approving authority

3.4
approving authority
appropriate of the following:

a) within the scope of the relevant national legislation (see foreword), and in respect of the control of the mass of gas sold: the Director of Trade Metrology;

b) within the scope of the relevant national legislation (see foreword), and in respect of the control of general safety: the Chief Inspector;

c) within the scope of SANS 10400 and in respect of the evaluation and control of installations in accordance with SANS 10087-1: the local authority in whose area of jurisdiction the installation is installed;

d) within the scope of the relevant national legislation (see foreword), and in respect of the control of the general safety: the Chief Inspector

3.5
appliance
complete operating unit that uses fuel gas to operate

3.6
appliance gas pressure regulator
see "gas pressure regulator"

3.7
assembly
system that includes connection by pipe or similar ducts, fittings and valves that operate under gauge pressure and are used for the conveyance of vapour

3.8
atmospheric burner
see "burner"

3.9
bathroom
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, etc.

3.10
bedroom
room used or intended to be used for sleeping

3.11
breather vent
orifice or opening designed to permit atmospheric pressure to act on one side of the diaphragm of a regulator or similar device

3.12
burner
device that positions a flame in the desired location by delivering gas and air to that location in such a manner that continuous ignition is accomplished and includes the following:

3.12.1
atmospheric burner
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

3.12.2
forced draught burner
system where all of the air, oxygen or a mixture of the two used for combustion is provided under pressure

3.12.3
induced draught burner
system where all or part of the air for combustion is introduced by providing suction in the combustion chamber by mechanical means

3.13
combustible material
material which will ignite and burn and includes material which has been flame-proofed

3.14
combustible surface
surface made of combustible material

3.15
combustion products
constituents resulting from the combustion of a fuel with air, oxygen or mixture of the two, including the inert gases associated with the fuel and the air but excluding any other diluent or contaminant

3.16
common flue
see "flue"

3.17
compressed natural gas
CNG
natural gas stored under pressure in a cylinder

3.18
competent person
any person that has the knowledge, training and experience specific to the work or task being performed

3.19
condensate
liquid which separates from a gas (including flue gas) due to a reduction in temperature

3.20
condensation
see "condensate"

3.21
consumer billing meter
see "meter"

3.22
consumer piping
system of pipes, fittings, components and equipment which conveys gas from the outlet of the consumer billing meter installation, or for gases stored in a tank or cylinder from the outlet of the first gas pressure regulator, to the appliance inlet

NOTE In the case of a reticulated LP gas system, the "first gas pressure regulator" refers to the first regulator on the site if no meter is installed.

3.23
consumer piping gas pressure regulator
see "gas pressure regulator"

3.24
critical location
area where gas cannot be freely vented to the outside atmosphere

3.25
cupboard
enclosed recess constructed primarily for storage purposes

3.26
decorative gas log fire
appliance which simulates a solid fuel fire, its primary function lying in the aesthetic effect of the flames

3.27
direct-fired air heater
appliance for heating a forced air stream where the combustion products are released with the heated air

3.28
draught diverter
device, without moving parts, fitted in the flue of an appliance for isolating the combustion system from the effects of pressure changes in the flue

3.29
dust trap
tee piece fitted at the lowest practical location in a riser and having a short vertical capped pipe fitted to it for the collection and removal of dust, scale, etc.

3.30
elevated cooking appliance
see "appliance"

3.31
enclosure
compartment, an enclosed area or a partitioned-off space primarily used for the installing of an appliance, gas cylinder, meter, gas pressure regulator or other associated equipment

3.32
excess air
air in excess of that required for complete combustion that is mixed unchanged with the combustion products, in the combustion chamber

3.33
excess flow valve
open valve that closes automatically when a predetermined flow rate in a particular direction is exceeded

3.34
fire damper
device for automatically closing off the flow of air through a ventilation opening in the event of fire

3.35
fire-resistant material
material having thermal and physical properties suitable for use in protecting a combustible surface, etc.

3.36
fitting
component used to join pipes, or to change direction or diameter of a pipe, or to provide a branch, or to terminate a pipe

3.37
flue
passage through which flue gases are conveyed from an appliance to a discharge point. Types of flue include:

3.37.1
common flue
flue conveying the flue gases from two or more appliances

3.37.2
natural draught flue
flue in which the draught is provided by the buoyancy (rising) effect of the hot gases in it

3.37.3
open flue
flue system containing a draught diverter or canopy

3.37.4
power flue
flue from which the flue gases are removed by a fan or other exhausting device installed in the flue

3.37.5
twin wall flue
type of flue in which the inner flue conduit is encased by an outer casing of specific dimensions

3.38
flue brick
hollow brick designed specially for use as a flue

3.39
flue cowl
device placed at the end of an open flue designed to prevent the entry of rain and minimize the disturbing effect of wind while not hindering the discharge of flue gases

3.40
flue gases
combustion products plus all diluents and contaminants

NOTE These include, where applicable excess air, dilution air, process air and waste products from the process.

3.41
flue terminal
point at which flue gases discharge from a flue

3.42
forced draught burner
see "burner"

3.43
gas
combustible fuel gas which may be one of the following:

3.43.1
natural gas
NG
hydrocarbon gas, consisting mainly of methane

3.43.2
simulated natural gas
SNG
gas comprising a mixture of LP Gas and air, in the approximate proportions of 55 % LP Gas and 45 % air for commercial propane

3.44
gas consumption
rate of energy consumed by an appliance under specific conditions and expressed in Megajoules per hour (MJ/h)

3.45
gas installation
combination of the following used or intended to be used in the supplying and utilization of gas, taken as separate items or as a whole: consumer piping, fittings, components, appliances, flues, sub-meters, apparatus or other devices and associated requirements

3.46
gas load
total gas consumption of all downstream appliances

3.47
gas pressure regulator
device that automatically regulates the outlet pressure of the gas passing through it to a predetermined value

NOTE In more 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.

3.47.1
appliance gas pressure regulator
gas pressure regulator fitted to an appliance

3.47.2
consumer piping gas pressure regulator
gas pressure regulator installed in the consumer piping to reduce the gas pressure to a section of consumer piping

3.47.3
zero regulator (zero governor)
gas pressure regulator that operates at zero or near zero (atmospheric) pressure, usually in conjunction with an air-gas proportioning device

3.48
high rise building
building having ten or more storeys above ground level

3.49
hose assembly
flexible tube or pipe complete with end couplings

3.50
hot-work
work performed using an open flame such as welding, cutting grinding etc.

3.51
hot water boiler
vessel wherein water is intended to be heated to a temperature exceeding 99 °C by the application of heat from the combustion products to the vessel without the generation of steam

3.52
ignition source
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

3.53
induced draught burner
see "burner"

3.54
insulating joint
fitting designed to prevent the flow of electric current across the joint

3.55
interlock
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

3.56
lockout
safety shut-down condition of the control system that requires a manual reset in order to restart

3.57
lower explosive limit
lowest percentage of gas in air at which combustion can be self-sustaining at standard temperature (15 °C) and pressure (101,325 kPa absolute)

3.58
mechanical joints
fittings excluding welded and soldered section

NOTE All other joints types are deemed to be mechanical joints.

3.59
main run
run of consumer piping from the meter, or for gas stored in cylinders, the first gas pressure regulator, to the furthest appliance position

3.60
manual shut-off valve
manually operated valve which allows an appliance or a section of consumer piping to be shut off

3.61
meter
device used to measure the volume of gas passing through it and includes the following:

3.61.1
consumer billing meter
meter that is used to bill the consumer for gas used

3.61.2
sub-meter
meter for measuring gas which has already passed through a consumer billing meter

3.62
natural draught burner
see "atmospheric burner"

3.63
natural draught flue
see "flue"

3.64
network
gas distribution system comprising a pipe, or system of pipes, for transporting gas, but excluding consumer piping

3.65
network operator
person or organization that owns or operates all, or part, of a network

3.66
non-return valve
valve designed to operate automatically to prevent reversal of flow in a pipe

3.67
open flue
see "flue"

3.68
operating pressure
gas pressure that the consumer piping or the appliance is or will be subjected to under normal operating conditions

NOTE For pressure testing purposes operating pressure is the lockup pressure of the next upstream regulator.

3.69
over-pressure protection
system preventing the pressure in piping or an appliance from exceeding a predetermined value

3.70
plant room
room designed to accommodate one or more appliances in which the appliances can be fully maintained and is not normally occupied or frequented for extended periods

3.71
pool heater
appliance designed for heating water in a swimming pool, spa pool or similar body of water

3.72
portable appliance
see "appliance"

3.73
power flue
see "flue"

3.74
premises
property including a house or building and any grounds belonging to it

3.75
pressure
pressure above atmospheric pressure, or gauge pressure

3.76
purge/purging
with respect to consumer piping means:

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.

3.77
push-on connector
method of attaching a laboratory bunsen burner to consumer piping in which a flexible tube end slides over a special nipple and is held by friction

NOTE The tube is usually made of rubber or synthetic rubber.

3.78
quick-connect device
two-part mating plug and socket assembly for connecting an appliance to a gas supply without the use of tools

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

3.79
rated working pressure
maximum allowable inlet pressure specified by the manufacturer

3.80
regulator
see "gas pressure regulator"

3.81
registered gas practitioner
person that has the ability, appropriate training, knowledge and experience to carry out the work that is undertaken in a safe and proper manner, and who is registered in accordance with the requirements of the relevant national legislation (see foreword)

3.82
riser
vertical section of the consumer piping

3.83
safety shut-off system
arrangement of valves and associated controls which shut off the supply of gas when required, by a device which senses the approach of an unsafe condition

3.84
safety shut-off valve
valve used to shut off the gas supply automatically when a signal is generated indicating the approach of an unsafe condition

3.85
steam boiler
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

3.86
sub-meter
see "meter"

3.87
tailpipe
provision placed at a low point in the consumer piping, to collect water and from which it can be removed

3.88
temperature limit device
device which automatically causes the gas supply to be interrupted when the temperature at the control point reaches a predetermined limit

3.89
trivet
grid located over the open burners of a cooking appliance to support vessels being heated

3.90
valve train
combination of valves, regulators, pipe pieces, unions, etc., which form an integrated system for flow or pressure control and safe operation of a burner

3.91
vent line
pipe which is connected to a gas pressure regulator, relief valve or a double block and vent safety shut-off system, and will convey escaping gas to a safe location

3.92
ventilation
supply and removal of air (by natural or mechanical means (or both)) to and from a space or spaces in a building

NOTE It normally comprises a combination of purpose-provided ventilation and infiltration.

3.92.1
permanent ventilation
ventilation opening which is permanently fixed in the open position

3.92.2
ventilation opening
any means of purpose-provided ventilation (whether it is permanent or closable), which opens directly to external air, such as the openable parts of a window, a louver or a background ventilator

NOTE It also includes any door that opens directly to external air.

3.93
vent valve
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

4 General work and safety requirements

4.1 General

All gas installations complete with all associated equipment and appliances and any subsequent alteration, repair or modification to an installation, shall be carried out by a registered gas practitioner qualified to the appropriate grade either domestic or commercial as relevant.

4.2 Termination of gas supply

4.2.1 Consumer piping, alterations, repairs and extensions

Prior to any re-connection the system shall be pressure tested for soundness and have been leak tested.

Where consumer piping is to be altered, repaired or extended, the work shall be performed with the gas supply turned off and where hot work is to be applied in a domestic or commercial environment the gas practitioner shall obtain permission from the gas supplier to shut-off the gas supply. Where this is not practicable, the supplier of the gas shall be consulted (see 4.9).

Before turning off a gas supply notify the consumer of the pending withdrawal of the gas supply.

4.2.2 Re-connection of gas supply

Before re-connection of the gas supply ensure all openings from which gas can escape are sealed or isolated, before allowing gas under pressure into the installation.

4.3 Gas supply and installation

Ensure that the following requirements are met before commencing with an installation:

a) a gas supply line with gas is available to the premises; and

b) the pressure of the gas available at the inlet to the consumer piping is sufficient to operate the appliance correctly.

4.4 Purging

4.4.1 Purging before commencing work

Before commencing work on consumer piping that contains or has contained gas, the piping shall be purged with an inert gas. The accumulation of any gas in the vicinity of the work shall be prevented.

NOTE For further information on purging a gas system see annex A.

4.4.2 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 an appliance. All branch lines are to be individually purged.

4.5 Sealing of gas pipes

4.5.1 Where an alteration, repair or extension to consumer piping necessitates the removal of an appliance or fitting or the cutting of an installed pipe, all open ends, other than those at the immediate work area, shall be sealed for the duration of the work.

Until all the appliances are connected, each point shall be securely capped or plugged, and marked to indicate that it is a gas point. Where the appliance is removed from the system in use, such a gas point shall also be capped or plugged.

When the work site is vacated all open ends shall be sealed as described above. The closing of a shut-off valve will not satisfy this requirement unless the outlet of the valve is sealed.

4.5.2 Where an outlet has been provided for connection of an 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 as in 4.5.1 above.

4.6 Leak testing

4.6.1 Leak testing gas installations

Immediately before any gas installation is put into operation the consumer piping, appliances and valve trains shall be tested in accordance with the requirements as given in annex B.

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

4.6.2 Leak testing after alteration, repair, extension or new installations

The gas tightness of any part of a gas installation, shall be tested, (50 kPa or 2 × the working pressure whichever is the greater is to be used) in accordance with annex B, immediately before supply is restored. Air or the gas for which the system is designed, or an inert gas shall be the only substances used within consumer piping for testing or the locating of gas leaks.

WARNING: Oxygen is not to be used as a substitute for air.

4.7 Hot-work on consumer piping

Where it is necessary to perform any hot-work on a branch or into consumer piping the gas supply shall be shut-off and the line purged prior to the hot-work commencing.

4.8 Increasing of operating pressure

Where it is necessary to increase the operating pressure the gas supplier shall be consulted and the following shall apply:

a) materials and components in the existing installation shall be checked to ensure that the existing installation can withstand the increased operating pressure;

b) consumer piping is to be tested in accordance with annex B; and

c) written permission is obtained from the gas supplier.

4.9 Unsafe gas installations

Any gas installation found to be unsafe and the gas supply cannot be isolated immediately shall be reported to the appropriate approving authority and gas supplier. (See also 4.10.1.) The consumer shall be notified immediately and the use of the installation shall be discontinued until it has been corrected. The installer shall notify the appropriate authority of such installations and changes.

4.10 Safety requirements

4.10.1 Gas leaks

Where there is a suspected gas leak or a gas leak or gas is present in the atmosphere, the gas supply to the area shall be isolated and closed immediately. Precautions shall be taken to minimize the possible accidental ignition of the gas. Smoking, open flames, welding or other ignition sources shall not be permitted in the vicinity.

The use of a soap and water solution applied externally to pipework and joints is a common practice within the gas industry to find gas leaks, however alternate methods such as gas detecting equipment can be used to locate a gas leaks for example a gas detecting sensor placed within a room or confined space.

WARNING: Under no circumstances shall matches, candles or any other ignition source be used to detect leaks in gas lines or joints.

4.10.2 Safe discharge of static electricity in plastic piping

4.10.2.1 When working on consumer piping constructed of plastics, measures shall be taken to ensure the safe discharge of any static electricity that may be present in the piping or become present during work.

4.10.2.2 When working on a live system the following method to get rid of the static electricity may be applied:

a) Wet the ground and dampen the pipe at the work area with a wet cloth.

b) 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.

4.10.3 Electrical safety bonding or bridging

Where a metal pipe is to be cut, or an appliance, component or fitting is to be disconnected from consumer piping, a suitable 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 and pipeline has been declared safe.

4.10.4 Clearing a blockage in consumer piping

Where a blockage is to be cleared from the consumer piping, all of the following shall apply:

a) The consumer billing meter and all appliances are to be disconnected or isolated before any suction or force is applied.

b) The pipeline needs to be purged using only air or inert gas to clear the blockage.

c) On completion of the work the consumer piping is to be tested in accordance with annex C.

5 Materials and components

5.1 General requirements

5.1.1 Material and component condition

All materials shall be checked prior to installation to ensure that such materials and components used in the system are free from damage and defects.

5.1.2 Acceptability of material and components

Materials and components selected for a gas installation shall be compatible and acceptable for use with the following:

a) type of gas being conveyed;

b) pressure to which they may be subjected; and

c) the environment in which they will be installed.

5.1.3 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 without the written approval of the manufacturer of the proprietary system. Transitions from conventional piping to the proprietary system shall be made with the appropriate proprietary components.

5.1.4 Re-use of materials and components

Before a pipe, fitting or any other item removed from any existing gas installation is re-used, it shall comply with the requirements as given in 5.1.1 and 5.1.2. A flange gasket shall never be re-used.

5.2 Materials

Materials used in the pipe system shall comply with the appropriate of the following standards as listed in table 1 and shall be clearly marked in accordance with the relevant manufacturing standard to prove such compliance:

Table 1 — Piping materials and duty limits

1	2	3	4	5	6	7
Operating limit	**Pipe**		**Fittings**		**Jointing**	
kPa	**Pipe**	**Limiting conditions**	**Fittings**	**Limiting conditions**	**Method**	**Limiting conditions**
200	Copper tubes (class I tubing or better): SANS 460 (phosphorus deoxidized copper Cu-DHP	For the following: Critical locations pipes (see 5.2.2)	Welded/soldered fittings: SANS 1067-2	None	Welded, brazed or soldered	None
		Buried pipes (see 5.2.1.8)	Compression fittings	Not allowed to be buried or in critical locations	Olive type	Not allowed to be buried or in critical locations
		Embedded pipes (see 5.2.1.9)			Flared type	
100	Corrugated stainless steel semi-rigid pipe and associated fittings: EN 15266	Not permitted for use as a final connection to an appliance (see 5.2.1.15)	Components that terminate with a thread and specified or provided by the manufacturer	Operating limit of 7 kPa	Mechanical jointing using components specified or provided by the pipe manufacturer	Joints to be accessible for inspection and renewal. Not to be welded or jointed by any other method
200	Steel pipes to: SANS 62-1 heavy duty	Only steel pipes to be used. External corrosion protection required. No galvanizing allowed.	Screwed fittings to SANS 62-2 or flanges made to SANS 1123	Not to be embedded if screwed or buried if flanged external corrosion protection required	Welded, or mechanical means Threads to be tapered	Can be screwed up to 32 mm dia. for schedule 40 above this pipe to be welded
	Steel pipes: BS 1600	Only steel pipes to be used. External corrosion protection required. No galvanizing allowed.	Steel fittings: BS 1600	Not to be embedded if screwed or buried if flanged external corrosion protection required	Welded, or mechanical means Threads to be tapered	Can be screwed up to 32 mm dia. for schedule 40. Can be screwed up to 80 mm dia. for schedule 80
100	HDPE pipes and fittings for use with petroleum product: SANS 4437	Only to be buried and not allowed under a building	Welded fittings	Only to be buried and not allowed under a building	Electrofusion or butt welding only SANS 10268-2	None
70	Composite pressure pipe	See 5.2.1.1 and 5.2.1.8	Fittings are to be compatible with the pipe selection (see 5.1.3)	See AS 4176	Joints to be formed using crimp tool acceptable to the manufacturer	See 5.2.1

5.2.1 Design and installation of piping

5.2.1.1 The following requirements shall be applied in addition to any similar site specific details that might be deemed necessary by the gas practitioner:

a) Composite pipe is subject to the following requirements:

1) usage above ground is allowed subject to the pipe being protected from direct sunlight;

2) when embedded in walls or floors, no joints shall be allowed in the embedded sections;

3) no joints are allowed in pipe sections passing through cavity walls;

4) use in ceilings is restricted. Composite pipes shall only be used in critical locations when sleeved in a steel sleeve;

5) contact with solvents shall be avoided;

6) the pipe shall not be closer than 150 mm to any heat source;

7) the maximum supply pressure shall not exceed 150 kPa;

8) the pipe shall not be connected directly to an appliance(s) that needs to be moved on a regular basis; and

NOTE The preferred type of crimp style for use in South Africa is the "U" type.

b) where electrical cables are being run on the same wall, gas pipes shall be at least 150 mm apart from the electrical cables and other electrical apparatus. This excludes electric cables in appliances.

5.2.1.2 Installations at residential and commercial premises that use natural gas systems above 500 MJ/h shall require plans. Buried pipelines shall be indicated on the building plan.

Plans and drawings shall preferably be drawn to one of the following scales, however, where permission from the local authority has been obtained, a marked-up drawing or diagram that indicates the meter, pipeline, and shut-off valve(s), and the required notes for this standard, shall be acceptable:

a) Site plans: 1:1 000, 1:500, 1:300, 1:200, or 1:100.

b) Layout drawings: 1:100, 1:50 or 1:20, provided that in the case of elevations 1:200 may be used.

NOTE The local authority may, in circumstances deemed exceptional by it, accept a scale not provided for in this subclause.

For other information regarding building regulations, refer to the relevant part of SANS 10400.

5.2.1.3 If the building shows any sign of settlement or cracking and in places where expansion joints are applied, the pipework shall be protected against stresses caused by further movement of the building. For example, the pipework should be mounted on wooden battens or ample bends that will allow the pipe to flex without being excessively stressed in the affected area.

5.2.1.4 Gas piping shall not be used as an earth for electrical circuits. Gas piping shall be identified for type or use and appropriately marked with "NG" every 2 m.

5.2.1.5 In buildings with wooden floors that consist of floor boards supported on joists and in which the piping is installed before the boards are laid, the pipes shall run between and parallel to the joists and shall be provided with proper supports. The usual method of securing the pipes to the side of a joist with clips is recommended.

Where this is not possible, they can be laid across the joists in notches, provided that the depth of the notches does not exceed one-fifth of the depth of a joist and their distance from the edge of the nearest support for the joist does not exceed one-sixth of the span between joist supports.

Where practicable, notches should have radiused corners, for example, the notches should be formed by cutting into drilled holes. Where pipes cannot be laid parallel to joists and the depth of the joists and the depth of the required notches do not allow the use of a pipe of the required size, a number of smaller pipes of equivalent total capacity can be used.

5.2.1.6 Burrs formed when a pipe is cut, shall be removed, and any dust, dirt and scale inside the piping and pipe fittings shall be cleaned out before assembly. During the installation stage, care shall be taken to ensure that the bore of a pipe is not restricted by the entry of any material.

While pipe fitting is in progress, all open pipe ends shall be temporarily capped or plugged (with a screwed plug or a cap specifically designed for the purpose) pending extension or completion of the installation. The use of wooden and similar plugs shall be strictly forbidden.

5.2.1.7 Emphasis shall be placed on the need to

a) avoid interference with other installed services,

b) provide reasonable access for inspection, and

c) obviate the exposure of the pipes to abnormally high or low temperatures.

5.2.1.8 Where pipelines are to be buried, all pipes shall be installed to a depth of at least 500 mm. For pipelines that are buried, the backfill shall incorporate an approved means (for example, chevron tape placed about halfway between the pipe and the surface) to identify the existence of the pipe. Buried pipelines paths shall be indicated on the building plan.

All buried pipes shall be corrosion protected.

All other joints that are not welded, soldered or electrofusion joints (for example mechanical joints) shall be available for maintenance and shall not be buried.

5.2.1.9 Where concealed pipework is required in a building that has floors of concrete or other solid material, where the building plans are required (see 5.2.1.2), they shall indicate one of the following concepts:

a) ducts/trenches of approved depth; or

b) sleeves; or

c) fully embedded pipes.

5.2.1.10 When pipes are chased in a concrete floor,

a) they shall require floor plans,

b) they shall be placed at least 50 mm below the top of the concrete,

c) all joints in copper pipes shall be brazed or soldered,

d) no mechanical joints shall be buried or embedded in floors or walls, and

e) steel and copper pipes shall be protected against corrosion in an approved manner.

NOTE Protection may mean an electrical conduit or HDPE piping for copper tubing, or a wrapping for copper or steel piping, or plastic coating, etc.

5.2.1.11 Pipes that are to be embedded in concrete before the completion of a floor shall

a) not have any type of mechanical joint including screwed joints,

b) require floor plans,

c) when steel or copper piping is used for this purpose, be protected against corrosion in an approved manner, and

d) be placed at least 50 mm below the top of the concrete.

5.2.1.12 If a system of ducts is used, ventilation to open air shall be provided at the highest point.

5.2.1.13 Branches in pipelines shall be developed with the use of standard wrought steel pipe fittings.

5.2.1.14 Where copper pipes are required to pass through any wall, they shall be sleeved.

5.2.1.15 Composite pipes are not permitted to be used as a final connection to an appliance.

5.2.2 Pipes in critical locations

5.2.2.1 Critical locations are locations where gas cannot be vented freely to the atmosphere. Examples of these locations are the cavities of cavity walls, lift shafts, flues, or air ducts.

5.2.2.2 Pipes shall not pass through the cavity of cavity walls or through lift shafts, flues, ceiling voids or air ducts unless they are designed and constructed in accordance with an approved standard applicable to critical locations. Pipes that pass through critical locations shall be welded.

Where pipes pass through walls that might or might not be regarded as cavity walls, such pipes shall be sleeved.

5.2.2.3 Where copper tubes are used, they shall have no joints and shall be sleeved. The sleeve shall be a steel tube that complies with SANS 62-1.

5.2.2.4 Gas pipelines shall not be installed in any dedicated emergency route. However, where approval from the local authority has been granted for installation in emergency routes, the pipe shall be schedule 40 piping, be of welded construction and have no mechanical joints.

5.2.2.5 Gas piping shall not be laid in the same service as "Electrical Bus-Bars".

5.2.2.6 Gas piping shall be at least 150 mm away from any electrical cables where they run parallel to each other (see also 5.2.1.10(e)). Gas piping may cross electric cables or vice versa, provided that these do not come into contact with each other and there are no joints in either line within 150 mm of such crossings.

An alternate method may be considered where the 150 mm cannot be achieved, such as, placing both the electrical cable and the gas pipe into separate isolation conduits.

5.2.2.7 The steel pipes listed in table 1 may be installed in critical locations, without additional sleeves and provided that no mechanical joints shall be made within these areas. Where pipes are to be welded, a competent person (welder) shall undertake this work.

5.2.2.8 Where pipes are installed in accordance with the requirements of 5.2.2.7, a pressure test of at least 400 kPa shall be done to ensure that no leaks are in the system. The pressure shall be maintained for at least 60 min to ensure that no pressure drop occurs.

5.2.3 Restricted fittings and piping

The fittings and piping listed are restricted as follows:

a) A push-on connector shall only be used in accordance with 6.9.

b) A brass fitting (mechanical joints) shall not be buried in the ground.

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

d) The fitting types

1) HDPE pipes and fittings shall not be used above ground. When used underground these assembled joints referred to in table 1, shall be electrofusion or butt welded to the pipe. Mechanical joints shall not be used underground however where a riser is used the mechanical joint shall be above ground with the riser section not being more than 3 times the diameter with a maximum height of 500 mm. Such risers shall be protected against ultraviolet radiation (UV).

2) that depend on metallic surface to non-metallic surface contact to provide a gastight seal; and

3) metallic fittings of the olive or compression type that contain non-metallic components.

e) 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.

f) No other piping system shall be hung from any gas line. A gas line shall be independently mounted at all times.

5.2.4 Prohibited fittings

The following fittings shall not be used:

a) A capillary fitting containing soft-solder.

b) A plain nipple (running/parallel thread).

c) A single plastic/rubber olive type fitting other than in a permanent joint.

d) A long screw (connector).

e) An internally threaded unplasticised polyvinylchloride (PVC-U) fitting.

5.2.5 Flue cowls

A flue cowl shall comply with the manufacturer's specification.

5.2.6 Fire-resistant material

Fire-resistant material shall comply with the requirements as found in SANS 10400.

5.2.7 Flue material

Material for flues shall comply with table 2.

5.2.8 Gasket material

The material for a gasket shall be acceptable for the operating pressure and temperature of the system and shall be compatible with the chemical constituents of natural gas. A metal gasket shall be acceptable for the application and have a melting point exceeding 500 °C.

NOTE An aluminium "O" ring and a spirally wound metal gasket are acceptable.

Table 2 — Flue materials

1	2	3	4	5
Material	**Protective finish**	**Application temperature restrictions**	**Limitations (see note)**	
Aluminium alloy 1100, 3003 0,7 mm thickness: AS/NZS 1734	None	Any appliance Not to exceed 300 °C	Only where accessible for inspection and renewal: Internal flues not to exceed 12 m in length, external flues not to exceed 7 m	
Aluminium alloy 1100, 3003 (flexible liner and flexible flue connector) a) Chimney liner flex – 2 ply 0,26 mm thickness b) Single wall flexible connector – 0,31 mm thickness	None	Any appliance Not to exceed 300 °C	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) or (b) to be used where mechanical damage could occur	
Bricks (clay building) Cement or lime mortar joints	None	Any appliance Not to exceed 300 °C	Only slight condensation allowable, minimum wall thickness of flue 50 mm	
Bricks	Inside face lined with acid-resisting tiles embedded in acid-resisting jointing material	Any appliance, particularly suitable for heavy condensation (not to exceed 300 °C)	Flues lined with non-absorbent tiles shall have provision made for condensate drainage	
Bricks	Faced with water and acid-proof cement mix	Any appliance (not to exceed 300 °C)	Only slight condensation allowable	
Copper not less than 0,5 mm thickness	None	Any appliance (not to exceed 300 °C)	Only slight condensation allowable	
Fibre cement, light grade (asbestos free)	Autoclaved	Any appliance (not to exceed 300 °C)	Only slight condensation allowable	
Fibre cement, heavy grade (asbestos free)	Autoclaved	High temperature flues (above 300 °C)	None	
NOTE In addition to the listed limitations, consideration needs to be given to the deleterious effect of some flue products from some appliances, e.g., pottery kilns, incinerators, atmosphere generators or the like.				

Table 2 (*continued*)

1	2	3	4	5
Material	**Protective finish**	**Application temperature restrictions**	**Limitations (see note)**	
Fire brick, set in fireclay	None	Especially very high temperature flues (above 300 °C)	None	
Flue bricks (see 3.38)	None or glazed internally	Any appliance but if condensation is heavy, internally glazed flue bricks shall be used (not to exceed 300 °C)	Approving authority to be consulted prior to commencement of work Joints to be acid-resisting Bricks glazed internally shall have provision made for condensate drainage Provision of an air gap between the flue brick and the finished wall may be necessary to minimize heat transfer Not glazed. Only slight condensation is allowable	
Mild steel 1,6 mm thickness	None	High temperature flues (above 300 °C)	Only where accessible for renewal	
Mild steel 0,6 mm thickness 0,8 mm thickness 1,0 mm thickness	Aluminised 122 g/m^2, or Z275 zinc	Any appliance (not to exceed 300 °C)	Only where accessible for inspection and renewal: Internal flues not to exceed 12 m in length, external flues not to exceed 7 m	
			Wall thickness mm	Maximum flue diameter mm
			0,6 0,8 1,0	100 200 300
NOTE In addition to the listed limitations, consideration needs to be given to the deleterious effect of some flue products from some appliances, e.g., pottery kilns, incinerators, atmosphere generators or the like.				

Table 2 (*concluded*)

1	2	3	4	5
Material	**Protective finish**	**Application temperature restrictions**	**Limitations (see note)**	
Precast concrete bricks or blocks	None	Any appliance (not to exceed 300 °C)	Only slight condensation allowable, minimum wall thickness of flue 50 mm	
Stainless steel 0,5 mm thickness 0,7 mm thickness	300 and 430 series grade	Any appliance (not to exceed 300 °C)	Wall thickness mm	Maximum flue diameter mm
			0,5 0,7	100 200
PVC-U	None	Low temperature flues (not to exceed 60 °C)	None	
NOTE In addition to the listed limitations, consideration needs to be given to the deleterious effect of some flue products from some appliances, e.g., pottery kilns, incinerators, atmosphere generators or the like.				

5.2.9 Vent line material

A vent line shall be constructed of the following material as appropriate:

a) Metal pipe and fittings, which comply with table 1, when in or under a building.

b) Metal pipe and fittings, or PVC-U pipe and fittings suitable for exposed conditions when outdoors.

5.3 Components

5.3.1 Automatic shut-off valves

When an automatic shut-off valve is used it shall comply with EN 161.

5.3.3 Manual shut-off valves

A manual shut-off valve shall be compatible for use with gas applications and shall comply with SANS 50331. Valves shall be 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.

5.3.4 Mating threads

5.3.4.1 Specifications for pipe threads

Metallic pipe and fitting threads shall be taper pipe threads and shall comply with SANS 1109-1 and SANS 1306-1.

5.3.5.2 Damaged threads

Pipe with threads that are stripped, chipped, corroded, or otherwise damaged shall not be used. Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used.

5.3.5.3 Thread compounds

Thread compounds shall be resistant to the action of natural gas or to any other chemical constituents of the gases to be conducted through the piping. Hemp shall not be used.

5.3.5.4 Metallic piping joints and fittings

The type of piping joint used shall be suitable for the pressure-temperature conditions and shall be selected giving consideration to joint tightness and mechanical strength under the service conditions. The joint shall be able to sustain the maximum end force due to the internal pressure and any additional forces due to temperature expansion or contraction, vibration, fatigue, or the weight of the pipe and its contents.

5.3.5.5 Quick-connect devices

A quick-connect device shall comply with AS 4267.

5.3.5.6 Vent valves

A vent valve shall comply with EN 161.

6 Installing piping

6.1 General

6.1.1 Condition of pipe and fittings

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

6.1.2 Protection of pipes in a corrosive environment

Before commencing a gas installation, it shall be established if any material used in the building construction is corrosive. Where there is such material present that may corrode pipes, the pipes shall be protected.

Unloading, hauling, handling and installing of pipe(s) shall be carried out with care to avoid damage to the pipe(s) or to any protective coating. Precautions shall be taken to prevent the ingress of dirt or other foreign matter from entering the pipe(s) during an installation.

6.1.3 Repair of defective pipe or fitting

Pipe or a fitting shall not be repaired except for repair of a defective welded or brazed joint where a leak has been detected. Where a defective pipe or fitting is found it shall be replaced.

6.1.4 Building strength and fire resistance

The design strength or fire resistance of a building, or part of a building, shall not be reduced by the installation of any pipe. (See SANS 10400-T for more detail).

6.1.5 Restriction on use of thread sealant

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

6.1.6 Welding of metallic pipe

All welding personnel shall be competent to weld metallic pipes.

6.1.7 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.

6.1.8 Identification of pipework

Above ground piping shall be identified as gas pipe and comply to the requirements as given in SANS 10140-3. The identification marking shall comply with figure 1. The identification markings are to be placed as follows:

a) at spacing of not more than 5 m;

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

c) on all tailpipes.

NOTE Durable adhesive pipe markers may be used for identifying piping. The identification is to comply with the requirements of SANS 10140-3 in all other respects.

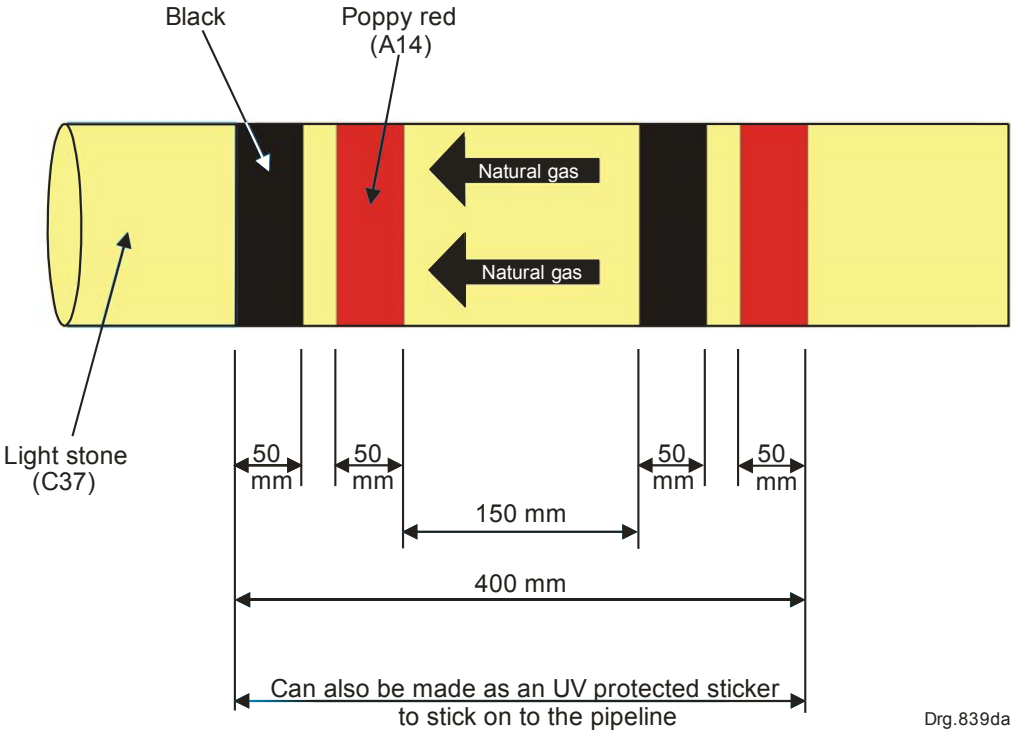


Figure 1 — Identification of pipework

6.2 Design of piping

6.2.1 Pressure rating of piping and components

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

a) 100 % of the inlet pressure to the next upstream regulator; or

b) the setting of any over-pressure protection fitted to the next upstream regulator.

6.2.2 The use of pressurized air, oxygen with a fuel gas

Where pressurized air, oxygen or a stand-by gas is to be used in conjunction with the fuel gas, an acceptable protective device, to avoid contamination of the fuel gas, shall be installed in the piping as close as possible to and upstream of the point of inter-connection of any gas and air, oxygen or stand-by gas line.

Acceptable protective device(s) include(s) but are not limited to:

a) a non-return valve;

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

c) a reverse flow detector 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.

6.2.3 Piping size

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

NOTE For pipe sizing, see annex D.

6.2.5 Flexibility of piping

Piping shall be designed to have sufficient flexibility to prevent all of the following:

a) Excessive stress in the piping material and attached equipment caused by thermal expansion and contraction.

b) Excessive bending or loading at joints.

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

NOTE The requirements of this subclause 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.

6.2.6 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 recommendations.

6.2.7 Means of disconnection

Where a manual shut-off valve is installed in piping, a means of disconnection shall be provided at the outlet of the valve.

6.2.8 Building isolation

Except in the case of single occupancy residential premises, where more than one building is to be supplied with gas from one billing meter all of the following shall apply:

a) The piping is to include a manual shut-off valve at the point of entry to each building. The piping shall be designed to ensure that when a valve is turned off, the gas supply to only one building is affected.

b) The valve is to be accessible and external to the building.

c) A durable permanent sign is to be located in a prominent position adjacent to the valve. The sign is to include the following wording – “GAS VALVE”.

6.2.9 Emergency valve (steam boilers and hot water boilers)

When a steam boiler or hot water boiler is installed, an emergency single-action quarter-turn manual shut-off valve of the ball type, to isolate the gas supply, shall be provided and:

a) be located in a safe, accessible position remote from the boiler;

b) be clearly identified by means of an appropriate sign; and

c) be located outside the plant room or boiler house.

6.3 Support of piping

6.3.1 Piping support system requirements

The piping support system shall comply with all of the following:

a) Be capable of supporting the piping system through construction and dimensions of the supporting devices and components. Strength and stability of attachments to the supporting structure shall be considered.

b) Firmly restrain the piping in the intended position and control movement of the piping system.

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 piping material.

6.3.2 Spacing of supporting devices

The spacing of supporting devices shall not exceed those given in table 3.

Table 3 — Spacing of supporting devices

1	2	3	4	5
	Vertical or horizontal run spacing m			
Nominal size DN	**Steel pipe**	**Copper pipe**	**Semi-rigid stainless steel pipe (CSST)**	**Composite 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	3	2	0,5	1,5
32	3	2,5	0,5	2
40	4	2,5	–	–
50	4,5	3	–	–
65	5	3	–	–
80	5,5	4	–	–
100	6,5	4	–	–
125	7	4	–	–
150	8	4	–	–
200	9,5	4	–	–

6.3.3 Diameter of rod hangers

The diameter of rod hangers shall comply with table 4.

Table 4 — Diameter of rod hangers

1	2
Nominal size DN	**Minimum rod diameter for single rod hangers** mm
up to 50	9,5
65 to 90	12,75
100 to 125	15,8
150 to 200	19,0

6.4 Corrosion control

6.4.2 Steel pipe emerging from the ground

Where steel pipe coated with high density polyethylene or coated with an appropriate proprietary wrapping is to emerge from the ground, the coating or wrapping shall be extended at least 300 mm out of the ground. The piping shall be so sealed as not to allow the ingress of water or foreign materials around the pipe.

NOTE This requirement applies to all locations where the piping enters or leaves the ground.

6.4.3 Piping with cathodic protection

Where piping include cathodic protection, an insulating joint shall be fitted

a) where the piping emerges from the ground; and

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

NOTE This requirement applies to all locations where the piping enters or leaves the ground.

6.4.4 Piping in a corrosive environment

Where a pipe or fitting is to be installed in a corrosive environment the pipe or fitting shall be protected.

NOTE The sheathing, coating or wrapping of a pipe or fitting, installing of cathodic protection, sacrificial anodes or rectifier units, dependent on the situation, will satisfy this requirement (see also 6.4.3).

6.4.5 Pipe protection

Where piping is to be in the ground and protection is required by 6.4.3 or table 1, the effectiveness of such protection shall be proved by recognized methods.

6.4.6 Corrosion protection of uncoated steel and copper pipe

Uncoated steel or copper piping shall be protected against corrosion as soon as possible after installation and before commissioning by

a) removing oil and grease by the use of a suitable solvent;

b) removing loose mill scale and rust;

c) after completion of a) and b), applying an adequate system which will provide durable protection; and

d) wrapping or sleeving the copper.

6.5 Pressure regulators

6.5.1 General

A regulator shall be acceptable to the (applicable standard for regulators and meters) and comply with the following:

a) meet the requirements of 6.2.1; and

b) have a capacity for the designed gas load and allowable pressure drop for the particular application.

6.5.2 Pressure regulator installation requirements

A gas pressure regulator shall be installed in accordance with the following:

a) above ground unless the authorized authority 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) readily accessible for maintenance and adjustment;

e) in a place where it will not be subjected to excessive temperature;

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

NOTE For the discharge of a breather vent within an enclosure or room (see 6.7.9).

g) Positioned to minimize exposure to physical damage.

6.5.3 Prohibited locations for a regulator

A gas pressure regulator shall not be installed in any critical location. Examples of such locations are as follows:

a) a lift shaft or lift motor room;

b) a room specifically intended for electrical switch gear;

c) a fire-isolated stairway or passageway;

d) a fire hydrant duct or hose reel cabinet;

e) sprinkler or hydrant pump room;

f) in such a position that would obstruct egress from a building; and

g) in a cavity wall.

6.5.4 Conditions for fitting gas pressure regulator(s)

A gas pressure regulator shall be fitted for any of the following conditions, as applicable:

a) Where any appliance in the premises is not fitted with an appliance gas pressure regulator.

b) Where the intended operating pressure of the piping exceeds the rated working pressure of the appliance gas pressure regulator(s).

c) Where the gas pressure to a section of piping would otherwise exceed the rated working pressure of the piping, fittings or components in that section.

6.5.5 Pressure test points at a piping gas pressure regulator

Pressure test points shall be provided at or near the outlet of any piping gas pressure regulator. (A pressure test point may also serve as the purge point required in the system to purge the gas line.)

6.5.6 Regulator operating notice

Where the outlet operating pressure setting of a gas pressure regulator exceeds 2,5 kPa there shall be a permanent and durable notice in a prominent position near the regulator showing the outlet pressure setting.

Wording for this notice may be:

"THIS REGULATOR OUTLET PRESSURE SETTING IS ____ kPa."

6.6 Pressure protection

6.6.1 Over-pressure protection

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

a) exceeds 7 kPa; and also

b) exceeds the fault pressure of piping and components supplied by the regulator up to and including the next downstream regulator. The over-pressure protection device shall ensure that piping and components supplied to the regulator up to and including the next downstream regulator will not be subjected to a pressure greater than fault pressure.

6.6.2 Over-pressure protection shuts off system requirements

Where an over-pressure protection system is of a type which shuts off the gas supply, all of the following shall apply:

a) The over-pressure protection system is to be of a manual reset type to restore supply.

b) A gas filter that will prevent the passage of foreign particles larger than 1 mm is to be located upstream and within 5 m of the device that shuts off the gas supply.

6.7 Venting

NOTE In this section the term "vent terminal" means a vent opening on a regulator or similar device having a diaphragm, or the terminal of a vent line.

6.7.1 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.

6.7.2 Vent line requirements

The following 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;

c) a gas pressure regulator incorporating a gas pressure relief device; and

d) a breather vent except where 6.7.9 or 6.7.10 applies.

6.7.3 Interconnection of vent lines

Vent lines shall not be interconnected unless they comply to the requirements as given in 6.7.4 to 6.7.11 (inclusive). Where the interconnection of vent lines from vented safety shut-off systems are required they shall be restricted to vented safety shut-off systems fitted to the same appliance.

6.7.4 Interconnection of breather lines

Where required the interconnection of breather lines shall be restricted to breather lines from the same appliance.

6.7.5 Size of a common vent line

Subject to 6.7.1, 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.

6.7.6 Size of vent line for a gas pressure regulator breather vent or relief device

Subject to 6.7.1, the minimum size of any vent line for a 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; and

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.

NOTE 1 Restrictions due to changes in direction are to be considered in determining vent line size.

NOTE 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.

6.7.7 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.

NOTE Restrictions due to changes in direction are to be considered in determining vent line size.

Table 5 — Vent pipe size for vented safety shut-off systems

1	2	3	4	5	6	7	8	9	10	11
Vent valve minimum nominal size	**Maximum length** mm									
	Vent line nominal size DN									
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						25	65	160		
65							32	80	200	
80								40	100	300

6.7.8 Requirements for discharging a breather vent into a room or enclosure

A breather vent is permitted to discharge into a room or enclosure when the diameter of the breather vent orifice does not exceed the maximum value determined by annex E.

NOTE 1 The maximum value determined by annex E is related to the room or enclosure size and the gas inlet pressure to the device, and assumes an air change rate of one room or enclosure volume per hour.

NOTE 2 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 explosive limit (LEL) of the air/gas mixture.

NOTE 3 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.

6.7.9 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 annex E;

b) such a restriction is approved by the manufacturer of the device or their representative; and

c) the orifice does not, under all operating conditions, adversely affect the operation of the device.

6.7.10 Vent terminal location

A vent terminal shall be located where gas discharge will dissipate without entering buildings or creating any hazard. The point of discharge shall:

a) be located so there is no ignition source or opening into a building within the exclusion zone shown in table 6. In cases where there is any object (e.g., wall, ground etc) in the direction of discharge and within the exclusion zone of figure 2 the point of discharge is to be located such that there is a clearance of at least distance L of table 6 to any ignition source or opening in all directions; and

b) be at least 3 m from a mechanical air inlet unless calculations based on figure 2 give a greater distance.

NOTE The requirements of this subclause do not apply to a breather vent terminal. See 6.5.2(f).

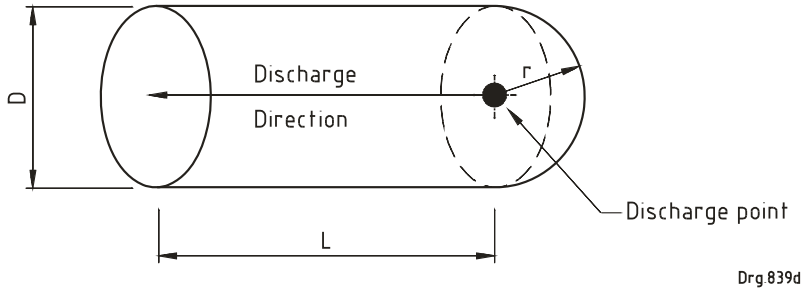


Figure 2 — Vent terminal location

Table 6 — Vent terminal exclusion zone

1	2	3	4
Vent terminal diameter	**Exclusion zone**		
	L	D	r
mm	m	m	m
Not exceeding 50	1,5	1	0,5
Exceeding 50	1,5 T	T	0,5 T
NOTE 1 $T = \frac{\text{Vent terminal diameter (mm)}}{50}$ NOTE 2 The exclusion zone above depicts a cylinder in the direction of discharge and a hemisphere behind the vent terminal discharge point.			

6.7.11 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. The vent line shall include a union near the device to be vented, unless the vent line can otherwise be readily removed.

6.8 Hose assemblies

6.8.1 Hose assembly requirements

A hose assembly shall be

a) as short as practicable and not exceed 2 m in length; and

b) of adequate diameter for the maximum gas consumption of the appliance.

NOTE Additional requirements regarding limitations on the length of hose assemblies when used to connect appliances are detailed in clause 7.

6.8.2 Prohibited location of hose assembly connection point

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

a) bedroom unless permanent ventilation is provided, (see 7.2.3 and 7.4);

b) bathroom;

c) sauna;

d) toilet; and

e) hallway unless permanent ventilation is provided, (see 7.2.3 and 7.4).

6.8.3 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) where to be used for a space heater, at least 1 m from a doorway.

6.8.4 Hose assembly — Prohibited installation methods

A hose assembly shall not pass

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

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

c) through a fixed partition; or

d) through the panel or casing of the appliance.

6.8.5 Hose assembly operating conditions

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

a) exposed to a temperature exceeding the maximum recommended by the hose manufacturer;

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

c) subject to damage by vermin.

6.8.6 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 piping by a threaded or other metal connection or connected as specified in 6.8.7.

6.8.7 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 as close as possible to the outlet of the permanent connection point. A union is to be fitted at either the inlet or outlet 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.

NOTE 1 The method in (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.

NOTE 2 The method in (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.

6.8.8 Appliance restraint where a hose assembly is used

Where a hose assembly connects to an 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, the extent of movement of the appliance shall be restrained by means other than the hose assembly.

6.9 Quick-connect devices

Where a quick-connect device socket is installed outside it shall be at least 300 mm above the ground or floor level.

A quick-connect device socket shall be so installed as to avoid the ingress of water, dust or other foreign materials.

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

6.10 Location of piping

6.10.1 General

a) Piping shall not be placed or located where physical damage to the pipe is likely to occur, unless protection is provided to prevent such damage.

b) Piping shall not be exposed to liquid discharge (e.g. from a water heater relief valve or appliance condensate drain).

c) Piping shall not be laid on the ground. Piping above the ground shall be at least 50 mm clear of the finished ground level.

6.10.2 Prohibited locations

Piping shall not be installed in any of the following locations:

a) Attached to a fence. (This does not include a solid brick wall but will include pre-cast, wooden fence etc.)

b) In a lift well.

c) In a clothes chute.

d) In a rubbish chute.

e) In a fire-hydrant cabinet.

f) In a fire hose reel cabinet.

g) In a ventilation duct.

h) In any dedicated emergency route. However, where approval from the local authority has been granted for installation in emergency routes, the pipe shall be schedule 40 piping, be of welded construction and have no mechanical joints.

i) In a fire control room.

j) Piping shall not be used to support an electrical conductor.

NOTE Local authorities may have additional restrictions for the placement and location of piping.

6.10.3 Separation from above ground electrical services (including conduit, wire, cable or earthing electrode)

Gas piping shall be at least 150 mm away from any electrical cables where they run parallel to each other. Gas piping may cross electric cables or vice versa, provided that these do not come into contact with each other and there are no joints in either line within 150 mm of such crossings. This excludes electric cables in appliances.

6.10.4 Separation from underground electrical services (including electrical earthing electrode, communication cables, supply cable and piping)

The separation between any underground piping and an electrical supply cable shall be at least 150 mm where the electrical supply cable is indicated along its length with orange marking tape and is provided with mechanical protection.

The separation between any underground piping and an electrical earthing electrode, for an electrical supply not exceeding 1 000 volts, shall be at least 500 mm. For an electrical supply exceeding 1 000 volts, the local authority shall be contacted for a ruling.

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

The separation between any underground piping and any other service other than an electrical or communication service shall be at least:

a) 150 mm for piping not exceeding 65 DN; and

b) 300 mm for piping exceeding 65 DN.

6.10.5 Crossover of other underground services

Any underground 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 150 mm.

6.10.6 Clearance from underground obstructions

Piping shall be installed with the following clearance to any underground obstruction to protect the piping from physical damage and to permit repairs.

The clearance shall be at least:

a) 100 mm for piping not exceeding 65 DN; and

b) 300 mm for piping exceeding 65 DN.

6.10.7 Bedding and support of pipe in the ground

Piping in the ground shall be bedded on a firm compacted surface along its entire length.
Bedding material and backfill shall

a) be of a type 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; and

c) shall be compacted to minimize subsequent trench subsidence.

Piping in the ground shall be covered in such a way to protect the pipe from physical damage, the depth of cover shall be at least 500 mm.

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

6.10.8 Installation of piping in a concealed locations

Where piping is to be in a concealed location (other than underground or embedded in concrete) the requirements detailed in table 7 shall apply.

6.10.9 Piping beneath a building and in the ground

Piping shall not be installed in the ground beneath a building.

6.10.10 Piping passing through building outer wall

Piping in the ground and passing through an outer 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) be sleeved when passing through any cavity wall; and

d) not be subjected to any load from the building.

Table 7 — Piping in concealed location

1	2	3	4
Operating pressure	**Accessibility (See note)**	**Ventilation required (see 6.10.14)**	**Pipe materials and jointing**
Up to and including 7 kPa	Accessible	Yes	Pipes and jointing as per table 1
	Inaccessible	Yes	Pipes as per table 1, all joints to be kept to a minimum
	Accessible or inaccessible	No	Pipes as per table 1, joints to be permanent and kept to a minimum
Exceeding 7 kPa	Accessible	Yes	Pipes as per table 1, joints to be permanent and kept to a minimum
	Inaccessible	Not to be installed	
NOTE 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.			

6.10.11 Ventilation of concealed piping

Where piping is to be installed in a void, duct or sleeve it shall comply with the following:

a) ventilation openings are to be provided to ensure ventilation to the outside atmosphere;

b) the openings are to be in a safe location; and

c) each opening is to have a free ventilation area that complies with table 8.

Table 8 — Ventilation for concealed piping

1	2
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 0,051 but not exceeding 7,5	0,05 m^2
Exceeding 7,51	0,006 × cross-sectional area of void, duct or sleeve in m

6.10.12 Piping embedded in concrete

6.10.12.1 Where piping is to be embedded in a concrete wall or floor the piping shall be corrosion protected and the following shall apply.

The piping shall be

a) copper tube, sleeved or wrapped with hard soldered joints;

b) composite pipe to be installed without joints;

c) plastic coated semi-rigid stainless steel without joints; or

d) black steel pipe with all joints welded.

6.10.12.2 Where pipes are embedded in walls or concrete floors plans of such installation shall be available to indicate the path of the pipeline.

NOTE SANS 62 seamed heavy black pipe may be used provided that corrosion protection is specified and the system is pressure tested to at least 400 kPa and is limited to a operating pressure less than 200 kPa.

The operating pressure is not to exceed 7 kPa.

The pipe shall be installed so that the top of the pipe is at least 50 mm below the finished floor level.

Where allowed, joints and fittings are to be kept to a minimum.

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

Where required, approval from the structural engineer shall be obtained.

The size of piping is not to reduce the design strength of the concrete slab.

Piping is not to extend through expansion joints in the concrete.

6.11 Installing non-metallic pipe

6.11.1 Route marking of piping

Where non-metallic pipe is buried the route shall be indicated using an appropriate method such as placing of bollards along the route. Chevron marker tape shall be laid half-way between the pipe and ground level.

NOTE For tracking purposes either a steel or copper wire should be wrapped around the pipe.

6.11.2 Securing the riser

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

6.12 Piping in a high-rise building

Plans shall be submitted to the local authority where piping is to be installed in any building of 30 m or higher. (See also SANS 10400).

6.12.1 Plan of piping to be displayed on site

A plan of the piping is to be prominently displayed in the fire control room or in another location acceptable to the local authority. The plan shall be current and shall:

a) detail the location of all emergency shut-off valves;

b) be vermin proof; and

c) be weatherproof.

6.12.2 Manual shut-off valve in riser and lateral

A manual shut-off valve shall be installed in an accessible position as follows:

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

b) in each lateral branch pipe as close as practicable to the main riser.

6.12.3 Support and flexibility of riser

A riser shall comply with the following, as appropriate:

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 is to be sleeved where it passes through each floor and ceiling slab, with any joint within the sleeve being welded or brazed.

c) Minimize strain at the junction of a lateral and a riser, due to the relative movement between a riser and the building.

6.13 Sub-meters

The requirements for the billing meter (master meter) are determined by the network operator. Some general guidelines regarding the siting of these meters are given in annex C. However, the network operator shall be contacted to obtain full details regarding the siting of the billing meter.

A sub-meter shall:

a) be constructed of materials, and use lubricants, suitable for natural gas; and

b) have a capacity suitable for the designed gas load and allowable pressure drop for the particular application.

6.13.1 Prohibited locations of a sub-meter

A sub-meter shall not be in any of the following locations:

a) A lift shaft or lift motor room.

b) A room specifically intended for electrical switch gear.

c) A fire-isolated stairway or passageway.

d) A fire hydrant or hose reel cabinet.

e) Sprinkler or hydrant pump room.

f) In such a position that would obstruct egress from a building.

g) A bedroom.

h) An area where excessive temperatures or sudden excessive 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.

m) In a cavity wall, except where 6.13.2 applies.

When sub-meters are installed they shall be installed in a location which permits ease of replacement, maintenance and reading, and is to be clearly identified with the gas installation it supplies.

6.13.2 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:

a) be constructed of non-combustible material;

b) be completely sealed from any adjoining recess or cavity;

c) be of size to permit ease of replacement and maintenance of the sub-meter; and

d) be ventilated directly to outside atmosphere.

6.13.3 Manual shut-off valve

A manual shut-off valve shall be provided in the piping upstream of the sub-meter. The valve shall be accessible for operation and be installed as close as practicable to the sub-meter.

A sub-meter shall be supported independently of, and connected to, the piping in such a way that strain on the sub-meter or connecting piping is minimized.

A sub-meter shall be attached direct to the piping by means of copper or steel connections.

6.14 Ventilation of gas equipment

6.14.1 Ventilation of an enclosure containing a meter or regulator

Where a meter or a regulator is to be installed in an enclosure, the enclosure requires ventilation. The enclosure shall be ventilated by one of the methods detailed in 6.14.2, 6.14.3 or 6.14.4.

6.14.2 Natural ventilation direct from outside

Two openings shall be provided directly to outside. 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. The minimum free ventilation area provided by each opening shall be calculated using the following formula:

$$M = R \times F$$

where

M is the minimum free ventilation area (cm^2);

R is equipment rated capacity (m^3/h); and

F is 10 for pressures not exceeding 7 kPa; or

20 for pressures exceeding 7 kPa but not exceeding 200 kPa; or

30 for pressures exceeding 200 kPa but not exceeding 1 050 kPa.

NOTE 1 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.

NOTE 2 The pressure used to determine *F* is the highest operating pressure in the enclosure.

6.14.3 Natural ventilation via adjacent room

The enclosure is to be provided with two openings positioned in accordance with the requirements of 6.14.2. The free area of each opening shall be twice that required by 6.14.2.

These requirements shall apply to all subsequent rooms until a room is ventilated to outside. That room shall be ventilated in accordance with 6.14.2.

6.14.4 Mechanical ventilation

Where the ventilation to the enclosure is to be provided by mechanical means, this shall be directly to outside and the system shall comply with table 9.

7 Installing appliances

7.1 Requirements for appliances

7.1.1 Appliance certification

All appliance(s) operating on a total gas demand equal to or less than 500 MJ shall comply with the SANS 1539 requirements.

7.1.2 Converting an appliance from another gas

An appliance may be converted to suit another gas type provided:

a) the appliance is suitable for that gas;

b) the conversion is in accordance with a conversion procedure acceptable to the manufacturer; and

c) the conversion is undertaken by a registered installer for that specific category.

Table 9 — Ventilation of gas equipment — Mechanical ventilation

1	2	3
Gas equipment in enclosure	**Minimum airflow to outside**[a] L/s	**Safety requirements for ventilation failure**
Meter or regulator (or both)	Equipment rated capacity[b] (m^3/h) × 0,1	An interlock which causes the gas supply to the equipment to shutdown and lockout OR A remote alarm which can only be reset at the enclosure
Gas pressure-raising device	Equipment rated capacity (m^3/h) × 0,3	
Gas equipment and appliance	The greater of that required for the appliance or equipment	An interlock which causes the gas supply to the appliances in the enclosure to shutdown and lockout and one of the following: An interlock which causes the gas supply to the equipment to shutdown and lockout OR A remote alarm which can only be reset at the enclosure
a) To enable this airflow to be achieved adequate airflow into the enclosure is required. b) 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.		

7.2 General installation requirements

7.2.1 Restriction on flueless appliances

7.2.1.1 A flueless appliance shall not be installed in a

a) bedroom (unless permanent ventilation is supplied as given in 7.4.1);

b) bathroom;

c) toilet; or

d) sauna.

7.2.1.2 An appliance shall not be installed;

a) internally if it is designed for outdoor installation; or

b) outdoors unless it is designed for outdoor installation.

NOTE An appliance designed for indoor installation may be installed outdoors in an enclosure if the requirements of clause 7 are satisfied.

7.2.2 Connection point for portable appliance

A connection point for a portable appliance shall not be located in a

a) bedroom (unless permanent ventilation is supplied and only one connection point is provided);

b) bathroom;

c) toilet;

d) sauna; or

e) hallway.

NOTE See also 6.8.3.

7.2.3 Ventilation

Appliances shall be ventilated to ensure correct and safe operation.

NOTE See 7.4.

Where ventilation of appliances is necessary they shall be installed in accordance with manufacturer's instructions.

7.2.4 Combustible surfaces

An appliance shall be installed such that the surface temperature of any nearby combustible surface will not exceed 65 °C above ambient.

NOTE 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.

7.2.5 Connection of an additional appliance

Before connecting an additional appliance to an existing piping system, the existing piping shall be checked for capacity. If found unsuitable, the existing piping shall be made suitable or separate piping shall be installed to accommodate the new appliance(s).

7.2.6 Automatic control to fail-safe

A control or control system which operates an appliance automatically, or unattended, or by remote control, shall fail-safe.

7.2.7 Electrical requirements

A gas appliance connected to the electricity supply shall have a means of electrical isolation, which is adjacent to the appliance location and is accessible with the appliance installed. The means of isolation is to be compliant with the SANS 10141.

Where interruption of the electricity supply can cause burner shutdown, then restoration of the electricity supply shall not be capable of causing a hazard.

7.2.8 Appliance support

An appliance shall be supported on or secured to a durable structure that is appropriate for the use and location of the appliance.

NOTE A fence is not normally considered a durable structure, however a brick wall used as a fence is generally deemed suitable.

7.2.9 Strain on appliance connection

An appliance shall be supported and secured so that the strain on any pipe connection is minimized.

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

An appliance other than a portable space heater, fitted with wheels or castors shall have means fitted to restrain the appliance during operation. An appliance designed to move on castors, rollers or wheels shall be connected to the piping using a hose assembly. Where a hose assembly connects to an 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, the extent of movement of the appliance shall be restrained by means other than the hose assembly.

Where an appliance manufacturer directs that an appliance be secured, the means of securing shall be suitable for the conditions of use. Wooden plugs shall not be used.

7.2.10 Connecting laboratory bunsen burners

A push-on connector shall only be used for connecting a laboratory bunsen burner 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.

7.3 Appliance location

7.3.1 Air movement systems

An appliance 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 appliance of the air required for combustion and draught diverter dilution;

b) cause the air pressure to be less than atmospheric at the appliance; or

c) otherwise adversely affect the operation of the appliance.

7.3.2 Appliance in a cupboard

Where an appliance is to be installed in a cupboard, the following shall apply:

a) the cupboard is not to be a storage area for flammable materials; and

b) a warning notice, stating

"THE STORAGE OF FLAMMABLE MATERIALS IN THIS CUPBOARD IS PROHIBITED"

is to be fixed in a prominent position, on or adjacent to the appliance.

7.3.3 Appliance in a residential garage, roof or ceiling voids.

No gas appliance shall be installed in a residential garage or in the ceiling space of a roof.

7.3.4 Appliance on roof or elevated structure

Where an appliance is to be located on a roof 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) other than in single residential premises, where the appliance is to be more than 3,5 m from ground or floor level, permanent means of access is to be provided; and

c) other than in a single residential premises, where the appliance is to be less than 2 m from the edge of the roof or structure, fixed guard rails, at least 1 m high are to be fitted between the appliance and the edge of the roof or structure.

NOTE Requirement (c) may not be necessary if the edge of the roof or structure has a parapet wall.

7.4 Air supply to appliances

An appliance shall only be installed in a location with ventilation for complete combustion of gas, proper flueing and to maintain ambient temperature of the immediate surroundings at safe limits, under normal operating conditions.

Further, appliances shall not be installed into any area where the air supply can become contaminated with combustion products, or contain chemicals or flammable vapours which could affect combustion.

7.4.1 Permanent ventilation requirements

7.4.1.1 General

Permanent ventilation is normally required if the oxygen in the air in a room will be used up by flames burning, people breathing, etc. If sufficient ventilation is not provided, the existing oxygen in the air will be used up, the flames will start to smoke and eventually go out and the people will lapse into unconsciousness and eventually suffocate. These processes start to happen when the normal oxygen content of the air in a room (21 % of fresh air is oxygen and 79 % is nitrogen) is reduced by about a third, i.e. to ± 14 %.

7.4.1.2 Installation of permanent ventilation openings

Ventilation openings shall be installed in such a way that they cannot be blocked.

NOTE An openable window is not permanent ventilation.

7.4.1.2.1 The size of permanent ventilation openings is related to the following important factors:

a) the total maximum heat input of the appliances installed in the room; and

b) the size (volume) of the room.

The following example may be used to determine the size of permanent ventilation openings:

There are 12 holes in a vent. If the size of each hole is 1 cm × 1 cm (length = 1 cm and height = 1 cm), then the total effective area of free air is 12 cm^2.

7.4.1.2.2 Where a flued appliance is installed, two permanent ventilation openings with a total free cross-sectional area of not less than 3 cm^2/MJ/h of heat input shall be installed, one at high level and one at low level.

7.4.1.2.3 Where a flueless appliance is installed, and permanent ventilation is required (see 7.4.1.2.2) two permanent ventilation openings with a total free cross-sectional area of not less than 13 cm^2/MJ/h of heat input shall be installed, one at high level and one at low level.

7.4.1.2.4 Where the heat input is greater than 0,37 MJ/h/m^3 of room volume, permanent ventilation shall be provided in the room.

EXAMPLE 1

A 25 MJ/h appliance requires a minimum room volume of 25 ÷ 0,37 = 67,57 m^3. If the room is smaller that this figure then permanent ventilation would be required. Based on the requirement in 7.4.1.2.3, the following calculation is used to determine the size of the vents:

(13 × 25) ÷ 2 = 162,5 cm^2

Two permanently open vents each of an open cross sectional area of 162,5cm^2 are required.

EXAMPLE 2

A 40 MJ/h appliance requires a minimum room volume of 40 ÷ 0,37 = 108,11 m^3. If the room is smaller that this figure then permanent ventilation would be required. Based on the requirement in 7.4.1.2.3, the following calculation used to determine the size of the vents:

(13 × 40) ÷ 2 = 260 cm^2

Two permanently open vents each of an open cross sectional area of 260 cm^2 are required.

7.4.1.2.5 A flueless heater shall not be installed in a bedroom without the provision of permanent ventilation (see 3.92.1). In such cases the requirement in 7.4.1.2.3 shall be applied. See also examples 1 and 2 in to determine the size of the vents.

7.4.1.2.6 When applying the calculation the heat input of any other gas, solid fuel or paraffin-burning appliances shall be added to the heat input of the flueless heater to be installed.

EXAMPLE 1

If existing appliances of the type indicated above, having a heat input of 15 MJ/h, share the same room volume as a flueless heater with a heat input of 40 MJ/h, then the calculation to establish the minimum room volume allowed for the installation of the flueless heater without the provision of permanent free air ventilation would be:

(15 + 40) ÷ 0,37 = 148,65 m^3.

EXAMPLE 2

If the total available room volume is 90 m^3 and there are already appliances in the room with a heat input of 12 MJ/h, then the calculation to find the maximum heat input that may be added to that room volume without the provision of permanent free air ventilation would be:

12 ÷ 0,37 = 32,43 m^3

90 − 32,43 = 57,57 m^3

57,57 × 0,37 = 21,30 MJ/h

Where the additional heater has a rated heat input in excess of 21,3 MJ/h then permanent ventilation is mandatory and the requirements of 7.4.1.2.3 shall be met.

7.4.1.2.7 Where an adjoining room or rooms share(s) a common opening with the room in which the appliance is to be installed, then the room volumes of both rooms may be added together for the purposes of compliance with the calculation in 7.4.1.2.4, providing that the opening between the two rooms is permanently open and cannot be closed, e.g. by a door, a movable divider or partition.

EXAMPLE 1

Room A = 6 m × 5 m × 2,7 m = 81 m^3

Room B = 5 m × 4,5 m × 2,7 m = 60,75 m^3

Thus the total available room volume is 81 + 60,75 = 141,75 m^3.

The maximum heat input that may be installed without the provision of permanent free air ventilation is therefore 141,75 × 0,37 = 52,45 MJ/h.

7.5 Appliance connection

7.5.1 Composite or plastic coated semi-rigid stainless steel piping shall not be used as an appliance connection. The exception to this is where plastic coated semi-rigid stainless steel piping forms part of a certified hose assembly or limited flexibility connector.

7.5.2 Each gas supply point shall be situated to suit the position of the appliance that it serves, and shall allow for convenient coupling to the appliance. Until the appliances are connected, each point shall be securely capped or plugged, and so marked as to indicate that it is a gas point. Where the appliance is removed from the system in use, such a gas point shall also be capped or plugged.

7.6 Air heating appliance in a confined space

Where an air-heating appliance is installed in a confined space the circulating air shall be ducted and be separated from air for combustion and draught diverter dilution.

NOTE Circulating air in this subclause means heated and return air.

7.7 Specific appliances — Installation

7.7.1 Domestic cooking appliance

7.7.1.1 Clearances around a cooking appliance

The required clearance between a cooking appliance, other than those covered under 7.7.3, and a combustible surface shall be at least that given in figure 3.

7.7.1.2 Protection of a combustible surface near a cooking appliance

The protection required in 7.7.1.1 shall ensure the surface temperature of the combustible surface does not exceed 45 °C above ambient.

NOTE The fixing of 5 mm thick ceramic tiles to the surface or attaching fire-resistant material to the surface and covering with sheet metal with a minimum thickness of 0,4 mm would satisfy this requirement.

7.7.1.3 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 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 cooking appliance.

7.7.1.4 Single boiling burners

A single boiling burner (ring burner) shall stand on a fire-resistant base, and comply with the clearance requirements of 7.7.1.1.

7.7.1.5 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

a) annealed copper pipe; or

b) a hose assembly.

7.7.1.6 Clearance from oven flue of elevated cooking appliance

The clearance between an overhead surface and the oven flue outlet of an elevated cooking appliance shall not be less than 200 mm.

7.7.1.7 Stabilization of a freestanding cooking appliance

The method recommended by the manufacturer to prevent the tilting of a freestanding cooking appliance, when in the installed position, shall be used.

7.7.1.8 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 12 m.

c) The height of the piping connection point above the floor shall be approximately equal to the height of the cooking appliance connection point.

d) The connection point in c) is to 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 (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 is to be fixed to the appliance and the wall within 50 mm of each connection point. The length of the chain or wire is not to 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 piping using a hose assembly, the hose assembly used shall comply to the requirements of AS/NZS 1869.

7.7.1.9 Under cooker connection

A freestanding cooking appliance having an under cooker connection point shall not be connected to that point using a hose assembly.

7.7.2 Inbuilt oven

7.7.2.1 Location of an inbuilt oven

The location of an inbuilt oven shall be such that it will allow operation of the oven and complete removal from the recess.

7.7.2.2 Size of recess

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.

7.7.2.3 Base of recess

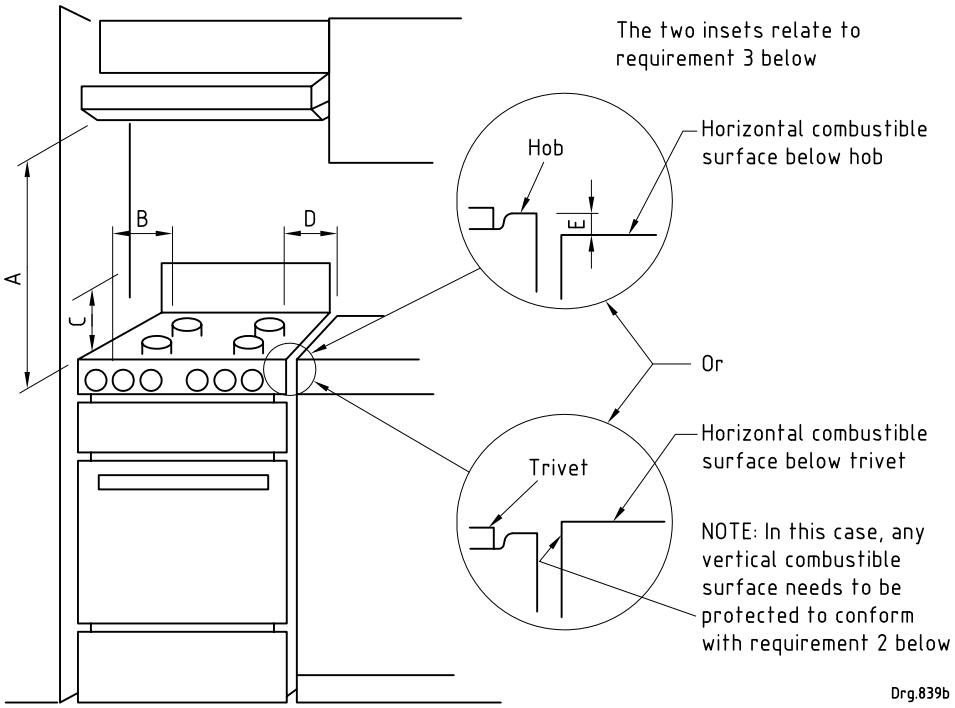
The base of the recess shall be capable of supporting the full weight of the oven.

7.7.2.4 Gas connection

Unless an inbuilt oven has been certified for connection using a hose assembly supplied by the appliance manufacturer, and the use of the hose assembly complies with 6.8, 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.

7.7.2.5 Electrical requirements

An electrical connection shall be to a readily accessible switched general purpose outlet 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.



1 Overhead clearances — (Measurement A)
Range hoods and exhaust fans shall be installed in accordance with the manufacturer's instructions. However, in no case shall the clearance between the highest part of the hob of the cooking appliance and a range hood be less than 600 mm or, for an overhead exhaust fan, 750 mm. Any other downward facing combustible surface less than 600 mm above the highest part of the hob shall be protected for the full width and depth of the cooking surface area in accordance with 7.7.1.2. However, in no case shall this clearance to any surface be less than 450 mm.
2 Side clearances — (Measurements B and C)
Where B, measured from the periphery of the nearest burner to any vertical combustible surface, or vertical combustible surface covered with toughened glass or sheet metal, is less than 200 mm, the surface shall be protected in accordance with 7.7.1.2 to a height of not less than 150 mm above the hob for the full dimension (width or depth) of the cooking surface area. Where the cooking appliance is fitted with a "splash back", protection of the rear wall is not required.
3 Additional requirements for freestanding and elevated 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 surface shall be above the trivet. See insets above.
NOTE 1 Requirement 3 does not apply to a freestanding or elevated cooking appliance, which is designed to prevent flames or the cooking vessels from extending beyond the periphery of the appliance. NOTE 2 The "cooking surface area" is defined as that part of the appliance where cooking normally takes place and does not include those parts of the appliance containing control knobs.

Figure 3 — Required clearances around domestic cooking appliances

7.7.3 Indoor open grid barbecues installed in residential premises — Clearances and protection

An indoor open grid barbecue in a residential premise shall be installed such that

a) any vertical combustible surface less than 200 mm from the cooking surface area is protected in accordance with 7.7.1.2 for a height of 150 mm; and

b) the following minimum clearances from the cooking surface area are observed:

1) Vertically to an overhead grease filter ..... 1 200 mm.

2) Vertically to a combustible surface ..... 1 200 mm.

3) Vertically to a non-combustible surface ..... 600 mm.

4) Horizontally to a vertical combustible surface ..... 200 mm.

NOTE 1 This subclause applies to appliances designed for use without a cooking vessel where cooking fats can fall onto and flare up from a heated perforated plate, volcanic rock or similar refractory material.

NOTE 2 Any combustible surface less than 1 200 mm but not less than 600 mm from the cooking surface area may be protected in accordance with 7.7.1.2.

NOTE 3 The "cooking surface area" is defined as that part of the appliance where cooking normally takes place and does not include those parts of the appliance containing control knobs.

7.7.4 Commercial catering equipment

7.7.4.1 Requirements for an appliance with wheels or castors

An appliance with wheels or castors shall have means fitted to restrain the appliance during operation.

7.7.4.2 Combination cooking ranges

Where two or more appliances are to be connected together to form a combination cooking range, the following shall apply:

a) the gas supply to the combined appliance is to be from one source;

b) each appliance shall be individually tapped off from the main gas supply line and have an individual shut-off valve;

c) appliances shall not be manifolded together by using any gas line or T-pieces; and

d) the main supply line shall have an emergency shut-off valve fitted in an accessible location to shut down the complete system.

7.7.4.3 Clearances to a grease filter

The clearance between a grease filter and the cooking surface of the appliances listed in table 10 shall not be less than that given in that table.

Table 10 — Clearances to grease filters

1	2
Appliance	**Minimum clearance** mm
Solid grill plate, deep fryer (top of pan)	600
Open flame appliance (i.e., hotplate burner)	1 050
Chinese cooking table, griddle, barbecue, char grill or open top flare grill	1 350

7.7.4.4 Clearances and protection around commercial catering equipment

The clearance to combustible surfaces from commercial catering equipment shall comply with the following requirements:

a) above the cooking surface of an appliance not covered in table 10: 600 mm;

b) subject to (c), from a cooking surface area having an open flame and no means of preventing cooking vessels from overhanging the edge of the appliance: 250 mm;

c) from the side of an open flame appliance, where the combustible surface is at least 100 mm below a cooking surface area: 50 mm;

d) from an appliance flueway or rear of an appliance with a "splashback": 50 mm; and

e) from the rear or side of an appliance which is not an open flame cooking appliance: 50 mm.

NOTE 1 The cooking surface area is defined as being that part of the appliance where cooking normally takes place and does not include those parts of the appliance containing control knobs.

NOTE 2 Example of the application of (c): 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.

NOTE 3 These clearances do not apply where an adjacent surface is of a non-combustible material or is combustible but is protected with fire-resistant material in accordance with annex B. The fire-resistant material may be covered by ceramic tiles or stainless steel to meet local health authority requirements.

NOTE 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.

7.7.4.5 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. The protection is to extend at least 50 mm beyond the perimeter of the appliance and is to be made impervious to cooking fats.

NOTE This requirement does not apply 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.

7.7.5 Instantaneous water heater

Instantaneous water heaters shall comply with the requirements of SANS 1539.

With the exception of type A instantaneous water heater of a maximum heat input of 42 MJ/h, unflued instantaneous water heaters shall not be installed indoors.

7.7.6 Storage water heater

7.7.6.1 When a storage water heater is to be installed inside a building, such storage water heaters shall be flued to the outside.

7.7.6.2 A storage water heater is to be installed on a level, stable base adequate to support the filled appliance.

7.7.7 Pool heater (including swimming, spa and therapeutic pool)

7.7.7.1 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; or

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.

7.7.7.2 Type of supporting base

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

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

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

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

7.7.7.4 Non-return valve required

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

7.7.7.5 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.

7.7.7.6 Requirements where a pool heater is used for a spa or therapeutic pool

Where a pool heater is used for a spa or therapeutic pool application, the heater or the installation shall have a manual reset temperature limit device that prevents the water temperature in the pool exceeding 45 °C. The manual reset temperature limit device is to act independently of the heater control thermostat and shall either shut off the gas supply to the burner by a separate gas valve, or switch off the circulating pump.

NOTE Consulting with the appliance manufacturer to determine which method of connecting the manual reset temperature limit device is most appropriate.

7.7.8 Space heater

7.7.8.1 Flued space heaters

A space heater, unless designated as a vent-free heater in terms of SANS 1539, shall be flued to the outside air when:

a) the output rating of the heater exceeds 16 MJ/h; and

b) the ratio of the input rating of the appliance(s) to the volume of the room exceeds 365 kJ/h/m^3 of free room space.

7.7.8.2 Flueless heater installation requirements for the provision of permanent free air ventilation

Where the output rating of the heater is less than 16 MJ/h permanent ventilation of the room shall be provided when the installation is done.

7.7.8.2.1 A vent-free heater shall not be installed in a bedroom without the provision of permanent ventilation. Where the heat input is greater than 0,25 MJ per m^3 of room volume, permanent ventilation shall be provided in the room.

7.7.8.2.2 The minimum size room volume in m^3 in which the appliance may be installed without the provision of permanent ventilation shall be based on the following requirement:

A 25 MJ appliance requires a minimum room volume of

$$25 \div 0{,}25 = 100\ m^3$$

7.7.8.2.3 When applying the calculation in 7.7.8.2.2, the heat input of any other gas or solid fuel or paraffin-burning appliances shall be added to the heat input of the vent-free heater to be installed.

EXAMPLE 1

If existing appliances of the type indicated above, having a heat input of 15 MJ, share the same room volume as a vent-free heater with a heat input of 40 MJ, then the calculation to establish the minimum room volume allowed for the installation of the vent-free heater without the provision of permanent free air ventilation would be

$$(15 + 40) \div 0{,}25 = 220\ m^3$$

EXAMPLE 2

If the total available room volume is 90 m^3 and there are already appliances in the room with a heat input of 12 MJ, then the calculation to find the maximum heat input that may be added to that room volume without the provision of permanent free air ventilation would be:

12 ÷ 0,25 = 48 m^3

90 − 32,43 = 57,57, m^3

57,57 × 0,25 = 14,39 MJ

7.7.8.2.4 Where an adjoining room or rooms share(s) a common opening with the room in which the appliance is to be installed, then the room volumes of both rooms may be added together for the purposes of compliance with the calculation in 7.7.8.2.2, providing that the opening between the two rooms is permanently open and cannot be closed, e.g. by a door.

EXAMPLE

Room A = 6 m × 5 m × 2,7 m = 81 m^3

Room B = 5 m × 4,5 m × 2,7 m = 60,75 m^3

Thus the total available room volume is 81 + 60,75 = 141,75 m^3.
The maximum heat input that may be installed without the provision of permanent free air ventilation is 141,75 × 0,25 = 35,44 MJ.

7.7.8.3 Requirements for elevated radiant heaters

An elevated radiant heater shall be installed to comply with all of the following:

a) be at a height complying with the manufacturer's installation instructions;

b) be supported independently of the piping; and

c) have a minimum clearance to combustible material above the heater as specified in table 11, unless adequate protection is provided.

Table 11 — Clearance to combustible material above elevated radiant heaters

1	2
Maximum input MJ/h	**Minimum clearance above appliance** mm
6	750
10	900
20	1 000
60	1 100

7.7.8.4 Requirements for fireplace and chimneys for gas fires

The fireplace and chimney for a fitted decorative fire into a pre-built brick fire box shall be non-combustible and the chimney shall have a minimum cross-sectional area of 400 cm^2 (e.g., a square section of 20 cm by 20 cm or a circular section of approximately 23 cm diameter) or as otherwise specified by the manufacturer.

The adequacy and effectiveness of any fireplace or chimney into which a decorative fire is installed shall be checked before and after installation. There shall be no significant spillage of flue gases from the fireplace or flue under stabilized operating conditions.

NOTE A smoke candle or other suitable device should be used to test the draft.

7.7.8.5 Damper

A damper shall not be fitted in a chimney, flue or on any fire box associated with the installation of a decorative gas log fire. Any damper, which is already in existence, shall either be removed or permanently fixed in the fully open position.

7.7.8.6 Flue cowl

A chimney or flue used with a decorative fire shall be fitted with a flue cowl which

a) for a fitted decorative fire, is at least 23 cm in diameter or as otherwise specified by the manufacturer; or

b) for a freestanding decorative fire is the same nominal diameter as the flue.

7.7.8.7 Gas light

There shall be a minimum clearance of 450 mm vertically and 125 mm horizontally between wall mounted or pendant light and any combustible material.

An internal pendant light shall be supported independently of the piping.

7.7.8.8 Refrigerator

7.7.8.8.1 A refrigerator shall not be located in a pantry, larder or bedroom

7.7.8.8.2 Where not otherwise given in the manufacturer's installation instructions the following minimum clearances shall apply:

a) 50 mm from the back wall; and

b) 300 mm above the flue outlet.

7.8 Flueing

7.8.1 General

7.8.1.1 Provision of a flue

Every appliance designed for connection to a flue shall be fitted with a flue in accordance with this standard and cognizance of the manufacturer's design requirements shall be adhered to. In addition, space heating flue installations shall comply with the requirements of SANS 10400-V.

7.8.1.2 Flue installation

The design strength or fire resistance of a building shall not be reduced by the installation of a flue.

7.8.2 Flue material

Material used in the construction of a flue shall be non-combustible and fit for purpose. Materials shall further be protected against corrosion. 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 wall flue; or

c) stainless steel or other corrosion-resistant material.

7.8.3 Flue design

7.8.3.1 General design requirements

The design of an open flue shall comply with annex F.

7.8.3.2 Exhausting of flue gases

A flue or chimney shall be designed so that, under normal operating conditions of the appliance, all flue gases are exhausted to outside atmosphere.

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.

7.8.3.3 Vertical rise

A flue fitted to an appliance that has an atmospheric burner shall be designed to run vertically for the maximum possible distance before any change in direction unless the appliance is designed and certified to accept a horizontal flue connection.

The length of the total lateral run in an open flue shall be as short as possible and not exceed 50 % of the total flue height. A lateral run of open flue shall be designed to rise not less than 20 mm per 1 m run.

7.8.3.4 Common (combined) flue

Where more than one appliance is connected to a common flue, each appliance shall have a flame-failure device (see figure F.6). In addition the burners of the appliances connected to the common flue shall be of the same type such that all are

a) atmospheric burners;

b) forced draught burners; or

c) induced draught burners.

7.8.3.5 Flue for gas and other fuels

A flue shall not discharge into a flue concurrently flueing discharge from another appliance fuelled by other than gas.

7.8.3.6 Restriction to the flow of the flue

A flue shall comply with the following:

a) changes of direction shall be kept to a minimum; and

b) a change in direction, shape or size shall be gradual to minimize restriction to the flow of flue gases.

7.8.3.7 Flue to include a draught diverter

The flue of an appliance shall include a draught diverter, except where any of the following apply:

a) where a draught diverter is an integral part of the appliance;

b) the appliance is a room-sealed type; or

c) the appliance is designed to operate with a forced or induced draught burner.

7.8.3.8 Power flue

Where satisfactory flueing relies on the operation of an extractor fan, the installation shall include the following:

a) a sensing device fitted in the flue that will prevent the flow of gas to the burner(s) when the fan is ineffective; and

NOTE Appliances with a permanent pilot need only be interlocked to cause the main burner to shut off.

b) each appliance shall be fitted with a safety shut-off system.

7.8.3.9 Flue cowl

The flue outlet shall be so positioned as to prevent downdraughts. Frequently this means that the outlet shall be above the highest point on the building, for example, approximately 1 m above the roof ridge or, in the case of a flat-roofed building, 1 m above the parapet. The outlet shall have a rainproof terminal or cowl of a type that does not restrict the flue. This cowl shall be screened to prevent birds from nesting in it.

7.8.4 Flue installation

7.8.4.1 Provision for removal of appliance

Where removal of an appliance requires 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 appliance flue connection is an acceptable method of connecting the flue to an appliance and satisfying this requirement.

7.8.4.2 Flue support

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

7.8.4.3 Flue joints

A flue with any soft-soldered joint shall be designed and supported to prevent stress being imparted onto the soft-soldered joint. Flue joints shall be adequately sealed and comply with the following:

a) where subjected to the weather, have downward facing sockets; and

b) where protected from the weather, have upward facing sockets.

7.8.4.4 Weatherproofing a flue pipe

Where a flue passes through a roof or an external wall, the penetration shall be made permanently weatherproof.

7.8.4.5 Brick or masonry flue

A brick or masonry flue shall be completely sealed from all cavities.

7.8.4.6 Clearance around a draught diverter

There shall be at least 75 mm clearance between a draught diverter relief opening and any wall surface.

7.8.5 Location of flue

7.8.5.1 Prohibited location of a flue

A flue shall not be located in, or through, lift wells, clothes chutes, rubbish chutes, air ducts or ventilating ducts.

7.8.5.2 Flue pipe extending into a chimney

A flue pipe or spigot shall

a) not extend so far into a chimney as to cause a restriction; and

b) be arranged to prevent any falling or loose material from entering or obstructing the flue.

7.8.5.3 Temperature limitation of combustible surfaces near a flue or chimney

The clearance between a combustible surface and a flue or chimney shall be sufficient to ensure the temperature of the combustible surface does not exceed 65 °C.

NOTE This requirement also applies to a combustible surface near a flue or chimney, which is protected by a heat shield or fire-resistant material.

7.8.5.4 Clearance from wiring and fittings and combustible materials

The clearance between a flue and any electrical wiring or fitting, telephone cable or communication wiring or combustible material shall not be less than 200 mm.

7.8.5.5 Protection of combustible surfaces

Where a combustible surface requires protection, the method used shall provide protection at least equivalent to one of the following (see figure 4):

a) Fire-resistant material attached to the combustible surface and covered with 0,4 mm sheet metal.

b) Sheet metal having a minimum thickness of 0,4 mm spaced out at least 190 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.

d) See also SANS 10400-V.

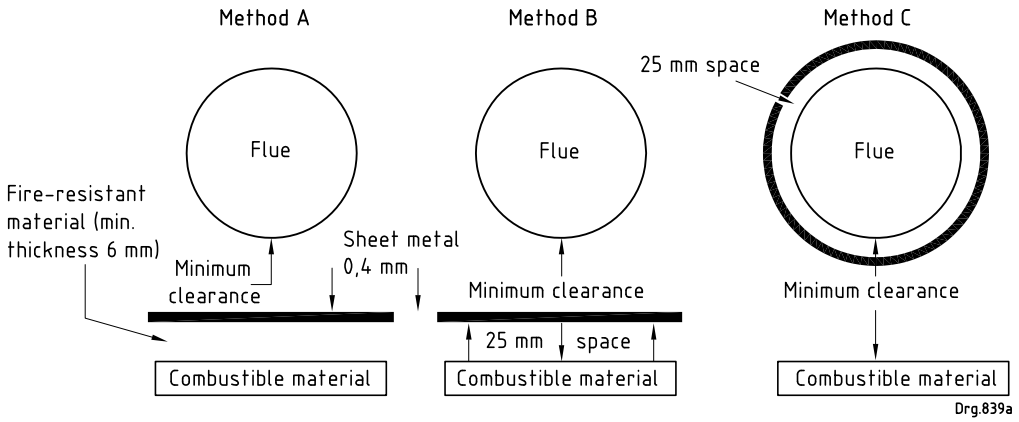


Figure 4 — Methods of protecting combustible surfaces

7.8.5.6 Protection of adjacent non-combustible materials

Where a flue is fitted 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 65 °C.

NOTE This requirement is to protect materials on or near the external surface of the wall or partition.

7.8.6 Terminating a flue — Location

7.8.6.1 The termination point of a flue shall be so located in relation to neighbouring structures that wind from any direction will not be likely to create downdraught in the flue or chimney.

Where a flue is to terminate above

a) a roof, the end of the flue shall be at least 1 m from the nearest part of the roof;

b) a trafficable roof designed for personal or public use, the end of the flue shall be at least 2 m above the roof level. This dimension is to be increased where necessary so that a minimum distance of 1 m is maintained above any surrounding parapet; or

c) a chimney, the end of the flue shall be at least 200 mm from the nearest part of the chimney; and

d) for thatch or shingle roof the distance shall be 1 m above the pitch of the roof.

NOTE 1 This distance is measured before the cowl (if required) is fitted to the end of the flue.

NOTE 2 In respect to a roof, the distance may not apply where the flue is equipped with a device, which will ensure effective flueing is achieved with a lesser clearance to the roof.

7.8.6.2 A power flue shall terminate in accordance with 7.8.6.1.

7.8.6.3 Except where 7.8.6.1 applies, a flue terminal shall be:

a) at least 1 m horizontally from a neighbouring structure; or

b) if less than 1 m horizontally from a neighbouring structure, at least 500 mm above that structure;

c) at least 1,5 m from any opening into a building; and

d) at least 200 mm from another flue terminal.

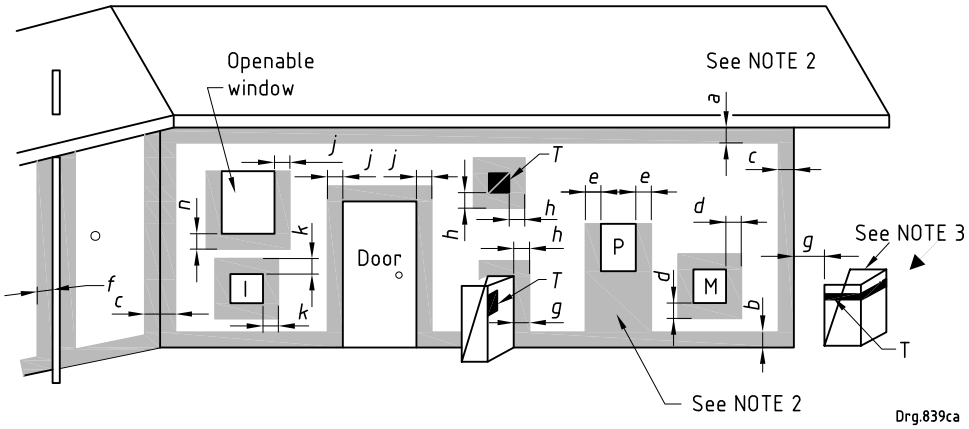
7.8.6.4 Location of a flue terminal (cowl) of a balanced flue appliance, fan-assisted flue appliance, room-sealed appliance or an outdoor appliance

The location of the flue terminal of a balanced flue appliance, fan-assisted flue appliance, room-sealed appliance, or an outdoor appliance shall comply with figure 5.

Where the flue terminal of a balanced flue appliance, a room-sealed appliance or the flue terminal of an appliance designed for outdoor installation is to be installed under a covered area

a) the covered area shall be open on at least two sides; and

b) the terminal shall be located to ensure a free flow of air across it is achieved.



Key

T = Flue terminal
M = Gas meter
I = Mechanical air inlet
P = Electricity meter or fuse box
Shading indicate prohibited areas for flue terminals

1	2	3	4
Reference	**Item**	**Minimum clearance** mm	
		Natural draft	**Fan assisted**
a	Below eaves and other projections:		
	• Appliances up to 50 MJ/h input	300	200
	• Appliances 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 4.5.7.11 for vent terminal location of regulator)	1 000	1 000
e	From an electricity meter or fuse box (P)	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	30
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:		
	• Appliances up to 150 MJ/h input	500	300
	• Appliances over 150 MJ/h input up to 200 MJ/h input	1 500	300
	• Appliances over 200 MJ/h input up to 250 MJ/h input	1 500	500
NOTE 1 All distances are measured to the nearest part of the terminal.			
NOTE 2 Prohibited area below electricity meter or fuse box extends to ground level.			
NOTE 3 See 7.8.5.1 for restrictions on a flue terminal under a covered area.			

Table (*concluded*)

1	2	3	4
Reference	**Item**	**Minimum clearance** mm	
		Natural draft	**Fan assisted**
j	• Appliances over 250 MJ/h input	1 500	1 500
	• All fan-assisted flue appliances, 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:		
	• Space heaters up to 50 MJ/h input	150	150
	• Other appliances up to 50 MJ/h input	500	500
	• Appliances over 50 MJ/h input and up to 150 MJ/h input	1 000	1 000
	• Appliances over 150 MJ/h input	1 500	1 500
NOTE 1 All distances are measured to the nearest part of the terminal.			
NOTE 2 Prohibited area below electricity meter or fuse box extends to ground level.			
NOTE 3 See 7.8.5.1 for restrictions on a flue terminal under a covered area.			

Figure 5 — Minimum clearances required for balanced flue terminals, fan assisted flue terminals, room-sealed appliances terminals or the terminals of outdoor appliances

8 Appliance commissioning

8.1 Commissioning of gas appliances

The commissioning of an appliance shall take full account of special design features, the manufacturer's instructions and the appliance safety requirements. All gas installations shall be installed, commissioned or removed by a registered gas practitioner (gas installer) only.

8.2 Commissioning requirements

The commissioning of an installation shall include all of the following:

a) All installations are to be check for leaks.

b) The appliance is to be checked to ensure safe working order.

c) Each burner of all the appliance is to be lit and where necessary adjusted, in accordance with the manufacturer's instructions. Once all adjustments have been done the entire system is to be checked for the correct operating pressure with all the burners lit.

d) The user, is to be instructed on the safe and correct operation of the appliance and any auxiliary equipment and be issued with a certificate of compliance.

e) The appliance operating instructions are to be handed to the user.

Annex A
(informative)

Purging

A.1 Introduction

A.1.1 General

Purging is carried out to avoid the possibility of an explosive air/gas mixture existing or forming in piping, appliances or confined spaces. Purging is the

a) displacement of air, or an inert gas, by a fuel gas; or

b) displacement of a fuel gas by air, or an inert gas.

NOTE Nitrogen is the preferred inert gas. Carbon dioxide is an alternative.

A.1.2 Precautions before purging commences

The following precautions are to 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 in or near the purge area.

A.2 Purging a service pipe

Purging a service pipe is normally the function of the network operator. Where the network operator permits other persons to purge a service pipe, the purge is to be carried out in accordance with the network operator's procedure.

NOTE A service pipe is that portion of piping between the gas main and the billing meter.

A.3 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. Observe the test dial or index to ensure the correct amount has passed through the meter.

NOTE 1 The volume of a meter is indicated on its badge.

NOTE 2 Where the network operator permits other persons to purge the billing meter, the above method is acceptable.

A.4 Purging a small volume installation with gas

A.4.1 General

A small volume gas installation is one with a total installed pipe volume of up to 0,03 m^3 (30 L). The pipe lengths given in table A.1 relate to an approximate volume of 0,03 m^3.

Table A.1 — Approximate pipe length for a volume of 0,03 m^3

1	2	3	4	5	6	7	8	9	10	11	12
Pipe material	**Approximate pipe length for a volume of 0,03 m^3** m										
	Nominal size DN										
	18	**20**	**23**	**25**	**32**	**40**	**50**	**63**	**80**	**90**	**100**
Steel	–	80	–	50	30	20	15	–	6	–	3,5
Copper	–	130	–	70	40	30	16	–	7,5	–	4
PVC-U	–	75	–	45	25	20	15	–	6	–	3,7
PE (to AS/NZS 4130)	–	150	–	–	–	29	–	13	–	6	–
Polyamide	153	–	88	–	–	28	18	11	–	5,3	–
NOTE For composite pipe volumes refer to manufacturer's specifications.											

A.4.2 Commencing the purge

Follow the following 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 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 with an open burner or burners at which to commence the purge. A cooking appliance is ideal.

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.

WARNING: Special care is to be taken to ensure that gases 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.

A.4.3 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. A change in the audible tone and smell is a good indication that gas is at the burner.

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.

A.4.4 Purging through an appliance fitted with a flame safeguard device

A.4.4.1 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.

A.4.4.2 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 bridging device across the appliance inlet union connection.

NOTE See 4.10.3.

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 soap and water solution.

f) Allow sufficient time for any gas to disperse.

NOTE 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.

g) Remove the bridging device.

h) Turn on the power supply and activate the ignition source. Ignition may not be successful immediately and lockout may occur a number of times before combustion is satisfactory.

i) Allow sufficient time for any un-burnt gas to disperse before re-setting the system.

A.4.4.3 Thermoelectric or bi-metallic device fitted

Where an appliance is fitted with one of these types of flame safeguard system, purging through a pilot alone can be quite time consuming.

The purging time may be shortened by following the following preliminary procedure:

a) Fit a bridging device across the appliance inlet union connection.

b) Slacken the union to allow gas to flow out, but do not fully disconnect it.

c) Turn on the appliance manual shut-off valve (where fitted).

d) As soon as the presence of gas is detected, tighten the union and test with soap and water solution.

e) Allow sufficient time for any gas to disperse.

NOTE 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 an ignition source is applied.

f) Remove the bridging device.

g) Follow the normal appliance lighting sequence, applying a continuously burning flame to the pilot.

NOTE 1 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.

NOTE 2 Do not use an LP Gas flame (or any other gas) for lighting appliances because overheating can damage the thermocouple lead or bi-metallic device.

h) Continue to purge until the pilot flame remains alight and stable.

i) Ensure the appliance main burner flame is stable and operates satisfactorily.

A.5 Purging piping of fuel gas

Where piping is to be opened for alteration, repair or extension, the section involved should be turned off from the supply at a convenient point and the piping vented to atmosphere.

If the section involved exceeds the length shown in table A.2, the remaining fuel gas should be displaced by an inert gas.

Table A.2 — Pipe length at which an inert gas purge is required

1	2
Nominal size DN	**Approximate pipe length** m
50	25
65	15
80	10
100	5
150	3
Over 150	All

Annex B
(normative)

Pressure testing a gas installation

B.1 Introduction

This annex details procedures for pressure testing a gas installation.

NOTE Refer to B.6 regarding the selection of a suitable test instrument.

B.2 Tests for a gas installation

B.2.1 General

The test described in B.3.2 is to be carried out before any appliances are connected. The test described in B.3 shall be carried out where appliances are connected. A satisfactory test result will ensure that the requirements of 2.6 are met.

B.2.2 Testing piping without appliances connected

This test is to be applied to:

a) new piping, before any appliances are connected; and

b) existing piping which has been altered, repaired or extended and the appliances can be isolated without being disconnected.

NOTE For extensive piping systems, it is advisable to individually test each section as it is completed. However, section testing does not preclude the requirement for a final test of the whole system.

B.2.3 Test procedure

The test is to be carried out as follows:

a) Ensure all open ends are plugged or capped.

b) Connect a suitable pressure gauge and pressurize the piping to 50 kPa or 2 times the operating pressure, whichever is the greater.

NOTE For test pressures up to 50 kPa, a manometer is a suitable pressure gauge.

c) Isolate the pressure source and allow a suitable period for the temperature of the testing medium within the piping to stabilize.

d) For piping with a volume not exceeding 30 L (0,03 m^3), there is to be no loss of pressure during a test period of 5 min.

e) Where the pipe volume exceeds 30 L, the test period required in d) is to be extended by 5 min for every additional 30 L or part thereof.

NOTE 1 The test period indicated is for where a manometer is used as the testing instrument.

NOTE 2 The test period does not include the temperature stabilization period required by B.2.3(c).

NOTE 3 The period for temperature stabilization will depend on a number of conditions including ambient temperature, test fluid temperature and proposed length of test period.

NOTE 4 See table A.1 for pipe lengths with a volume equivalent to 0,03 m^3.

B.3 Testing piping with appliances connected

B.3.1 General

The following test is to be applied where:

a) new piping previously tested in accordance with B.3.2 has had appliances connected; and where

b) existing piping has been altered, repaired or extended; and it is not practicable, without disconnection, to isolate or protect the existing appliances from the higher test pressures required by B.3.2.

B.3.2 Test procedure

The test is to be carried out as follows:

a) Ensure all open ends are plugged or capped.

b) Ensure all appliance control valves are closed, and all manual shut-off valves opened.

c) Attach a suitable pressure gauge.

NOTE For test pressures up to 7 kPa, a manometer is a suitable pressure gauge.

d) Ensure the meter control valve or the cylinder valve, if applicable, is not passing gas.

e) Subject the piping to operating pressure.

f) Isolate the pressure source and allow a suitable period for the temperature of the testing medium within the piping to stabilize.

g) For piping with a volume not exceeding 30 L (0,03 m^3), the installation is to be gastight during a test period of 5 min/h). Where the volume exceeds 30 L, the test period required is to be extended by 5 min for every additional 30 L or part thereof.

NOTE 1 The test period indicated is for where a manometer is used as the testing instrument.

NOTE 2 The test period does not include the temperature stabilization period required by B.3.2(c).

NOTE 3 The period for temperature stabilization will depend on a number of conditions including ambient temperature, test fluid temperature and proposed length of test period.

NOTE 4 See table A.1 for pipe lengths with a volume equivalent to 0,03 m^3.

B.4 Testing downstream of a manual shut off valve

The piping, components, equipment and valve train downstream of an appliance manual shut off valve are to be gastight when tested at operating pressure.

B.5 Testing a connection made after a test procedure

A connection made after a test has been completed is to be checked for leakage at operating pressure, using a soap and water solution or other suitable leakage detection method.

B.6 Electing the test instrument

The instrument selected to test a gas installation shall be suitable for the application.

NOTE Table B.2 has been compiled to assist in selecting a suitable test instrument.

Table B.2 — Test instruments

1	2	3	4	5
Instrument	**Test pressure range**	**Pipe volume**	**Limitation**	**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 pressures 5 min for each 30 L	5 min for each 30 L
Manometer (mercury-filled)	–	–	No longer recommended because of health and safety issues involving mercury	–
Manometer (digital read-out)	Up to 200 kPa	Up to 0,3 m^3	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
Instrument	Test pressure range	Pipe volume	Limitation	Test time
Bourdon gauge (dial gauge)	Up to 700 kPa	Any	Generally poor at indicating minor escapes. All pipe joints should be checked with a soap and water solution	Over 30 min
			Larger dials will assist in providing accurate reading. Range and scale need to be suitable for test pressure, i.e., scale should not exceed test pressure × 2	
Pressure recorder			Time consuming but essential where a record of the test is required	
(Pen and ink chart)	Up to 700 kPa	Any	Test period is exactly one revolution of a circular chart	24 h
(One revolution of a circular chart in 24 h)			Temperature changes shall be considered because they can affect the indicated result. (Some pressure recorders are temperature compensated)	
			Generally unsuitable for existing gas installations	

Annex C
(informative)

Billing meters

C.1 Meter location

The location and the method of installation of a billing meter are determined by the network operator. Ventilation of the meter location is to be in accordance with 6.14.4.

C.2 Requirements

Contact should be made with the network operator to determine the meter location and relevant installation requirements before any work commences.

C.3 Prohibited locations

Meters are not to be installed in any of the following locations:

a) A bedroom.

b) A lift shaft or lift motor room.

c) A room specifically intended for electrical switchgear.

d) A fire-isolated stairway or passage.

e) Sprinkler or hydrant pump room.

f) Near a source of ignition.

g) In such a position that would obstruct egress from a building.

h) In such a position where the meter would be subject to physical damage unless adequately protected.

i) In an area where excessive temperatures or sudden excessive changes in temperature may occur.

j) In the foundation area under a building.

k) In a cavity wall, unless installed in a ventilated enclosure which meets the requirements of the network operator and the cavity is sealed.

l) In a position where access for reading or maintenance is restricted.

m) In an unventilated position.

n) On the ground.

o) On a floor which is frequently wetted.

p) On a floor which contains material which may corrode the meter.

C.4 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 Piping should also be appropriately marked prior to meter installation.

C.5 Subsequent work

The network operator's requirements are to be maintained when subsequent work which involves access to the billing meter is carried out. Ensure the following are provided on completion of such work:

a) security;

b) ventilation;

c) corrosion protection; and

d) access for reading and maintenance.

Annex D
(informative)

Pipe sizing

D.1 Introduction

The method of sizing piping described in this annex is suitable where the allowable pressure drop measured in kilopascals (kPa) is:

Natural gas 0,075, 0,12, 0,25, 0,75, 1,5 or 10.

The sizing of piping for materials or conditions other than those in the pipe sizing tables D.1 to D.30 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 pressures, other pressure drops and special appliance requirements.

D.2 New piping systems

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

D.3 Existing piping systems

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

D.4 Information required prior to pipe sizing

The following information will be required prior to pipe sizing:

a) the type of gas, including the heating value (MJ/m^3) and relative density (RD);

b) the gas consumption of each appliance (MJ/h);

c) an allowance, if any, where there is a probability that not all appliances will be used at the same time;

d) the pressure available at the start of the piping;

e) the allowable pressure drop. The pressure drop should be such as to ensure that at least the minimum inlet pressure required by the appliance is available at the appliance; and

f) the proposed layout of the piping system including all pipe lengths and the location of each appliance.

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

D.5 Method of pipe sizing

A worked example is given to explain a method of pipe sizing for a typical piping system that will be using natural gas at 1,2 kPa at the start of the piping.

NOTE Other methods of pipe sizing may be used.

D.6 Piping layout

Sketch the intended piping layout (see figure D.1), include the appliance positions and add the following:

a) all pipe lengths (m) and the gas consumption of each appliance (MJ/h);

b) allocate a letter to each branch, commencing at the meter with the letter "A"; and

c) allocate a letter to each appliance position.

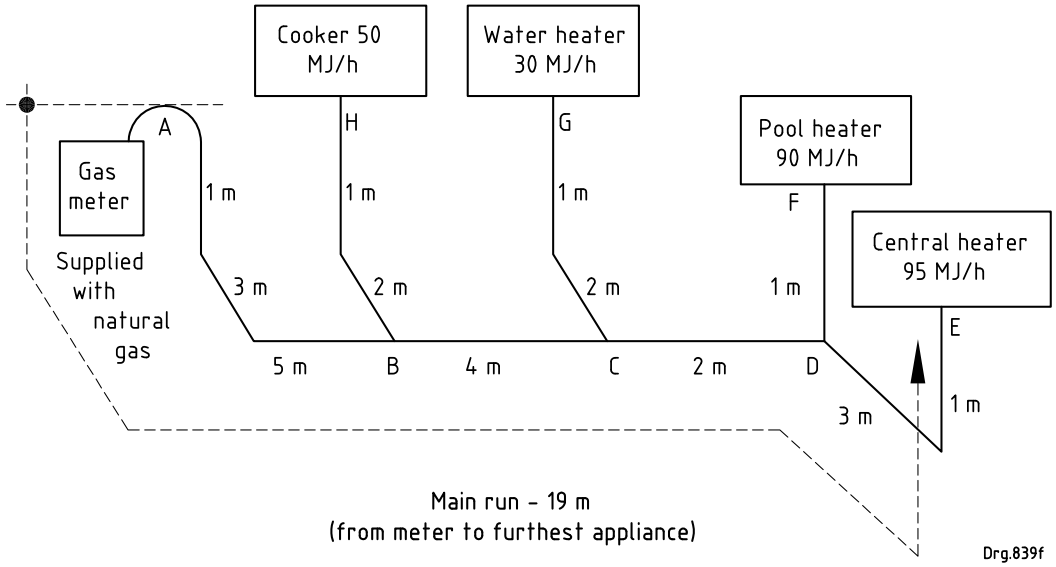


Figure D.1 — Example of consumer piping layout

D.7 Determine the main run

The main run is the length of 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 D.1 is from the meter to the central heater, which is 19 m.

D.8 Select the piping material

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

NOTE Steel piping is used for the example.

D.9 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. The tables within this annex include an allowance for the number of fittings that could be expected to be used in good practice.

NOTE For the example, use table D.8 natural gas flow through steel pipe which has an allowable pressure drop of 0,075 kPa.

D.10 Chart for pipe sizes

Prepare a chart for pipe sizes, as follows:

a) Indicate, in the column marked "pipe section", each section of piping including each branch.

b) Indicate, in the column marked "gas flow", the amount of gas (MJ/h) flowing through each section.

c) The column indicating nominal size will be completed in D.11.

Table D.1 — Example of chart for pipe sizes

1	2	3
Pipe section	**Gas flow** MJ/h	**Nominal size** DN
A – B	50 + 30 + 90 + 95 = 265	32
B – C	30 + 90 + 95 = 215	32
C – D	90 + 95 = 185	25
D – E	95	20
D – F	90	20
C – G	30	15
B – H	50	15

D.11 Selecting the pipe size

D.11.1 General

Refer to the appropriate pipe sizing table (table D.8 for the example), then:

a) Select the main run length shown under "length of straight pipe". If the main run falls between two figures, use the greater. Therefore, in the example, 20 m is used because the main run length is 19 m.

b) Section A – B 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, 419.

c) Read across to the indicated "Nominal size", which is DN 32 in the example.

d) Insert the pipe size in the prepared chart (see D.6)

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.

D.11.2 Pipe sizing tables

The pipe sizing tables indicate the flow of gas, in mega joules per hour, through pipes of various materials. The heating value quoted in each table 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.

D.11.3 Pipe sizing tables for low pressure gas

These tables are suitable for use where the allowable pressure drop is: 0,075 kPa, 0,12 kPa, 0,25 kPa, 0,75 kPa or 1,5 kPa for natural gas, 0,25 kPa for LP Gas or 0,075 kPa for all other gases.

Table D.2 — Pipe sizing tables for low pressure gas

1	2	3	4	5	6
Table	**Type of gas**	**Hv** MJ/m^3	**Rd**	**Material**	**Pressure drop** kPa
E3	NATURAL GAS (NG)	38	0,6	COPPER	0,075
E4		38	0,6	COPPER	0,12
E5		38	0,6	COPPER	0,25
E6		38	0,6	COPPER	0,75
E7		38	0,6	COPPER	1,5
E8		38	0,6	STEEL	0,075
E9		38	0,6	STEEL	0,25
E10		38	0,6	STEEL	0,75
E11		38	0,6	STEEL	1,5
E12		38	0,6	POLYAMIDE	0,075
E13		38	0,6	POLYAMIDE	0,25
E14		38	0,6	POLYAMIDE	0,75
E15		38	0,6	POLYAMIDE	1,5
E16		38	0,6	PE to AS/NZS 4130, T3	0,075
E17		38	0,6	PE to AS/NZS 4130, T4	0,075
E18		38	0,6	PE to AS/NZS 4130, T3	0,25
E19		38	0,6	PE to AS/NZS 4130, T4	0,25
E20		38	0,6	PE to AS/NZS 4130, T3	0,75
E21		38	0,6	PE to AS/NZS 4130, T4	0,75
E22		38	0,6	PE to AS/NZS 4130, T3	1,5
E23		38	0,6	PE to AS/NZS 4130, T4	1,5
E24		38	0,6	PVC-U	0,075
E25		38	0,6	PVC-U	0,12
E26		38	0,6	PVC-U	0,25
E27		38	0,6	PVC-U	0,75
E28		38	0,6	PVC-U	1,5
E29		38	0,6	COPPER	10,0
E30		38	06	STEEL	10,0
NOTE 1 PVC-U is unplasticised poly(vinyl chloride). NOTE 2 PE is polyethylene.					

Table D.3 — Pressure drop of 0,075 kPa
Natural gas flow through copper (MJ/h)
(This table is suitable for supply pressure around 1,1 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
6	6	3	2	2	1	1	1	1	1
8	18	9	6	5	4	3	3	2	2
10	27	15	10	8	6	5	4	4	3
15	61	45	38	32	26	21	18	16	14
20	205	137	108	95	87	80	75	71	67
25	466	313	247	209	184	165	151	141	134
32	912	614	486	412	362	326	298	276	257
40	1 559	1 052	834	708	622	560	513	475	443
50	3 562	2 410	1 915	1 627	1 432	1 291	1 182	1 095	1 024
65	6 662	4 516	3 594	3 055	2 692	2 428	2 224	2 062	1 928
80	10 753	7 300	5 814	4 945	4 361	3 934	3 606	3 343	3 127
	20	25	30	35	40	45	50	55	60
15	13	10	9	7	6	6	5	5	4
20	64	58	53	45	40	35	32	29	26
25	128	116	108	100	95	90	86	82	79
32	242	213	191	177	168	159	152	146	141
40	417	367	330	301	279	260	245	231	222
50	964	848	763	698	647	604	568	538	511
65	1 816	1 599	1 440	1 319	1 221	1 142	1 074	1 017	967
80	2 946	2 595	2 340	2 143	1 986	1 856	1 748	1 655	1 575
100	6 619	5 836	5 265	4 825	4 474	4 185	3 942	3 734	3 554
125	12 274	10 829	9 774	8 962	8 313	7 779	7 329	6 945	6 612
150	19 932	17 594	15 886	14 571	13 519	12 654	11 926	11 303	10 763
	65	70	75	80	85	90	100	120	140
15	4	4	3	3	3	3	3	2	2
20	24	23	21	20	19	18	16	13	11
25	76	74	70	66	62	59	53	44	38
32	136	131	127	124	121	118	112	103	96
40	214	207	201	196	191	186	178	164	153
50	488	467	449	432	417	404	380	341	312
65	924	885	851	819	791	765	720	648	592
80	1 504	1 441	1 385	1 335	1 289	1 247	1 174	1 057	967
100	3 396	3 256	3 130	3 017	2 915	2 821	2 657	2 394	2 191
125	6 319	6 060	5 828	5 618	5 429	5 255	4 950	4 463	4 088
150	10 289	9 868	9 491	9 152	8 844	8 563	8 068	7 277	6 669
	160	180	200	220	240	260	280	300	320
15	2	1	1	1	1	1	1	1	1
20	10	9	8	7	7	6	6	5	5
25	33	29	26	24	22	20	19	18	16
32	89	79	71	64	59	54	51	47	44
40	145	137	131	125	121	116	112	104	98
50	293	279	267	256	246	238	230	223	217
65	548	512	481	455	433	413	395	382	371
80	895	836	786	744	707	675	647	621	598
100	2 030	1 897	1 786	1 690	1 608	1 535	1 471	1 414	1 362
125	3 789	3 543	3 336	3 159	3 006	2 871	2 752	2 645	2 549
150	6 182	5 782	5 446	5 159	4 910	4 691	4 497	4 323	4 167

Table D.4 — Pressure drop of 0,12 kPa
Natural gas flow through copper (MJ/h)
(This table is suitable for supply pressure around 1,25 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
6	7	5	4	4	4	3	3	3	2
8	19	14	12	10	9	9	7	7	6
10	31	22	18	16	15	14	12	10	9
15	77	55	46	41	37	34	29	26	23
20	269	180	142	120	106	98	92	87	82
25	610	410	325	275	242	217	199	184	172
32	1 190	803	637	540	475	427	391	362	338
40	2 032	1 373	1 091	926	815	734	672	622	581
50	4 635	3 141	2 498	2 123	1 871	1 687	1 545	1 432	1 339
65	8 658	5 878	4 681	3 982	3 511	3 167	2 903	2 691	2 518
80	13 962	9 491	7 566	6 439	5 680	5 127	4 700	4 359	4 079
	20	25	30	35	40	45	50	55	60
15	20	16	14	12	10	9	8	7	7
20	79	71	66	61	58	55	51	46	42
25	161	142	132	123	116	111	106	101	97
32	318	279	251	230	212	198	186	179	172
40	547	481	433	396	366	342	322	304	289
50	1 261	1 110	1 000	915	847	792	745	705	671
65	2 371	2 089	1 883	1 725	1 598	1 494	1 407	1 332	1 267
80	3 843	3 387	3 055	2 799	2 594	2 426	2 285	2 164	2 059
100	8 619	7 603	6 861	6 291	5 834	5 459	5 143	4 873	4 639
125	15 962	14 089	12 721	11 668	10 825	10 132	9 549	9 050	8 618
150	25 898	22 869	20 657	18 952	17 588	16 466	15 522	14 714	14 013
	65	70	75	80	85	90	100	120	140
15	6	6	5	5	5	5	4	3	3
20	39	36	34	32	30	28	25	21	18
25	94	91	88	86	83	81	78	70	60
32	166	161	156	152	148	145	138	127	119
40	276	264	254	245	236	228	218	201	188
50	641	614	590	568	548	531	499	449	410
65	1 210	1 160	1 115	1 074	1 037	1 004	945	850	778
80	1 967	1 886	1 813	1 747	1 688	1 633	1 538	1 385	1 267
100	4 433	4 251	4 088	3 941	3 807	3 686	3 471	3 129	2 866
125	8 237	7 900	7 599	7 327	7 080	6 855	6 459	5 826	5 338
150	13 397	12 851	12 362	11 922	11 522	11 157	10 515	9 488	8 697
	160	180	200	220	240	260	280	300	320
15	3	2	2	2	2	2	1	1	1
20	16	14	13	12	11	10	9	8	8
25	53	47	42	38	35	32	30	28	26
32	112	106	102	97	94	87	81	76	71
40	178	169	161	155	149	144	139	135	131
50	380	354	333	315	302	291	282	274	267
65	720	672	633	598	569	543	520	500	481
80	1 174	1 097	1 032	977	929	887	849	816	786
100	2 656	2 483	2 337	2 213	2 106	2 011	1 927	1 853	1 785
125	4 949	4 628	4 359	4 129	3 929	3 754	3 599	3 460	3 335
150	8 065	7 545	7 108	6 735	6 411	6 126	5 874	5 648	5 444

Table D.5 — Pressure drop of 0,25 kPa
Natural gas flow through copper (MJ/h)
(This table is suitable for supply pressure around 1,5 kPa to 2,5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
6	18	10	7	5	4	3	3	3	2
8	34	25	20	15	12	10	9	8	7
10	45	34	28	25	21	17	15	13	11
15	118	79	64	56	51	47	44	42	39
20	409	275	218	184	162	146	133	123	115
25	925	624	495	420	369	332	304	281	263
32	1 801	1 218	968	821	723	652	597	553	516
40	3 070	2 079	1 654	1 405	1 238	1 116	1 022	947	886
50	6 983	4 742	3 777	3 213	2 834	2 556	2 343	2 173	2 032
65	13 019	8 857	7 063	6 013	5 306	4 789	4 392	4 074	3 812
80	20 965	14 281	11 398	9 709	8 571	7 740	7 099	6 587	6 166
	20	25	30	35	40	45	50	55	60
15	38	34	28	24	21	19	17	15	14
20	108	98	91	85	80	76	73	70	67
25	247	217	195	179	165	154	145	139	134
32	486	427	385	352	326	304	286	271	257
40	834	734	661	605	560	523	493	466	443
50	1 914	1 687	1 520	1 393	1 290	1 206	1 136	1 076	1 023
65	3 592	3 167	2 857	2 618	2 427	2 270	2 138	2 025	1 927
80	5 812	5 126	4 626	4 240	3 932	3 679	3 466	3 284	3 126
100	12 999	11 475	10 361	9 504	8 818	8 253	7 779	7 373	7 020
125	24 030	21 224	19 173	17 593	16 329	15 288	14 413	13 665	13 014
150	38 935	34 402	31 089	28 535	26 491	24 809	23 394	22 182	21 131
	65	70	75	80	85	90	100	120	140
15	13	12	11	11	10	9	9	7	6
20	65	62	61	59	57	56	53	44	38
25	130	125	122	118	115	113	107	99	93
32	246	235	226	218	210	203	191	175	164
40	423	405	389	375	362	350	330	296	271
50	977	937	900	867	838	811	763	687	628
65	1 841	1 765	1 697	1 636	1 580	1 529	1 440	1 297	1 187
80	2 987	2 864	2 754	2 655	2 565	2 483	2 338	2 108	1 930
100	6 711	6 436	6 191	5 969	5 769	5 585	5 263	4 747	4 350
125	12 444	11 937	11 484	11 075	10 704	10 366	9 770	8 817	8 083
150	20 207	19 387	18 654	17 992	17 392	16 845	15 879	14 336	13 148
	160	180	200	220	240	260	280	300	320
15	5	5	4	4	4	3	3	3	3
20	33	29	26	24	22	20	19	18	16
25	87	83	79	76	73	68	63	59	55
32	155	147	141	135	130	125	121	118	114
40	250	234	222	213	205	198	192	186	181
50	582	543	511	483	460	439	420	404	389
65	1 100	1 027	967	915	870	831	796	765	737
80	1 788	1 672	1 574	1 490	1 417	1 354	1 297	1 247	1 201
100	4 033	3 772	3 552	3 365	3 202	3 060	2 933	2 820	2 718
125	7 497	7 015	6 609	6 262	5 961	5 697	5 463	5 253	5 064
150	12 197	11 416	10 758	10 196	9 708	9 279	8 899	8 559	8 253

Table D.6 — Pressure drop of 0,75 kPa
Natural gas flow through copper (MJ/h)
(This table is suitable for supply pressure around 2,75 kPa to 5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
10	83	56	44	39	36	33	31	29	28
15	219	147	116	98	86	78	71	66	62
20	752	508	403	342	301	271	248	230	215
25	1 691	1 145	911	774	682	614	563	521	487
32	3 281	2 227	1 773	1 508	1 330	1 199	1 099	1 019	953
40	5 577	3 791	3 022	2 572	2 269	2 047	1 877	1 740	1 628
50	12 637	8 611	6 873	5 855	5 169	4 668	4 282	3 973	3 719
65	23 496	16 037	12 814	10 923	9 649	8 718	8 000	7 425	6 953
80	37 764	25 805	20 633	17 599	15 552	14 056	12 902	11 979	11 219
	20	25	30	35	40	45	50	55	60
15	60	54	50	47	44	42	40	38	37
20	202	177	160	146	135	126	119	112	107
25	459	404	364	333	308	288	271	256	244
32	897	790	712	652	604	565	532	503	479
40	1 534	1 352	1 219	1 117	1 035	968	911	863	821
50	3 505	3 092	2 790	2 557	2 371	2 219	2 090	1 980	1 885
65	6 555	5 785	5 223	4 790	4 444	4 159	3 919	3 715	3 537
80	10 579	9 341	8 437	7 740	7 182	6 724	6 338	6 008	5 721
100	21 684	19 159	17 313	15 890	14 751	13 814	13 025	12 351	11 765
125	43 470	38 429	34 742	31 900	29 624	27 751	26 174	24 824	23 652
150	70 298	62 168	56 222	51 635	47 963	44 938	42 393	40 214	38 321
	65	70	75	80	85	95	100	120	140
15	36	34	33	32	30	27	25	21	18
20	102	99	96	94	91	87	85	78	73
25	233	223	214	206	199	187	181	163	149
32	457	438	421	406	392	367	357	321	293
40	784	752	723	696	673	631	613	552	505
50	1 801	1 727	1 661	1 601	1 547	1 452	1 410	1 271	1 164
65	3 380	3 242	3 118	3 006	2 905	2 728	2 650	2 389	2 189
80	5 470	5 246	5 047	4 866	4 703	4 417	4 291	3 872	3 549
100	11 250	10 793	10 385	10 016	9 682	9 097	8 839	7 979	7 317
125	22 622	21 709	20 891	20 153	19 484	18 312	17 796	16 073	14 747
150	36 658	36 658	33 860	32 669	31 587	29 694	28 859	26 075	23 930
	160	180	200	220	240	260	280	300	320
20	69	66	63	60	58	56	54	52	49
25	138	131	126	121	116	112	109	105	102
32	271	254	238	226	214	205	196	188	181
40	467	437	411	389	370	353	338	325	313
50	1 078	1 008	949	898	854	816	782	751	724
65	2 029	1 898	1 787	1 693	1 611	1 539	1 475	1 418	1 366
80	3 290	3 078	2 899	2 747	2 614	2 498	2 395	2 303	2 220
100	6 788	6 352	5 986	5 673	5 401	5 162	4 950	4 761	4 590
125	13 685	12 812	12 077	11 448	10 903	10 424	9 998	9 618	9 275
150	22 213	20 800	19 611	18 594	17 711	16 936	16 247	15 632	15 076

Table D.7 — Pressure drop of 1,5 kPa
Natural gas flow through copper (MJ/h)
(This table is suitable for supply pressure around 5 kPa to 10 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
6	41	28	24	21	19	18	16	15	13
8	88	59	47	40	36	34	31	30	28
10	125	84	66	56	49	45	42	40	38
15	329	221	175	149	131	118	108	100	93
20	1 125	761	605	514	453	408	374	346	324
25	2 522	1 712	1 364	1 160	1 022	922	845	783	733
32	4 885	3 323	2 649	2 255	1 989	1 796	1 646	1 527	1 429
40	8 291	5 648	4 508	3 839	3 389	3 060	2 807	2 604	2 437
50	18 746	12 799	10 229	8 720	7 704	6 960	6 387	5 929	5 552
65	34 803	23 800	19 038	16 242	14 356	12 977	11 914	11 062	10 361
80	55 875	38 255	30 622	26 138	23 112	20 898	19 191	17 824	16 698
	20	25	30	35	40	45	50	55	60
15	87	77	69	64	61	58	55	53	51
20	305	268	241	221	204	191	180	170	161
25	690	608	547	501	464	434	409	387	368
32	1 346	1 186	1 070	980	908	849	800	758	721
40	2 297	2 025	1 827	1 675	1 553	1 453	1 369	1 296	1 234
50	5 234	4 620	4 171	3 825	3 549	3 321	3 130	2 966	2 824
65	9 771	8 629	7 795	7 152	6 637	6 214	5 858	5 553	5 289
80	15 751	13 916	12 574	11 541	10 713	10 032	9 459	8 969	8 543
100	35 030	30 970	28 000	25 710	23 877	22 367	21 097	20 009	19 065
125	64 500	57 050	51 600	47 395	44 028	41 255	38 921	36 923	35 187
150	104 197	92 195	83 411	76 634	71 205	66 733	62 969	59 745	56 944
	65	70	75	80	85	90	100	120	140
15	49	48	46	45	44	43	41	38	35
20	154	148	142	137	132	127	120	108	101
25	351	337	324	312	301	291	274	247	225
32	689	660	634	611	591	572	538	484	443
40	1 179	1 130	1 087	1 048	1 012	980	922	831	761
50	2 700	2 589	2 490	2 401	2 320	2 246	2 116	1 908	1 748
65	5 056	4 850	4 666	4 499	4 348	4 211	3 968	3 581	3 282
80	8 169	7 837	7 540	7 273	7 030	6 808	6 417	5 793	5 312
100	18 235	17 498	16 839	16 245	15 705	15 213	14 345	12 957	11 887
125	33 661	32 307	31 095	30 002	29 010	28 104	26 507	23 953	21 984
150	54 483	52 298	50 342	48 577	46 976	45 514	42 935	38 810	35 630
	160	180	200	220	240	260	280	300	320
15	32	28	25	23	21	20	18	17	16
20	95	90	86	83	80	77	75	72	70
25	209	195	183	173	165	157	150	145	141
32	410	383	361	341	325	310	297	285	275
40	705	659	620	587	558	533	511	491	473
50	1 620	1 515	1 427	1 352	1 286	1 229	1 178	1 132	1 091
65	3 043	2 847	2 682	2 541	2 419	2 311	2 216	2 131	2 054
80	4 927	4 611	4 345	4 117	3 920	3 746	3 592	3 455	3 331
100	11 032	10 328	9 736	9 229	8 789	8 403	8 060	7 753	7 477
125	20 408	19 111	18 020	17 087	16 276	15 564	14 932	14 367	13 857
150	33 084	30 989	29 226	27 716	26 406	25 254	24 233	23 318	22 494

Table D.8 — Pressure drop of 0,075 kPa
Natural gas flow through steel pipe (MJ/h)
(This table is suitable for supply pressure around 1,1 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	167	113	93	83	75	70	65	62	59
20	377	256	204	173	152	137	129	122	116
25	710	484	385	328	289	260	238	221	207
32	1 511	1 033	825	703	620	560	513	476	445
40	2 280	1 562	1 249	1 064	940	849	778	722	676
50	4 279	2 938	2 353	2 008	1 775	1 604	1 472	1 366	1 279
65	8 565	5 898	4 731	4 043	3 576	3 235	2 971	2 759	2 584
80	13 146	9 066	7 280	6 225	5 510	4 986	4 581	4 256	3 988
100	26 574	18 371	14 774	12 646	11 204	10 145	9 326	8 669	8 127
125	44 750	30 986	24 945	21 369	18 944	17 162	15 784	14 677	13 764
150	72 431	50 226	40 471	34 693	30 771	27 890	25 660	23 869	22 390
	20	25	30	35	40	45	50	55	60
15	56	51	42	36	32	28	25	23	21
20	111	101	93	87	82	78	75	72	69
25	194	171	159	149	141	134	128	123	118
32	419	369	332	304	282	263	248	234	225
40	637	561	506	463	429	401	378	357	340
50	1 206	1 064	960	880	816	763	718	680	647
65	2 437	2 152	1 944	1 783	1 654	1 548	1 458	1 382	1 315
80	3 762	3 324	3 003	2 756	2 557	2 394	2 257	2 139	2 037
100	7 670	6 784	6 134	5 632	5 230	4 898	4 619	4 380	4 172
125	12 994	11 499	10 403	9 557	8 878	8 318	7 847	7 443	7 092
150	21 143	18 722	16 945	15 573	14 471	13 563	12 798	12 142	11 572
	65	70	75	80	85	90	100	120	140
15	20	18	17	16	15	14	13	11	9
20	65	60	56	52	49	47	42	35	30
25	114	111	108	105	102	99	95	88	76
32	217	211	204	199	194	189	181	167	157
40	325	311	299	288	278	269	257	238	223
50	618	593	570	549	530	513	483	435	398
65	1 257	1 205	1 159	1 117	1 079	1 045	984	887	812
80	1 947	1 867	1 796	1 731	1 673	1 620	1 526	1 376	1 260
100	3 990	3 828	3 683	3 552	3 433	3 324	3 133	2 827	2 592
125	6 784	6 509	6 264	6 042	5 841	5 658	5 334	4 816	4 417
150	11 071	10 626	10 227	9 867	9 541	9 243	8 716	7 874	7 224
	160	180	200	220	240	260	280	300	320
15	8	7	6	6	5	5	5	4	4
20	26	23	21	19	17	16	15	14	13
25	67	59	53	49	44	41	38	36	33
32	148	140	134	129	124	119	116	109	102
40	210	200	191	183	177	171	165	160	156
50	368	344	327	314	303	293	284	275	268
65	752	703	661	626	595	568	544	523	504
80	1 168	1 091	1 028	973	925	884	847	814	784
100	2 403	2 248	2 117	2 006	1 909	1 823	1 748	1 680	1 620
125	4 097	3 834	3 613	3 423	3 259	3 114	2 986	2 871	2 768
150	6 704	6 276	5 915	5 607	5 339	5 103	4 894	4 707	4 539

Table D.9 — Pressure drop of 0,25 kPa
Natural gas flow through steel pipe (MJ/h)
(This table is suitable for supply pressure around 1,5 kPa to 2,5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	327	222	177	151	133	120	110	102	97
20	729	500	400	341	301	272	249	231	216
25	1 365	938	752	642	567	513	470	437	409
32	2 889	1 992	1 599	1 367	1 210	1 094	1 005	933	874
40	4 348	3 003	2 413	2 064	1 828	1 654	1 520	1 412	1 323
50	8 127	5 625	4 526	3 876	3 435	3 111	2 860	2 658	2 492
65	16 202	11 240	9 058	7 764	6 886	6 241	5 741	5 340	5 009
80	24 810	17 233	13 899	11 922	10 579	9 591	8 827	8 212	7 705
100	49 973	34 780	28 086	24 114	21 414	19 428	17 889	16 652	15 630
125	93 947	58 502	47 285	40 624	36 095	32 761	30 177	28 100	26 383
150	135 587	94 600	76 519	65 778	58 470	53 091	48 921	45 566	42 794
	20	25	30	35	40	45	50	55	60
15	93	85	79	74	70	66	63	61	59
20	204	179	162	148	137	131	125	120	116
25	385	340	306	281	260	243	229	217	206
32	825	728	657	603	559	523	493	467	445
40	1 248	1 103	996	914	848	794	748	709	675
50	2 352	2 080	1 881	1 727	1 603	1 502	1 416	1 342	1 279
65	4 729	4 186	3 788	3 480	3 233	3 030	2 858	2 711	2 583
80	7 277	6 445	5 835	5 363	4 984	4 671	4 408	4 182	3 986
100	14 767	13 090	11 859	10 906	10 141	9 509	8 977	8 521	8 124
125	24 934	22 116	20 045	18 442	17 155	16 092	15 196	14 427	13 758
150	40 454	35 900	32 552	29 960	27 878	26 158	24 708	23 463	22 380
	65	70	75	80	85	90	100	120	140
15	57	55	53	52	50	47	42	35	30
20	112	109	105	103	100	98	93	86	81
25	197	189	182	175	170	166	159	147	138
32	425	407	392	377	365	353	332	299	274
40	645	619	595	574	554	537	505	456	417
50	1 223	1 173	1 128	1 088	1 051	1 018	959	865	793
65	2 471	2 371	2 281	2 201	2 128	2 061	1 943	1 754	1 608
80	3 813	3 660	3 522	3 399	3 286	3 183	3 002	2 711	2 487
100	7 774	7 464	7 186	6 935	6 707	6 499	6 131	5 542	5 088
125	13 169	12 646	12 178	11 754	11 370	11 019	10 399	9 405	8 638
150	21 427	20 580	19 821	19 135	18 512	17 943	16 938	15 327	14 082
	160	180	200	220	240	260	280	300	320
15	26	24	21	19	18	16	15	14	13
20	76	72	69	64	58	54	50	47	44
25	130	124	118	114	109	106	102	99	97
32	254	237	224	216	208	201	195	189	184
40	386	361	340	322	306	292	280	269	261
50	735	687	647	613	583	557	534	513	494
65	1 492	1 396	1 315	1 246	1 186	1 133	1 086	1 044	1 007
80	2 308	2 160	2 036	1 929	1 837	1 756	1 683	1 619	1 561
100	4 723	4 423	4 171	3 954	3 766	3 601	3 454	3 323	3 205
125	8 023	7 515	7 088	6 723	6 405	6 125	5 877	5 655	5 455
150	13 084	12 261	11 567	10 973	10 457	10 003	9 599	9 238	8 913

Table D.10 – Pressure drop of 0,75 kPa
Natural gas flow through steel pipe (MJ/h)
(This table is suitable for supply pressure around 2,75 kPa to 5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
6	38	29	24	22	20	18	16	14	13
8	112	77	61	53	48	45	42	40	38
10	238	194	155	133	117	106	97	90	84
15	580	400	321	274	242	219	201	187	175
20	1 291	893	718	614	544	492	452	420	394
25	2 407	1 668	1 343	1 150	1 019	923	849	789	740
32	5 072	3 523	2 841	2 437	2 162	1 960	1 803	1 677	1 573
40	7 619	5 299	4 277	3 670	3 257	2 954	2 719	2 530	2 374
50	14 198	9 891	7 992	6 865	6 097	5 533	5 095	4 744	4 453
65	28 221	19 695	15 932	13 696	12 175	11 054	10 186	9 487	8 909
80	43 140	30 137	24 396	20 983	18 659	16 948	15 621	14 553	13 670
100	86 671	60 637	49 134	42 293	37 634	34 201	31 538	29 395	27 622
125	139 413	97 626	79 156	68 168	60 683	5 516	50 886	47 440	44 590
150	224 854	157 591	127 852	110 154	98 095	89 207	82 308	76 753	72 158
	20	25	30	35	40	45	50	55	60
15	165	145	131	120	111	104	98	94	91
20	371	328	296	272	252	236	222	211	201
25	698	618	558	513	476	446	420	398	379
32	1 486	1 315	1 190	1 094	1 016	952	898	852	812
40	2 242	1 986	1 798	1 653	1 536	1 440	1 359	1 289	1 228
50	4 207	3 730	3 379	3 108	2 890	2 710	2 558	2 428	2 315
65	8 421	7 472	6 774	6 234	5 800	5 441	5 139	4 879	4 653
80	12 925	11 474	10 406	9 580	8 915	8 366	7 903	7 506	7 160
100	26 125	23 209	21 063	19 400	18 063	16 958	16 025	15 225	14 528
125	42 182	37 491	34 038	31 362	29 209	27 430	25 928	24 638	23 515
150	68 275	60 711	55 140	50 821	47 346	44 474	42 049	39 965	38 151
	65	70	75	80	85	95	100	120	140
15	88	85	83	81	79	75	74	68	64
20	192	184	177	170	165	154	150	135	126
25	363	348	334	323	312	293	284	256	235
32	776	745	717	691	668	628	610	551	505
40	1 175	1 128	1 086	1 047	1 013	952	925	835	766
50	2 215	2 127	2 047	1 976	1 911	1 797	1 746	1 578	1 448
65	4 454	4 278	4 119	3 976	3 846	3 619	3 518	3 182	2 922
80	6 855	6 584	6 342	6 122	5 923	5 574	5 420	4 904	4 506
100	13 914	13 368	12 879	12 437	12 035	11 330	11 019	9 978	9 173
125	22 526	21 646	20 857	20 144	19 497	18 360	17 858	16 179	14 879
150	36 553	35 132	33 857	32 705	31 658	29 820	29 008	26 292	24 190
	160	180	200	220	240	260	280	300	320
15	60	57	55	53	51	49	45	42	40
20	119	114	109	104	101	97	94	91	89
25	217	203	191	181	172	165	160	156	152
32	468	438	412	391	372	355	340	327	315
40	711	665	626	594	565	540	518	498	480
50	1 344	1 259	1 187	1 125	1 071	1 024	982	945	911
65	2 714	2 542	2 398	2 274	2 166	2 072	1 988	1 912	1 844
80	4 186	3 923	3 701	3 510	3 345	3 200	3 070	2 955	2 850
100	8 527	7 994	7 545	7 160	6 825	6 530	6 269	6 034	5 822
125	13 836	12 975	12 250	11 627	11 086	10 610	10 187	9 807	9 465
150	22 501	21 108	19 932	18 924	18 047	17 276	16 590	15 975	15 420

Table D.11 — Pressure drop of 1,5 kPa
Natural gas flow through steel pipe (MJ/h)
(This table is suitable for supply pressure around 5 kPa to 10 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	849	588	473	405	359	325	298	277	260
20	1 885	1 309	1 055	905	802	727	669	622	583
25	3 508	2 440	1 970	1 691	1 501	1 361	1 253	1 166	1 094
32	7 377	5 143	4 157	3 572	3 173	2 880	2 652	2 470	2 318
40	11 070	7 726	6 249	5 372	4 775	4 335	3 994	3 720	3 493
50	20 600	14 397	11 658	10 029	8 919	8 102	7 468	6 958	6 536
65	40 891	28 620	23 197	19 970	17 773	16 153	14 896	13 885	13 048
80	62 461	43 752	35 481	30 560	27 207	24 735	22 817	21 273	19 996
100	125 345	87 907	71 349	61 493	54 775	49 823	45 978	42 883	40 321
125	210 036	147 421	119 720	103 228	91 985	83 695	77 258	72 075	67 785
150	338 525	237 767	193 182	166 632	148 531	135 181	124 815	116 466	109 555
	20	25	30	35	40	45	50	55	60
15	245	217	196	180	167	156	147	139	133
20	551	487	441	405	376	352	332	315	300
25	1 033	915	828	761	707	663	625	593	565
32	2 191	1 942	1 760	1 619	1 505	1 411	1 332	1 265	1 206
40	3 301	2 929	2 655	2 442	2 272	2 131	2 012	1 911	1 822
50	6 180	5 487	4 977	4 581	4 264	4 001	3 780	3 589	3 424
65	12 342	10 965	9 952	9 166	8 535	8 013	7 572	7 194	6 865
80	18 916	16 814	15 266	14 065	13 100	12 302	11 628	11 050	10 546
100	38 156	33 938	30 831	28 421	26 482	24 878	23 524	22 361	21 348
125	64 159	57 092	51 885	47 845	44 594	41 906	39 635	37 683	35 984
150	103 714	92 326	83 934	77 422	72 180	67 845	64 182	61 034	58 292
	65	70	75	80	85	90	100	120	140
15	127	122	117	113	109	105	100	93	87
20	287	275	265	255	247	239	225	203	186
25	541	519	500	482	466	451	425	384	352
32	1 154	1 108	1 066	1 029	995	964	909	822	754
40	1 744	1 674	1 612	1 556	1 505	1 458	1 376	1 244	1 142
50	3 278	3 149	3 033	2 928	2 832	2 745	2 591	2 345	2 154
65	6 575	6 317	6 085	5 877	5 687	5 513	5 206	4 714	4 334
80	10 102	9 708	9 354	9 034	8 743	8 477	8 008	7 254	6 671
100	20 456	19 662	18 949	18 306	17 720	17 185	16 240	14 721	13 546
125	34 486	33 153	31 958	30 877	29 895	28 996	27 408	24 857	22 881
150	55 874	53 724	51 795	50 051	48 464	47 014	44 449	40 329	37 136
	160	180	200	220	240	260	280	300	320
15	82	78	75	72	69	67	65	63	61
20	172	161	152	144	137	132	128	125	121
25	327	305	288	273	259	248	238	228	220
32	700	655	618	585	557	533	511	491	474
40	1 061	993	936	888	846	808	776	746	719
50	2 001	1 875	1 769	1 677	1 598	1 529	1 467	1 411	1 361
65	4 028	3 776	3 564	3 381	3 223	3 084	2 960	2 849	2 749
80	6 203	5 816	5 490	5 211	4 968	4 754	4 564	4 394	4 240
100	12 601	11 821	11 164	10 600	10 109	9 677	9 293	8 949	8 638
125	21 294	19 982	18 876	17 927	17 101	16 374	15 727	15 148	14 625
150	34 571	32 451	30 662	29 127	27 791	26 614	25 568	24 630	23 783

Table D.12 — Pressure drop of 0,075 kPa
Natural gas flow through polyamide pipe (Nylon 11) (MJ/h)
(This table is suitable for supply pressure around 1,1 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
18	170	114	93	82	74	68	64	60	57
20	237	159	125	108	98	90	85	80	76
23	364	244	193	163	143	130	121	115	109
25	469	315	249	211	185	166	152	142	135
32	923	621	492	417	367	330	302	279	261
40	1 784	1 204	955	810	713	642	588	544	508
50	3 245	2 194	1 744	1 481	1 304	1 175	1 076	997	932
75	9 819	6 664	5 307	4 513	3 980	3 590	3 290	3 050	2 853
90	15 906	10 810	8 616	7 332	6 468	5 837	5 352	4 963	4 644
110	27 326	18 598	14 837	12 635	11 152	10 068	92 340	8 567	8 018
	20	25	30	35	40	45	50	55	60
18	55	48	40	35	30	27	24	22	20
20	72	65	60	56	49	43	39	36	33
23	104	94	87	81	77	73	69	66	61
25	129	117	108	101	95	90	86	83	79
32	245	215	193	179	169	161	154	148	142
40	478	420	378	346	320	299	281	266	252
50	877	771	694	635	588	549	517	489	465
75	2 688	2 367	2 134	1 954	1 811	1 693	1 594	1 509	1 436
90	4 375	3 856	3 478	3 186	2 953	2 762	2 601	2 463	2 344
110	7 557	6 664	6 012	5 511	5 110	4 780	4 503	4 266	4 061
	60	70	75	80	85	90	100	120	140
18	19	17	16	15	14	13	12	10	9
20	30	28	26	24	23	22	20	16	14
23	57	52	49	46	43	41	37	31	26
25	77	74	71	67	63	59	53	44	38
32	137	133	129	125	122	119	113	105	98
40	241	232	226	220	214	209	199	184	172
50	444	425	408	393	379	367	345	310	287
75	1 371	1 314	1 263	1 217	1 175	1 137	1 070	963	881
90	2 239	2 146	2 063	1 989	1 921	1 859	1 750	1 576	1 442
110	3 880	3 720	3 577	3 448	3 331	3 224	3 036	2 736	2 505
	160	180	200	220	240	260	280	300	320
18	8	7	6	5	5	5	4	4	4
20	12	11	10	9	8	8	7	7	6
23	23	20	18	17	15	14	13	12	11
25	33	30	27	24	22	20	19	18	17
32	90	80	72	66	60	55	52	48	45
40	162	154	147	141	136	131	127	123	119
50	271	258	246	236	227	220	213	206	200
75	815	762	716	678	644	615	589	566	545
90	1 336	1 248	1 174	1 111	1 057	1 009	966	929	894
110	2 321	2 169	2 042	1 933	1 839	1 756	1 683	1 617	1 558

Table D.13 — Pressure drop of 0,25 kPa
Natural gas flow through polyamide pipe (Nylon 11) (MJ/h)
(This table is suitable for supply pressure around 1,5 kPa to 2,5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
18	341	229	181	153	135	121	111	102	97
20	473	318	252	213	187	169	154	143	133
23	724	488	387	328	288	260	237	220	205
25	931	628	498	422	371	334	306	283	265
32	1 823	1 233	979	832	732	660	604	559	523
40	3 510	2 378	1 892	1 608	1 417	1 277	1 170	1 085	1 014
50	6 364	4 321	3 441	2 927	2 581	2 328	2 134	1 978	1 850
75	19 153	13 043	10 408	8 865	7 825	7 066	6 481	6 013	5 628
90	30 957	21 108	16 857	14 365	12 686	11 460	10 514	9 758	9 135
110	53 060	36 226	28 954	24 689	21 813	19 712	18 092	16 795	15 728
	20	25	30	35	40	45	50	55	60
18	92	84	78	73	68	65	62	59	57
20	125	111	102	96	90	86	82	79	76
23	193	169	152	139	130	123	118	113	109
25	249	219	197	180	166	155	146	140	135
32	492	433	389	356	330	308	290	274	261
40	955	840	757	693	642	600	564	534	508
50	1 743	1 535	1 384	1 267	1 174	1 098	1 034	979	931
75	5 305	4 679	4 222	3 870	3 588	3 357	3 163	2 996	2 852
90	8 612	7 599	6 860	6 290	5 835	5 460	5 145	4 876	4 642
110	14 830	13 093	11 824	10 846	10 064	9 420	8 879	8 416	8 014
	65	70	75	80	85	90	100	120	140
18	55	53	52	50	47	45	40	34	29
20	73	71	69	67	65	63	60	54	47
23	105	102	99	96	94	91	87	80	75
25	130	126	122	119	116	113	108	100	93
32	249	238	229	220	213	206	193	177	166
40	485	465	447	430	415	402	378	340	311
50	889	852	819	789	762	737	694	625	571
75	2 725	2 613	2 512	2 422	2 340	2 265	2 133	1 922	1 760
90	4 436	4 254	4 091	3 945	3 811	3 690	3 476	3 134	2 871
110	7 661	7 348	7 068	6 816	6 587	6 378	6 010	5 421	4 968
	160	180	200	220	240	260	280	300	320
18	25	22	20	18	17	15	14	13	13
20	41	36	33	30	27	25	23	22	20
23	71	67	61	56	51	47	44	41	38
25	88	83	79	76	73	68	63	59	55
32	156	149	142	136	131	127	122	119	115
40	287	268	252	238	230	222	215	209	203
50	529	494	465	440	418	399	382	367	353
75	1 631	1 524	1 435	1 359	1 292	1 234	1 183	1 137	1 095
90	2 661	2 488	2 343	2 219	2 111	2 017	1 933	1 858	1 791
110	4 606	4 309	4 059	3 845	3 659	3 496	3 352	3 223	3 106

Table D.14 — Pressure drop of 0,75 kPa
Natural gas flow through polyamide pipe (Nylon 11) (MJ/h)
(This table is suitable for supply pressure around 2,75 kPa to 5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
18	803	542	431	365	321	290	265	245	229
20	1 067	721	573	486	428	386	353	327	306
23	1 563	1 058	842	715	630	567	520	481	450
25	1 944	1 317	1 048	890	784	707	648	600	561
32	3 801	2 581	2 056	1 749	1 542	1 391	1 275	1 182	1 105
40	7 085	4 820	3 844	3 272	2 887	2 606	2 389	2 216	2 074
50	12 899	8 790	7 016	5 977	5 277	4 765	4 371	4 056	3 797
75	37 958	25 938	20 740	17 690	15 633	14 129	12 969	12 041	11 277
90	61 875	42 331	33 871	28 905	25 554	23 103	21 213	19 700	18 454
110	104 860	71 826	57 515	49 107	43 432	39 280	36 077	33 513	31 400
160	282 473	193 905	155 467	132 863	117 594	106 417	97 790	90 879	85 185
200	506 559	348 149	279 336	238 843	211 479	191 441	175 972	163 576	15 3361
	20	25	30	35	40	45	50	55	60
18	216	190	171	156	144	135	127	120	114
20	288	253	228	208	193	180	169	160	152
23	424	373	336	307	284	266	250	237	225
25	528	465	419	383	355	332	312	295	281
32	1 041	917	827	757	701	656	617	584	556
40	1 954	1 722	1 553	1 423	1 319	1 234	1 162	1 101	1 047
50	3 578	3 156	2 848	2 611	2 421	2 265	2 134	2 022	1 925
75	10 634	9 390	8 481	7 780	7 220	6 759	6 371	6 039	5 751
90	17 406	15 376	13 892	12 749	11 834	11 081	10 447	9 905	9 434
110	29 623	26 179	23 662	21 721	20 168	18 889	17 813	16 892	16 093
	65	70	75	80	85	95	100	120	140
18	109	105	102	99	96	92	90	83	78
20	145	139	134	129	124	117	114	106	99
23	215	206	198	190	184	172	167	150	137
25	268	257	247	238	229	215	209	188	172
32	531	509	489	471	455	427	414	373	341
40	1 001	959	922	889	858	805	782	704	645
50	1 839	1 763	1 696	1 635	1 579	1 482	1 440	1 297	1 188
75	5 498	5 274	5 073	4 892	4 728	4 440	4 314	3 892	3 567
90	9 021	8 654	8 326	8 030	7 761	7 292	7 085	6 394	5 863
110	15 390	14 767	14 209	13 706	13 249	12 451	12 099	10 925	10 020
	160	180	200	220	240	260	280	300	320
18	93	89	85	81	78	75	73	71	69
20	129	123	118	113	109	105	102	99	96
23	159	148	141	136	131	126	122	119	116
25	316	295	277	262	249	238	228	219	211
32	597	558	525	497	472	451	432	415	400
40	1 101	1 029	969	917	872	833	798	767	739
50	2 067	1 933	1 820	1 724	1 640	1 567	1 502	1 444	1 392
75	3 308	3 094	2 915	2 761	2 628	2 511	2 407	2 315	2 231
90	5 438	5 088	4 795	4 543	4 325	4 134	3 964	3 812	3 675
110	9 297	8 702	8 201	7 773	7 402	7 075	6 786	6 527	6 294

Table D.15 — Pressure drop of 1,5 kPa
Natural gas flow through polyamide pipe (Nylon 11) (MJ/h)
(This table is suitable for supply pressure around 5 kPa to 10 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
18	938	634	504	428	377	340	311	288	269
20	1 297	879	699	594	523	471	432	400	374
23	1 979	1 343	1 069	908	801	722	661	613	573
25	2 537	1 723	1 372	1 166	1 028	928	850	788	737
32	4 944	3 363	2 682	2 282	2 014	1 817	1 666	1 545	1 446
40	9 469	6 453	5 151	4 388	3 874	3 498	3 209	2 977	2 787
50	17 096	11 670	9 325	7 949	7 022	6 344	5 821	5 403	5 059
75	51 074	34 960	27 981	23 882	21 115	19 092	17 531	16 281	15 252
90	82 305	56 402	45 173	38 573	34 118	30 858	28 344	26 329	24 671
110	140 617	96 480	77 327	66 065	58 459	52 891	48 595	45 153	42 318
	20	25	30	35	40	45	50	55	60
18	253	223	201	183	170	159	149	141	134
20	352	310	279	255	236	221	208	196	187
23	540	475	428	392	363	339	319	302	287
25	694	611	551	504	467	437	411	389	370
32	1 362	1 201	1 083	992	919	860	810	767	730
40	2 627	2 317	2 090	1 916	1 777	1 662	1 566	1 484	1 412
50	4 769	4 209	3 800	3 485	3 233	3 025	2 851	2 702	2 572
75	14 386	12 710	11 484	10 539	9 783	9 161	8 637	8 189	7 800
90	23 274	20 570	18 592	17 068	15 847	14 843	13 997	13 274	12 645
110	39 931	35 306	31 923	29 315	27 226	25 506	24 059	22 819	21 743
	65	70	75	80	85	90	100	120	140
18	128	123	118	113	109	106	100	92	86
20	178	171	164	158	153	148	139	125	114
23	274	263	253	243	235	227	214	192	176
25	353	339	325	314	303	293	276	248	227
32	697	668	642	619	598	579	545	490	449
40	1 349	1 294	1 244	1 199	1 159	1 121	1 056	952	871
50	2 459	2 358	2 268	2 186	2 113	2 045	1 927	1 737	1 592
75	7 458	7 155	6 884	6 639	6 417	6 215	5 858	5 287	4 848
90	12 093	11 604	11 165	10 770	10 411	10 084	9 507	8 584	7 873
110	20 798	19 958	19 207	18 530	17 915	17 354	16 365	14 782	13 563
	160	180	200	220	240	260	280	300	320
18	81	77	74	71	68	66	64	62	60
20	107	102	98	94	90	87	84	82	80
23	163	152	143	135	129	125	121	118	114
25	210	196	184	174	166	158	151	145	141
32	416	388	365	346	329	314	301	289	278
40	807	755	710	672	640	611	585	563	542
50	1 475	1 379	1 299	1 230	1 171	1 118	1 072	1 030	993
75	4 497	4 208	3 965	3 757	3 577	3 418	3 278	3 152	3 039
90	7 305	6 837	6 444	6 108	5 816	5 559	5 332	5 128	4 945
110	12 588	11 785	11 110	10 533	10 031	9 591	9 200	8 850	8 535

Table D.16 — Pressure drop of 0,075 kPa
Natural gas flow through polyethylene pipe (Nylon 11) (MJ/h)
(This table is suitable for supply pressure around 1,1 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. outside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	164	110	90	79	72	66	62	58	55
25	327	219	173	146	128	119	111	105	99
32	791	532	422	357	314	282	258	239	223
40	1 115	798	633	536	472	425	388	359	336
50	2 142	1 447	1 149	975	858	773	707	655	612
63	4 057	2 746	2 183	1 854	1 633	1 472	1 348	1 249	1 168
75	6 489	4 398	3 500	2 975	2 622	2 364	2 166	2 008	1 877
90	10 590	7 189	5 726	4 870	4 294	3 874	3 551	3 292	3 080
110	18 130	12 326	9 826	8 364	7 379	6 660	6 107	5 664	5 300
160	49 082	33 455	26 714	22 763	20 102	18 158	16 660	15 461	14 475
	20	25	30	35	40	45	50	55	60
20	53	46	38	33	29	25	23	21	19
25	95	86	79	74	70	66	63	57	52
32	210	184	168	157	149	141	135	129	125
40	316	277	249	228	211	199	190	182	176
50	576	506	455	416	385	360	338	320	304
63	1 099	967	871	797	738	689	649	614	584
75	1 768	1 557	1 402	1 284	1 189	1 111	1 046	990	942
90	2 901	2 556	2 304	2 110	1 955	1 828	1 721	1 630	1 550
110	4 994	4 402	3 970	3 638	3 372	3 154	2 970	2 813	2 677
160	13 645	12 040	10 869	9 966	9 245	8 651	8 152	7 725	7 355
	65	70	75	80	85	90	100	120	140
20	18	16	15	14	13	13	11	10	8
25	48	45	42	39	37	35	31	26	22
32	120	116	113	110	107	104	99	91	82
40	170	164	159	155	151	147	141	130	121
50	290	278	267	257	250	244	233	215	202
63	557	534	513	494	477	461	434	390	356
75	899	862	828	798	770	745	701	631	577
90	1 481	1 419	1 364	1 314	1 269	1 228	1 156	1 041	952
110	2 558	2 452	2 357	2 272	2 194	2 124	2 000	1 801	1 648
160	7 030	6 741	6 483	6 250	6 039	5 847	5 508	4 966	4 550
	160	180	200	220	240	260	280	300	320
20	7	6	6	5	5	4	4	4	4
25	20	17	16	14	13	12	11	10	10
32	72	64	57	52	48	44	41	38	36
40	114	108	103	95	87	80	74	70	65
50	190	181	172	165	159	153	148	144	140
63	329	312	298	286	275	266	258	250	243
75	534	498	468	443	421	402	385	373	363
90	881	823	774	732	696	665	637	611	589
110	1 527	1 427	1 342	1 271	1 208	1 154	1 105	1 062	1 023
160	4 217	3 943	3 713	3 516	3 346	3 196	3 064	2 945	2 838

Table D.17 — Pressure drop of 0,075 kPa
Natural gas flow through polyethylene pipe (Nylon 11) (MJ/h)
(AS/NZS 4130, Table 4, SDR 11)
(This table is suitable for supply pressure around 1,1 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. inside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	364	244	193	163	143	130	121	115	109
25	686	461	365	309	272	245	224	207	193
32	1 277	861	683	579	509	458	419	388	362
40	1 823	1 230	976	828	729	656	601	556	520
50	3 359	2 272	1 806	1 533	1 350	1 217	1 114	1 032	965
80	13 813	9 384	7 478	6 362	5 612	5 064	4 642	4 305	4 027
100	27 113	18 453	14 721	12 536	11 064	9 989	9 162	8 500	7 955
150	75 965	51 833	41 415	35 307	31 191	28 183	25 865	24 009	22 482
	20	25	30	35	40	45	50	55	60
20	104	94	87	81	77	73	69	66	61
25	181	161	149	140	132	125	119	115	110
32	341	299	269	246	228	212	202	194	187
40	489	430	387	353	327	305	287	271	258
50	908	799	719	658	609	569	535	507	482
80	3 794	3 344	3 015	2 762	2 560	2 394	2 254	2 135	2 031
100	7 497	6 611	5 965	5 467	5 070	4 743	4 468	4 232	4 028
150	21 198	18 713	16 897	15 499	14 380	13 460	12 687	12 025	11 450
	65	70	75	80	85	90	100	120	140
20	57	52	49	46	43	41	37	31	26
25	106	103	100	97	94	92	88	78	67
32	181	175	170	165	161	157	150	138	129
40	246	237	230	224	218	213	203	188	175
50	460	440	423	407	393	380	358	321	296
80	1 940	1 860	1 788	1 723	1 664	1 610	1 516	1 365	1 249
100	3 849	3 691	3 549	3 421	3 305	3 199	3 012	2 714	2 485
150	10 945	10 498	10 098	9 737	9 409	9 111	8 584	7 743	7 096
	160	180	200	220	240	260	280	300	320
20	23	20	18	17	15	14	13	12	11
25	58	52	47	42	39	36	33	31	29
32	122	115	110	106	97	90	83	78	73
40	165	157	150	144	138	133	129	125	121
50	279	265	254	243	234	226	219	212	206
80	1 156	1 080	1 016	962	914	873	836	803	774
100	2 302	2 152	2 026	1 918	1 824	1 742	1 669	1 604	1 546
150	6 579	6 153	5 796	5 490	5 225	4 992	4 786	4 601	4 435

Table D.18 — Pressure drop of 0,25 kPa
Natural gas flow through polyethylene pipe (Nylon 11) (MJ/h)
(AS/NZS 4130, Table 3, SDR 11)
(This table is suitable for supply pressure around 1,5 kPa to 2,5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. outside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	329	221	175	148	130	117	107	99	94
25	651	438	347	294	259	233	213	197	184
32	1 565	1 058	840	713	627	565	517	479	448
40	2 337	1 581	1 257	1 067	940	847	776	719	672
50	4 211	2 855	2 272	1 932	1 702	1 535	1 407	1 304	1 219
63	7 947	5 399	4 302	3 660	3 228	2 912	2 670	2 476	2 316
75	12 682	8 627	6 880	5 857	5 168	4 665	4 277	3 968	3 713
90	20 650	14 065	11 225	9 562	8 441	7 622	6 992	6 487	6 072
110	35 266	24 053	19 213	16 375	14 463	13 066	11 989	11 127	10 418
160	95 077	65 001	51 995	44 362	39 214	35 450	32 548	30 224	28 311
	20	25	30	35	40	45	50	55	60
20	90	82	75	70	66	63	60	58	55
25	173	152	137	125	119	113	108	103	99
32	421	371	333	305	282	264	248	235	223
40	633	556	501	458	424	396	373	353	336
50	1 148	1 011	911	834	772	722	679	643	612
63	2 182	1 922	1 733	1 588	1 471	1 376	1 295	1 227	1 167
75	3 498	3 084	2 782	2 549	2 363	2 210	2 082	1 972	1 877
90	5 723	5 048	4 555	4 176	3 872	3 623	3 413	3 234	3 078
110	9 822	8 668	7 825	7 176	6 657	6 230	5 871	5 564	5 297
160	26 702	23 586	21 308	19 554	18 150	16 994	16 022	15 190	14 468
	65	70	75	80	85	90	100	120	140
20	53	52	50	48	45	42	38	32	27
25	96	93	90	88	85	83	79	73	68
32	213	204	196	188	182	176	168	156	145
40	320	307	295	284	274	265	249	224	205
50	584	560	538	518	500	484	455	410	374
63	1 115	1 068	1 027	990	956	925	871	784	717
75	1 793	1 719	1 652	1 593	1 538	1 489	1 402	1 263	1 156
90	2 942	2 820	2 712	2 614	2 526	2 445	2 303	2 075	1 901
110	5 063	4 856	4 670	4 503	4 351	4 212	3 968	3 578	3 278
160	13 834	13 271	12 768	12 314	11 902	11 526	10 864	9 805	8 990
	160	180	200	220	240	260	280	300	320
20	24	21	19	17	16	15	14	13	12
25	64	58	52	47	43	40	37	35	33
32	137	130	125	119	115	111	107	104	101
40	193	184	176	168	162	157	152	147	143
50	346	323	304	288	273	261	251	244	237
63	664	620	583	552	525	501	480	461	444
75	1 070	1 000	941	891	847	809	775	745	718
90	1 761	1 646	1 550	1 467	1 396	1 333	1 277	1 228	1 183
110	3 039	2 842	2 676	2 534	2 412	2 304	2 208	2 123	2 046
160	8 338	7 802	7 351	6 966	6 631	6 338	6 077	5 844	5 634

Table D.19 — Pressure drop of 0,25 kPa
Natural gas flow through polyethylene pipe (Nylon 11) (MJ/h)
(AS/NZS 4130, Table 4, SDR 11)
(This table is suitable for supply pressure around 1,5 kPa to 2,5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. inside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	724	488	387	328	288	260	237	220	205
25	1 359	918	729	618	544	490	449	415	388
32	2 519	1 705	1 355	1 151	1 014	914	837	775	725
40	3 587	2 431	1 934	1 643	1 448	1 306	1 196	1 109	1 037
50	6 588	4 473	3 563	3 030	2 672	2 411	2 209	2 048	1 916
83	2 6901	18 336	14 640	12 474	11 015	9 948	9 127	8 470	7 929
100	52 648	35 945	28 728	24 496	21 643	19 558	17 950	16 664	15 605
150	146 902	100 530	80 462	68 679	60 729	54 915	50 431	46 841	43 884
	20	25	30	35	40	45	50	55	60
20	193	169	152	139	130	123	118	113	109
25	365	321	289	264	244	228	215	203	193
32	682	600	541	495	458	428	403	381	362
40	976	859	774	708	656	613	577	546	519
50	1 805	1 590	1 433	1 313	1 216	1 137	1 071	1 014	964
83	7 474	6 594	5 952	5 457	5 061	4 736	4 463	4 229	4 026
100	14 714	12 990	11 731	10 761	9 985	9 346	8 810	8 350	7 951
150	41 397	36 579	33 057	30 343	28 170	26 382	24 878	23 590	22 472
	65	70	75	80	85	90	100	120	140
20	105	102	99	96	94	91	87	80	75
25	184	176	169	164	160	156	149	138	129
32	346	331	318	307	296	286	269	242	221
40	496	475	457	440	425	411	386	348	318
50	921	883	848	817	789	764	719	647	592
83	3 847	3 689	3 548	3 420	3 305	3 199	3 013	2 717	2 488
100	7 601	7 291	7 013	6 762	6 535	6 328	5 962	5 379	4 929
150	21 490	20 619	19 839	19 136	18 498	17 916	16 890	15 249	13 986
	160	180	200	220	240	260	280	300	320
20	71	67	61	56	51	47	44	41	38
25	122	115	110	106	102	98	95	92	89
32	206	196	187	180	173	167	162	157	153
40	294	274	258	244	234	226	219	213	207
50	548	512	481	455	433	413	396	380	366
83	2 306	2 156	2 030	1 922	1 829	1 747	1 674	1 609	1 551
100	4 570	4 275	4 027	3 814	3 630	3 469	3 325	3 197	3 082
150	12 975	12 144	11 445	10 847	10 328	9 872	9 468	9 106	8 780

Table D.20 — Pressure drop of 0,75 kPa
Natural gas flow through polyethylene pipe
(AS/NZS 4130, Table 3, SDR 11)(MJ/h)
(This table is suitable for supply pressure around 2,75 kPa to 5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. outside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	589	398	315	267	235	212	194	179	168
25	1 209	818	650	552	486	438	401	371	347
32	2 894	1 963	1 562	1 328	1 171	1 056	967	897	839
40	4 127	2 803	2 233	1 899	1 675	1 511	1 385	1 284	1 201
50	7 749	5 272	4 205	3 579	3 158	2 851	2 614	2 425	2 269
63	14 071	9 590	7 657	6 523	5 760	5 202	4 772	4 428	4 145
75	23 227	15 850	12 663	10 794	9 535	8 614	79 904	7 336	6 869
90	46 490	31 784	25 422	21 688	19 169	17 327	15 907	14 770	13 834
110	78 749	53 906	43 148	36 830	32 566	29 448	27 043	25 117	23 531
160	172 814	146 685	117 566	100 447	88 886	80 424	73 895	68 664	64 355
	20	25	30	35	40	45	50	55	60
20	158	138	125	114	105	98	93	89	86
25	326	287	258	263	219	204	192	182	173
32	790	695	627	574	531	497	467	442	421
40	1 131	997	898	823	762	713	671	635	604
50	2 138	1 885	1 700	1 558	1 444	1 350	1 272	1 205	1 146
63	3 907	3 446	3 110	2 851	2 644	2 474	2 331	2 208	2 102
75	6 476	5 715	5 160	4 732	4 390	4 108	3 871	3 669	3 493
90	13 047	11 522	10 408	9 550	8 863	8 298	7 823	7 416	7 063
110	22 196	19 611	17 722	16 266	15 100	14 141	13 334	12 643	12 044
160	60 727	53 699	48 558	44 593	41 419	38 805	36 605	34 721	33 086
	65	70	75	80	85	95	100	120	140
20	83	81	78	76	74	71	69	64	59
25	165	158	152	146	141	132	128	118	111
32	402	385	370	356	344	323	313	282	258
40	577	553	532	512	495	464	451	406	371
50	1 095	1 050	1 009	973	940	882	856	771	706
63	2 009	1 926	1 852	1 786	1 725	1 619	1 573	1 418	1 298
75	3 339	3 202	3 079	2 969	2 869	2 694	2 617	2 360	2 162
90	6 752	6 477	6 231	6 009	5 808	5 455	5 300	4 783	4 384
110	11 517	11 049	10 631	10 254	9 912	93 13	9 049	8 169	7 491
160	31 648	30 373	29 231	28 201	27 266	25 631	24 909	22 504	20 651
	160	180	200	220	240	260	280	300	320
20	56	53	51	49	46	42	39	37	34
25	105	99	95	91	88	85	82	79	77
32	238	223	209	198	188	179	173	168	163
40	343	321	302	285	271	259	248	238	229
50	654	611	575	544	517	494	473	455	438
63	1 203	1 125	1 059	1 002	954	911	873	839	808
75	2 004	1 874	1 764	1 671	1 590	1 519	1 456	1 400	1 349
90	4 066	3 824	3 583	3 395	3 232	3 088	2 961	2 847	2 745
110	6 949	6 503	6 129	5 808	5 530	5 285	5 069	4 875	4 700
160	19 168	17 947	16 921	16 042	15 279	14 610	14 015	13 484	13 004

Table D.21 — Pressure drop of 0,75 kPa
Natural gas flow through polyethylene pipe
(AS/NZS 4130, Table 4, SDR 11)(MJ/h)
(This table is suitable for supply pressure around 2,75 kPa to 5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. inside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	1 493	1 011	804	683	601	542	496	460	430
25	2 458	1 667	1 326	1 127	994	896	821	761	711
32	5 331	3 623	2 888	2 457	2 168	1 956	1 793	1 663	1 556
40	8 180	5 567	4 441	3 781	3 336	3 012	2 762	2 562	2 397
50	15 370	10 478	8 367	7 129	6 295	5 685	5 216	4 840	4 531
80	48 537	33 187	26 545	22 647	20 018	18 095	16 612	15 426	14 448
100	94 495	64 711	51 810	44 231	39 117	35 375	32 489	30 178	28 275
	20	25	30	35	40	45	50	55	60
20	405	356	320	293	271	254	239	226	215
25	670	590	531	486	450	421	396	375	357
32	1 466	1 292	1 164	1 067	989	924	870	824	784
40	2 259	1 992	1 797	1 646	1 526	1 428	1 345	1 274	1 212
50	4 271	3 768	3 401	3 118	2 892	2 706	2 549	2 415	2 299
80	13 626	12 034	10 871	9 975	9 258	8 668	8 171	7 746	7 378
100	26 673	23 570	21 302	19 554	18 155	17 003	16 034	15 204	14 484
	65	70	75	80	85	95	100	120	140
20	205	196	188	182	175	164	159	143	132
25	341	326	314	302	292	273	265	239	218
32	749	718	690	665	642	603	585	527	482
40	1 158	1 110	1 067	1 029	994	932	905	816	747
50	2 197	2 107	2 026	1 953	1 887	1 772	1 721	1 551	1 421
80	7 054	6 766	6 509	6 277	6 067	5 699	5 537	4 997	4 581
100	13 851	13 290	12 787	12 334	11 923	11 204	10 887	9 829	9 015
	160	180	200	220	240	260	280	300	320
20	124	118	113	108	104	101	98	95	92
25	202	188	177	168	160	154	150	145	141
32	446	417	392	371	353	337	323	310	298
40	691	646	608	576	547	523	501	481	463
50	1 316	1 231	1 159	1 097	1 044	997	955	918	885
80	4 248	3 974	3 744	3 547	3 377	3 227	3 094	2 975	2 868
100	8 364	7 828	7 377	6 992	6 658	6 364	6 103	5 870	5 660

Table D.22 — Pressure drop of 1,5 kPa
Natural gas flow through polyethylene pipe
(AS/NZS 4130, Table 3, SDR 11)(MJ/h)
(This table is suitable for supply pressure around 5 kPa to 10 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. outside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	906	613	487	413	364	328	300	278	260
25	1 780	1 207	960	816	719	649	594	551	260
32	4 248	2 889	2 303	1 959	1 728	1 560	1 430	1 326	515
40	6 323	4 305	3 434	2 924	2 580	2 329	2 136	1 981	1 241
50	11 346	7 736	6 177	5 263	4 648	4 198	3 851	3 573	1 854
63	21 315	14 558	11 637	9 922	8 767	7 921	7 270	6 749	3 345
75	33 909	23 187	18 547	15 823	13 985	12 642	11 605	10 776	6 320
90	55 039	37 681	30 162	25 745	22 764	20 584	18 902	17 555	10 093
110	93 686	64 221	51 444	43 934	38 864	35 153	32 291	29 998	16 446
160	251 131	172 525	138 381	118 290	104 716	94 776	87 103	80 955	75 889
	20	25	30	35	40	45	50	55	60
20	245	215	194	177	164	153	144	136	129
25	485	427	384	352	326	304	287	271	258
32	1 169	1 030	929	851	788	737	694	657	625
40	1 747	1 540	1 389	1 273	1 180	1 104	1 040	985	937
50	3 153	2 781	2 510	2 301	2 134	1 997	1 881	1 783	1 697
63	5 959	5 260	4 749	4 356	4 042	3 783	3 565	3 379	3 217
75	9 518	8 406	7 593	6 966	6 465	6 052	5 705	5 409	5 151
90	15 513	13 706	12 385	11 366	10 551	9 880	9 316	8 833	8 414
110	26 520	23 441	21 189	19 453	18 063	16 919	15 956	15 132	14 417
160	71 623	63 356	57 307	52 641	48 903	45 825	43 234	41 016	39 089
	65	70	75	80	85	90	100	120	140
20	124	118	114	109	106	102	97	90	84
25	246	236	227	218	211	204	192	173	158
32	597	573	550	530	512	496	467	420	384
40	895	858	825	795	768	743	700	630	577
50	1 622	1 555	1 495	1 441	1 392	1 348	1 270	1 144	1 048
63	3 075	2 949	2 837	2 735	2 643	2 559	2 411	2 175	1 993
75	4 925	4 724	4 544	4 382	4 235	4 101	3 865	3 487	3 196
90	8 045	7 719	7 426	7 162	6 923	6 705	6 320	5 705	5 231
110	13 788	13 230	12 731	12 280	11 872	11 499	10 841	9 790	8 981
160	37 395	35 892	34 546	33 333	32 231	31 225	29 452	26 616	24 430
	160	180	200	220	240	260	280	300	320
20	79	75	72	69	66	64	62	60	58
25	146	136	128	123	118	114	111	107	104
32	356	332	313	296	281	269	257	247	238
40	534	499	470	445	423	404	387	372	358
50	971	908	855	809	770	735	704	677	652
63	1 847	1 727	1 627	1 541	1 466	1 401	1 343	1 291	1 244
75	2 964	2 773	2 612	2 475	2 355	2 251	2 158	2 075	2 000
90	4 852	4 540	4 278	4 054	3 860	3 689	3 538	3 402	3 280
110	8 333	7 800	7 352	6 968	6 635	6 343	6 084	5 852	5 643
160	22 680	21 240	20 028	18 991	18 091	17 300	16 598	15 970	15 404

Table D.23 — Pressure drop of 1,5 kPa
Natural gas flow through polyethylene pipe
(AS/NZS 4130, Table 4, SDR 11)(MJ/h)
(This table is suitable for supply pressure around 5 kPa to 10 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. inside diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
20	1 979	1 343	1 069	908	801	722	661	613	573
25	3 693	2 510	2 000	1 702	1 501	1 354	1 241	1 151	1 077
32	6 812	4 638	3 700	3 151	2 781	2 510	2 302	2 136	1 999
40	9 675	6 594	5 264	4 484	3 959	3 575	3 279	3 043	2 848
50	17 692	12 078	9 651	8 228	7 268	6 567	6 026	5 593	5 237
80	71 582	49 038	3 9267	33 526	29 650	26 815	24 628	22 876	21 434
100	139 533	95 734	76 729	65 553	58 006	52 481	48 218	44 803	41 989
150	387 088	266 173	213 611	182 669	161 755	146 438	134 611	125 133	117 322
	20	25	30	35	40	45	50	55	60
20	540	475	428	392	363	339	319	302	287
25	1 014	894	806	738	684	639	602	570	542
32	1 883	1 661	1 498	1 373	1 273	1 190	1 121	1 062	1 011
40	2 684	2 368	2 136	1 958	1 816	1 699	1 601	1 516	1 443
50	4 937	4 358	3 934	3 608	3 347	3 132	2 952	2 797	2 663
80	20 219	17 868	16 148	14 823	13 762	12 889	12 154	11 525	10 979
100	39 621	35 032	31 675	29 086	27 014	25 307	23 871	22 641	21 574
150	110 744	97 992	88 659	81 458	75 689	70 938	66 938	63 512	60 536
	65	70	75	80	85	90	100	120	140
20	274	263	253	243	235	227	214	192	176
25	518	496	477	460	444	430	404	364	333
32	966	926	890	858	829	802	755	680	623
40	1 379	1 322	1 272	1 226	1 184	1 146	1 079	973	891
50	2 546	2 441	2 348	2 264	2 187	2 118	1 995	1 799	1 648
80	10 499	10 074	9 693	9 349	9 037	8 753	8 251	7 450	6 832
100	20 635	19 803	19 057	18 385	17 775	17 218	16 237	14 667	13 457
150	57 920	55 598	53 519	51 644	49 942	48 388	45 648	41 264	37 884
	160	180	200	220	240	260	280	300	320
20	163	152	143	135	129	125	121	118	114
25	308	288	271	256	244	232	223	214	206
32	577	539	507	480	457	436	418	401	387
40	825	771	726	687	654	624	598	575	554
50	1 528	1 429	1 345	1 274	1 212	1 158	1 110	1 067	1 028
80	6 339	5 932	5 591	5 299	5 045	4 822	4 625	4 448	4 289
100	12 489	11 693	11 023	10 450	9 953	9 516	9 128	8 781	8 468
150	35 178	32 951	31 077	29 473	28 080	26 856	25 770	24 798	23 921

Table D.24 — Pressure drop of 0,075 kPa
Natural gas flow through PVC-U pipe (MJ/h)
(This table is suitable for supply pressure around 1,1 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	223	149	118	102	93	86	80	76	72
20	425	285	226	191	168	151	138	131	124
25	872	587	465	394	346	312	285	264	246
32	1 771	1 195	948	804	708	637	583	540	505
40	2 526	1 707	1 356	1 151	1 013	913	835	774	723
50	4 693	3 178	2 527	2 147	1 892	1 705	1 562	1 447	1 353
65	9 228	6 262	4 986	4 240	3 738	3 372	3 090	2 865	2 680
80	14 378	9 769	7 785	6 624	5 843	5 273	4 834	4 483	4 194
100	28 260	19 235	15 346	13 069	11 535	10 415	9 552	8 862	8 295
125	53 064	36 176	28 890	24 620	21 743	19 641	18 022	16 726	15 659
150	72 528	49 482	39 534	33 702	29 772	26 900	24 686	22 915	21 457
	20	25	30	35	40	45	50	55	60
15	69	62	57	51	45	40	36	32	30
20	119	108	99	93	88	83	79	76	73
25	231	203	183	171	161	153	147	141	135
32	475	417	375	343	317	296	279	264	250
40	681	598	539	493	456	426	400	379	360
50	1 274	1 121	1 010	924	856	800	752	712	677
65	2 524	2 223	2 004	1 835	1 700	1 589	1 496	1 417	1 348
80	3 951	3 482	3 140	2 876	2 666	2 493	2 348	2 223	2 116
100	7 817	6 894	6 220	5 702	5 287	4 946	4 659	4 414	4 201
125	14 763	13 027	11 760	10 784	10 004	9 362	8 822	8 361	7 960
150	20 231	17 858	16 125	14 790	13 723	12 844	12 106	11 474	10 925
	65	70	75	80	85	90	100	120	140
15	27	25	24	22	21	20	18	15	13
20	70	66	61	58	54	51	46	38	33
25	131	126	123	119	116	113	108	100	93
32	239	231	224	218	213	207	198	183	171
40	344	329	316	304	294	284	268	248	232
50	647	619	595	573	553	535	503	453	414
65	1 287	1 234	1 186	1 142	1 103	1 067	1 004	904	827
80	2 021	1 937	1 862	1 794	1 733	1 677	1 579	1 422	1 301
100	4 015	3 849	3 701	3 568	3 447	3 336	3 142	2 831	2 593
125	7 608	7 296	7 017	6 766	6 537	6 329	5 962	5 377	4 926
150	10 444	10 017	9 634	9 290	8 977	8 692	8 190	7 387	6 770
	160	180	200	220	240	260	280	300	320
15	11	10	9	8	7	7	6	6	6
20	29	26	23	21	19	18	16	15	14
25	83	74	66	60	55	51	47	44	41
32	161	153	146	140	135	130	126	122	118
40	219	208	199	190	183	177	171	166	161
50	383	357	337	324	312	301	292	283	275
65	765	715	672	636	605	577	553	531	511
80	1 205	1 125	1 059	1 002	953	910	871	837	806
100	2 402	2 245	2 113	2 001	1 903	1 818	1 742	1 674	1 613
125	4 566	4 269	4 021	3 808	3 623	3 461	3 318	3 189	3 074
150	6 276	5 870	5 529	5 237	4 984	4 762	4 565	4 389	4 230

Table D.25 — Pressure drop of 0,12 kPa
Natural gas flow through PVC-U pipe (MJ/h)
(This table is suitable for supply pressure around 1,25 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	275	182	144	124	113	105	98	93	88
20	519	348	276	233	205	184	168	160	151
25	1 064	716	567	481	422	381	348	322	300
32	2 161	1 458	1 157	981	864	777	711	659	616
40	3 082	2 083	1 654	1 404	1 236	1 114	1 019	944	882
50	5 725	3 877	3 083	2 619	2 308	2 080	1 906	1 765	1 651
65	11 258	7 640	6 083	5 173	4 560	4 114	3 770	3 495	3 270
80	17 541	11 918	9 498	8 081	7 128	6 433	5 897	5 469	5 117
100	34 477	23 467	18 722	15 944	14 073	12 706	11 653	10 812	10 120
125	64 738	44 135	35 246	30 036	26 526	23 962	21 987	20 406	19 104
150	88 484	60 368	48 231	41 116	36 322	32 818	30 117	27 956	26 178
	20	25	30	35	40	45	50	55	60
15	84	76	70	62	55	49	44	39	37
20	145	132	121	113	107	101	96	93	89
25	282	248	223	209	196	187	179	172	165
32	580	509	458	418	387	361	340	322	305
40	831	730	658	601	556	520	488	462	439
50	1 554	1 368	1 232	1 127	1 044	976	917	869	826
65	3 079	2 712	2 445	2 239	2 074	1 939	1 825	1 729	1 645
80	4 820	4 248	3 831	3 509	3 253	3 041	2 865	2 712	2 582
100	9 537	8 411	7 588	6 956	6 450	6 034	5 684	5 385	5 125
125	18 011	15 893	14 347	13 156	12 205	11 422	10 763	10 200	9 711
150	24 682	21 787	19 673	18 044	16 742	15 670	14 769	13 998	13 329
	65	70	75	80	85	90	100	120	140
15	33	31	29	27	26	24	22	18	16
20	85	81	74	71	66	62	56	46	40
25	160	154	150	145	142	138	132	122	113
32	292	282	273	266	260	253	242	223	209
40	420	401	386	371	359	346	327	303	283
50	789	755	726	699	675	653	614	553	505
65	1 570	1 505	1 447	1 393	1 346	1 302	1 225	1 103	1 009
80	2 466	2 363	2 272	2 189	2 114	2 046	1 926	1 735	1 587
100	4 898	4 696	4 515	4 353	4 205	4 070	3 833	3 454	3 163
125	9 282	8 901	8 561	8 255	7 975	7 721	7 274	6 560	6 010
150	12 742	12 221	11 753	11 334	10 952	10 604	9 992	9 012	8 259
	160	180	200	220	240	260	280	300	320
15	13	12	11	10	9	9	7	7	7
20	35	32	28	26	23	22	20	18	17
25	101	90	81	73	67	62	57	54	50
32	196	187	178	171	165	159	154	149	144
40	267	254	243	232	223	216	209	203	196
50	467	436	411	395	381	367	356	345	336
65	933	872	820	776	738	704	675	648	623
80	1 470	1 373	1 292	1 222	1 163	1 110	1 063	1 021	983
100	2 930	2 739	2 578	2 441	2 322	2 218	2 125	2 042	1 968
125	5 571	5 208	4 906	4 646	4 420	4 222	4 048	3 891	3 750
150	7 657	7 161	6 745	6 389	6 080	5 810	5 569	5 355	5 161

Table D.26 — Pressure drop of 0,25 kPa
Natural gas flow through PVC-U pipe (MJ/h)
(This table is suitable for supply pressure around 1,5 kPa to 2,5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	444	299	237	200	176	158	145	134	125
20	844	569	451	383	337	303	277	257	240
25	1 724	1 165	926	786	692	623	570	528	494
32	3 484	2 361	1 878	1 596	1 407	1 268	1 162	1 077	1 007
40	4 962	3 366	2 680	2 278	2 008	1 811	1 660	1 539	1 439
50	9 188	6 244	4 977	4 235	3 736	3 371	3 090	2 866	2 681
65	18 005	12 260	9 782	8 331	7 354	6 640	6 090	5 650	5 288
80	27 997	19 085	15 239	12 985	11 466	10 357	9 502	8 818	8 255
100	54 866	37 463	29 943	25 533	22 560	20 387	18 712	17 371	16 268
125	102 760	70 266	56 213	47 964	42 401	38 333	35 196	32 684	30 617
150	140 280	95 989	76 823	65 570	57 978	52 426	48 144	44 715	41 892
	20	25	30	35	40	45	50	55	60
15	117	105	97	91	86	81	78	75	72
20	225	198	178	163	150	140	134	129	124
25	465	409	368	336	311	291	274	259	246
32	948	834	752	688	637	595	560	530	504
40	1 355	1 193	1 076	985	912	853	803	760	723
50	2 526	2 226	2 007	1 839	1 704	1 594	1 501	1 421	1 352
65	4 984	4 395	3 966	3 635	3 371	3 153	2 971	2 814	2 679
80	7 782	6 866	6 197	5 682	5 270	4 932	4 647	4 403	4 192
100	15 340	13 543	12 230	11 219	10 410	9 745	9 185	8 706	8 291
125	28 877	25 509	23 047	21 150	19 632	18 383	17 332	16 433	15 652
150	39 517	34 916	31 554	28 962	26 888	25 180	23 744	22 515	21 448
	65	70	75	80	85	90	100	120	140
15	69	67	65	63	61	60	57	50	42
20	120	116	113	110	107	104	99	92	86
25	235	225	216	208	201	194	183	169	158
32	481	461	443	427	412	399	375	337	308
40	690	661	636	612	591	572	538	484	443
50	1 292	1 238	1 190	1 147	1 108	1 072	1 009	909	832
65	2 560	2 454	2 360	2 274	2 197	2 127	2 003	1 805	1 653
80	4 006	3 842	3 695	3 562	3 442	3 332	3 138	2 829	2 592
100	7 926	7 602	7 312	7 051	6 814	6 598	6 217	5 609	5 141
125	14 967	14 358	13 814	13 323	12 877	12 471	11 755	10 610	9 729
150	20 510	19 678	18 934	18 263	17 653	17 098	16 118	14 552	13 346
	160	180	200	220	240	260	280	300	320
15	37	33	30	27	25	23	21	20	19
20	81	77	73	70	64	59	55	51	48
25	149	142	135	130	125	121	117	113	110
32	285	266	250	237	228	221	214	207	202
40	410	383	360	340	324	309	296	284	273
50	770	719	677	641	609	581	557	535	515
65	1 531	1 431	1 347	1 275	1 213	1 159	1 110	1 067	1 028
80	2 402	2 246	2 115	2 002	1 905	1 820	1 744	1 676	1 616
100	4 766	4 458	4 200	3 978	3 786	3 618	3 468	3 335	3 214
125	9 024	8 444	7 956	7 540	7 178	6 860	6 578	6 326	6 099
150	12 381	11 588	10 920	10 350	9 854	9 419	9 033	8 688	8 377

Table D.27 — Pressure drop of 0,75 kPa
Natural gas flow through PVC-U pipe (MJ/h)
(This table is suitable for supply pressure around 2,75 kPa to 5 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	833	560	443	376	330	298	272	252	236
20	1 591	1 069	847	718	631	568	520	482	451
25	3 228	2 171	1 720	1 458	1 282	1 155	1 057	979	917
32	6 578	4 424	3 504	2 970	2 613	2 353	2 153	1 994	1 869
40	9 393	6 318	5 005	4 242	3 731	3 360	3 075	2 848	2 670
50	17 262	11 618	9 203	7 801	6 862	6 179	5 655	5 238	4 915
65	34 262	23 064	18 270	15 486	13 622	12 267	11 227	10 398	9 760
80	52 755	35 540	28 153	23 862	20 990	18 902	17 300	16 022	15 058
100	103 316	69 653	55 174	46 766	41 137	37 045	33 904	31 400	29 547
125	193 637	130 633	103 479	87 710	77 153	69 478	63 587	58 890	55 480
150	265 317	179 038	141 822	120 209	105 741	95 222	87 149	80 711	76 071
	20	25	30	35	40	45	50	55	60
15	222	196	177	162	150	140	132	125	119
20	424	374	337	309	286	268	252	239	227
25	863	762	689	632	585	547	515	488	464
32	1 760	1 554	1 406	1 289	1 195	1 115	1 051	996	948
40	2 514	2 221	2 010	1 844	1 709	1 595	1 503	1 424	1 356
50	4 630	4 097	3 714	3 411	3 162	2 949	2 780	2 635	2 509
65	9 194	8 139	7 381	6 781	6 286	5 862	5 527	5 239	4 989
80	14 189	12 585	11 437	10 520	9 754	9 092	8 576	8 133	7 747
100	27 850	24 746	22 534	20 752	19 246	17 927	16 918	16 051	15 295
125	52 305	46 556	42 476	39 160	36 328	33 819	31 931	30 305	28 889
150	71 724	63 883	58 329	53 799	49 913	46 455	43 869	41 643	39 701
	65	70	75	80	85	90	100	120	140
15	113	109	105	101	97	94	89	80	73
20	217	208	200	193	186	180	170	153	140
25	444	425	409	394	381	369	347	313	287
32	906	868	835	805	777	753	709	640	586
40	1 296	1 242	1 195	1 152	1 113	1 077	1 015	916	839
50	2 399	2 300	2 212	2 133	2 061	1 995	1 881	1 699	1 558
65	4 770	4 574	4 400	4 242	4 099	3 969	3 742	3 380	3 101
80	7 408	7 107	6 837	6 593	6 372	6 170	5 820	5 263	4 832
100	14 630	14 038	13 508	13 029	12 594	12 197	11 511	10 420	9 572
125	27 640	26 528	25 531	24 631	23 812	23 064	21 778	19 732	18 139
150	37 988	36 464	35 097	33 861	32 738	31 711	29 949	27 145	24 961
	160	180	200	220	240	260	280	300	320
15	68	63	60	56	54	51	49	47	46
20	130	121	114	108	103	98	94	90	87
25	266	249	234	222	211	202	193	186	179
32	544	508	479	454	432	412	395	380	366
40	778	728	686	650	618	591	566	544	525
50	1 445	1 353	1 274	1 207	1 149	1 098	1 053	1 013	976
65	2 876	2 692	2 536	2 403	2 288	2 186	2 096	2 016	1 943
80	4 485	4 199	3 958	3 751	3 572	3 414	3 274	3 148	3 035
100	8 890	8 326	7 851	7 443	7 088	6 777	6 500	6 252	6 028
125	16 855	15 793	14 896	14 127	13 457	12 868	12 344	11 875	11 452
150	23 199	21 741	20 509	19 451	18 531	17 721	17 001	16 356	15 774

Table D.28 — Pressure drop of 1,5 kPa
Natural gas flow through PVC-U pipe (MJ/h)
(This table is suitable for supply pressure around 5 kPa to 10 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	1 219	826	657	558	491	443	405	376	351
20	2 304	1 563	1 245	1 058	933	841	771	715	668
25	4 675	3 180	2 535	2 158	1 904	1 718	1 575	1 461	1 367
32	9 401	6 407	5 114	4 357	3 846	3 473	3 186	2 956	2 767
40	13 353	9 109	7 275	6 200	5 476	4 946	4 538	4 211	3 943
50	24 619	1 821	13 448	11 469	10 134	9 158	8 406	7 804	7 308
65	48 033	32 874	26 309	22 453	19 851	17 948	16 480	15 305	14 337
80	74 482	51 029	40 864	34 890	30 858	27 908	25 632	23 810	22 309
100	145 376	99 752	79 954	68 311	60 448	54 692	50 250	46 692	43 760
125	271 307	186 417	149 538	127 837	113 173	102 435	94 146	87 503	82 030
150	369 734	254 215	204 002	174 445	154 468	139 837	128 541	119 488	112 027
	20	25	30	35	40	45	50	55	60
15	331	291	262	240	222	207	195	184	175
20	629	554	499	457	424	396	373	353	335
25	1 288	1 135	1 023	937	869	812	765	725	689
32	2 608	2 300	2 075	1 902	1 764	1 650	1 555	1 473	1 402
40	3 717	3 279	2 960	2 714	2 517	2 355	2 219	2 103	2 002
50	6 891	6 084	5 494	5 039	4 676	4 377	4 125	3 910	3 723
65	13 523	11 946	10 793	9 905	9 194	8 609	8 117	7 696	7 330
80	21 045	18 598	16 809	15 430	14 326	13 417	12 652	11 998	11 429
100	41 293	36 511	33 014	30 316	28 157	26 378	24 882	23 600	22 488
125	77 421	68 489	61 953	56 910	52 872	49 545	46 745	44 348	42 265
150	105 744	93 565	84 652	77 774	72 265	67 727	63 907	60 635	57 793
	65	70	75	80	85	90	100	120	140
15	167	160	154	148	143	139	130	117	108
20	320	307	295	284	274	265	250	225	205
25	659	631	607	585	565	547	514	463	424
32	1 340	1 284	1 235	1 190	1 150	1 113	1 048	945	865
40	1 913	1 835	1 764	1 701	1 643	1 591	1 498	1 351	1 237
50	3 559	3 414	3 284	3 166	3 060	2 963	2 791	2 518	2 307
65	7 009	6 724	6 469	6 239	6 030	5 840	5 504	4 968	4 555
80	10 930	10 487	10 091	9 733	9 409	9 113	8 591	7 756	7 114
100	21 510	20 642	19 865	19 165	18 529	17 949	16 926	15 290	14 029
125	40 435	38 810	37 356	36 044	34 854	33 767	31 850	28 784	26 421
150	55 295	53 078	51 093	49 302	47 677	46 193	43 576	39 390	36 163
	160	180	200	220	240	260	280	300	320
15	102	97	93	89	86	83	80	78	75
20	190	177	167	158	150	143	138	134	130
25	392	367	345	326	310	296	284	273	263
32	801	749	705	668	635	606	581	558	538
40	1 147	1 072	1 009	956	909	868	832	800	771
50	2 139	2 001	1 885	1 785	1 699	1 623	1 556	1 496	1 442
65	4 224	3 953	3 724	3 529	3 360	3 211	3 079	2 961	2 854
80	6 600	6 177	5 821	5 517	5 253	5 021	4 816	4 632	4 466
100	13 021	12 191	11 493	10 895	10 377	9 921	9 517	9 155	8 830
125	24 530	22 973	21 663	20 542	19 569	18 714	17 955	17 276	16 664
150	33 579	31 452	29 663	28 131	26 801	25 633	24 596	23 668	22 831

Table D.29 — Pressure drop of 10 kPa
Natural gas flow through copper pipe (MJ/h)
(This table is suitable for supply pressures within the range 400 kPa to 100 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	1 342	914	729	621	548	494	453	420	393
20	4 527	3 094	2 474	2 109	1 864	1 684	1 545	1 434	1 343
25	10 064	6 896	5 521	4 712	4 166	3 767	3 458	3 212	3 008
32	19 357	13 288	10 650	9 097	8 048	7 280	6 687	6 212	5 821
40	32 682	22 466	18 021	15 402	13 632	12 336	11 335	10 533	9 872
50	73 336	50 516	40 569	34 705	30 738	27 830	25 584	23 784	22 299
65	135 405	93 412	75 084	64 272	56 952	51 586	47 439	44 113	41 371
80	216 505	149 527	120 268	102 996	91 300	827 21	76 091	70 771	66 384
100	475 343	328 883	264 808	226 950	201 295	182 721	167 910	156 227	146 588
125	867 024	600 676	484 027	415 059	368 299	182 468	307 415	286 099	268 508
150	1 390 676	964 440	777 614	667 096	592 136	537 088	494 495	460 297	432 071
	20	25	30	35	40	45	50	55	60
15	370	326	294	270	250	234	220	208	198
20	1 266	1 117	1 008	925	858	803	756	717	682
25	2 837	2 506	2 264	2 077	1 927	1 804	1 701	1 612	1 536
32	5 491	4 853	4 386	4 026	3 738	3 501	3 301	3 130	2 982
40	9 315	8 237	7 447	6 838	6 351	5 949	5 611	53 22	5 070
50	21 049	18 624	16 849	15 479	14 381	13 477	12 716	12 064	11 497
65	39 060	34 578	31 295	28 760	26 729	25 055	23 646	22 438	21 389
80	62 688	55 515	50 259	46 200	42 947	40 265	38 007	36 072	34 390
100	138 464	122 692	111 130	102 198	95 035	89 129	84 154	79 889	76 183
125	253 677	224 879	203 760	187 438	174 346	163 549	154 450	146 651	139 871
150	408 269	362 040	328 128	301 912	280 879	263 530	248 909	236 373	225 473
	65	70	75	80	85	90	100	120	140
15	189	181	174	168	162	157	148	133	122
20	652	625	601	580	560	542	511	460	422
25	1 468	1 408	1 354	1 306	1 262	1 222	1 152	1 039	952
32	2 851	2 735	2 632	2 539	2 454	2 376	2 240	2 022	1 854
40	4 849	4 653	4 478	4 320	4 176	4 045	3 814	3 444	3 160
50	10 999	10 557	10 162	9 805	9 481	9 185	8 663	7 829	7 185
65	20 466	19 647	18 914	18 252	17 652	17 103	16 136	14 588	13 395
80	32 911	31 598	30 423	29 362	28 399	27 519	25 968	23 484	21 568
100	72 923	70 028	67 435	65 095	62 970	61 029	57 605	52 123	47 891
125	133 907	128 610	123 864	119 582	115 692	112 139	105 870	95 829	88 077
150	215 886	207 368	199 737	192 849	186 593	180 878	170 793	154 637	142 161
	160	180	200	220	240	260	280	300	320
15	113	105	99	94	89	85	81	78	75
20	391	365	344	325	310	296	283	272	262
25	883	826	778	737	701	670	642	618	595
32	1 720	1 609	1 517	1 437	1 368	1 308	1 254	1 206	1 163
40	2 932	2 744	2 587	2 452	2 335	2 232	2 140	2 059	1 985
50	6 670	6 246	5 890	5 585	5 320	5 087	4 880	4 695	4 529
65	12 439	11 652	10 990	10 422	9 930	9 497	9 113	8 770	8 460
80	20 034	18 771	17 707	16 796	16 006	15 310	14 694	14 141	13 643
100	44 502	41 709	39 358	37 344	35 595	34 057	32 692	31 470	30 367
125	81 865	76 746	72 436	68 743	65 534	62 714	60 209	57 967	55 944
150	132 161	123 920	116 979	111 032	105 864	101 320	97 285	93 672	90 412

Table D.30 — Pressure drop of 10 kPa
Natural gas flow through steel pipe (MJ/h)
(This table is suitable for supply pressures within the range 40 kPa to 100 kPa)

1	2	3	4	5	6	7	8	9	10
Nom. diam.	**Length of straight pipe in metres**								
(DN)	2	4	6	8	10	12	14	16	18
15	3 117	2 187	1 775	1 530	1 362	1 239	1 144	1 066	1 003
20	6 876	4 830	3 924	3 384	3 016	2 745	2 534	2 364	2 224
25	12 741	8 956	7 280	6 282	5 602	5 100	4 710	4 395	4 135
32	26 670	18 764	15 264	13 178	11 755	10 706	9 890	9 233	8 689
40	39 930	28 105	22 869	19 749	17 621	16 050	14 831	13 848	13 034
50	74 071	52 166	42 466	36 685	32 741	29 831	27 570	25 749	24 240
65	146 581	10 3291	84 118	72 692	64 897	59 144	54 674	51 071	48 088
80	223 526	15 7560	128 343	110 930	99 050	90 282	83 470	77 979	73 432
100	447 455	31 5545	257 118	222 295	198 535	180 998	167 372	156 389	147 294
125	74 8567	528 043	430 362	372 142	332 416	303 096	280 311	261 947	246 738
150	1 204 868	850 126	692 990	599 329	535 420	488 250	451 593	422 048	397 578
	20	25	30	35	40	45	50	55	60
15	949	844	766	706	658	618	584	555	530
20	2 105	1 873	1 703	1 570	1 463	1 375	1 301	1 236	1 181
25	3 915	3 486	3 170	2 925	2 727	2 563	2 425	2 306	2 203
32	8 229	7 332	6 671	6 157	5 743	5 401	5 111	4 862	4 646
40	12 345	11 003	10 012	9 243	8 624	8 111	7 678	7 305	6 981
50	22 964	20 475	18 639	17 213	16 064	15 113	14 309	13 618	13 015
65	45 565	40 643	37 011	34 190	31 918	30 036	28 445	27 077	25 884
80	69 586	62 083	56 547	52 246	48 781	45 912	43 486	41 399	39 580
100	139 600	12 4589	11 3 512	104 906	97 972	92 230	87 373	83 197	79 555
125	233 874	208 771	190 247	175 854	164 255	154 651	146 528	139 542	133 449
150	376 880	336 490	306 683	283 523	264 859	249 402	236 330	225 086	215 281
	65	70	75	80	85	90	100	120	140
15	508	488	470	454	439	426	402	364	335
20	1 131	1 088	1 048	1 013	981	951	899	815	750
25	2 112	2 030	1 958	1 892	1 832	1 777	1 680	1 524	1 403
32	4 454	4 284	4 131	3 993	3 868	3 753	3 549	3 222	2 969
40	6 694	6 439	6 210	6 004	5 815	5 643	5 338	4 848	4 468
50	12 484	12 010	11 586	11 202	10 852	10 532	9 966	9 056	8 350
65	24 832	23 895	23 054	22 293	21 601	20 968	19 847	18 044	16 645
80	37 976	36 547	35 264	34 104	33 048	32 082	30 372	27 621	25 485
100	76 343	73 483	70 914	68 591	66 476	64 541	61 116	55 605	51 326
125	128 076	123 290	118 992	115 105	111 566	108 328	102 598	93 374	86 211
150	206 631	198 928	192 010	185 752	180 056	174 843	165 618	1507 67	139 233
	160	180	200	220	240	260	280	300	320
15	311	292	276	261	249	238	229	220	213
20	698	654	618	587	559	536	514	495	478
25	1 306	1 226	1 158	1 100	1 049	1 005	965	929	897
32	2 765	2 596	2 454	2 332	2 225	2 131	2 048	1 973	1 905
40	4 162	3 910	3 696	3 513	3 353	3 212	3 087	2 975	2 873
50	7 782	7 312	6 915	6 573	6 276	6 014	5 781	5 572	5 383
65	15 518	14 586	13 798	13 122	12 532	12 012	11 550	11 135	10 760
80	23 766	22 343	21 141	20 108	19 207	18 414	17 707	17 073	16 500
100	47 880	45 028	42 618	40 546	38 740	37 148	35 731	34 459	33 309
125	80 442	75 667	71 631	68 161	65 136	62 469	60 095	57 964	56 037
150	129 943	122 253	115 751	110 161	105 288	100 992	97 166	93 732	90 627

Annex E
(normative)

Determination of maximum breather vent orifice size for devices not vented to outside atmosphere

E.1 Introduction

The following nomograms are designed for use with natural gas, LP Gas and TLP for room or enclosure volume from 1 m to 1 000 m^3. The gas pressure range is from 1 kPa to 200 kPa. The nomograms assume uniform airflow through a room or enclosure and, in the case of an escape, uniform dispersal of gas throughout the enclosure. In reality however, even if the overall air-change rate is acceptable (equal to or greater than 1 air-change per hour), conditions in the vicinity of the device may be less than ideal and some care needs to be exercised in the application of the nomograms for any or all of the following reasons:

a) The RD (relative density) of a gas influences its ability to disperse in air. The lower the RD, the greater the ease with which the gas is able to disperse.

b) Airflow patterns through a room or enclosure, in particular in the vicinity of a gas escape, greatly affect the ability of the air to dilute the gas to safe levels. The greater the local air movement, the greater the ease with which the gas is able to disperse.

c) The selection of a comparatively large breather vent orifice size, using the appropriate nomogram, may in the event of a gas escape, result in accelerating the formation of a localized unacceptable air-gas concentration for the above reasons.

In such instances, consideration should be given to venting the device to the atmosphere.

E.2 Using the nomograms

To use the nomograms:

a) Select the applicable nomograms for gas type, gas pressure and room or enclosure size or vent diameter.

b) From values of V, d or P, if any two are known, the remaining unknown value can be determined by placing a straightedge between the known values.

E.3 Example using a nomograms

Using natural gas, an inlet pressure of 1,1 kPa and a known enclosure volume of 8 m^3, the following procedure should be adopted to find the breather vent orifice size:

a) Select nomogram 1 (see example).

b) Find value 1,1 on the "P" scale and 8 on the "V" scale.

c) Place a straightedge between the values "f" "P" and "V" "d"). Find valued "d" of 1 mm. (Note that this is a maximum value).

Determination of maximum breather vent orifice diameter (d) for pressure (P) between 1 kPa and room volume (V) up to 1000 m^3. Examples of using a nomogram are illustrated in figures E.1 and E.2.

Nomogram is based on: $d = \frac{0,360\sqrt{V}}{\sqrt[4]{P}}$

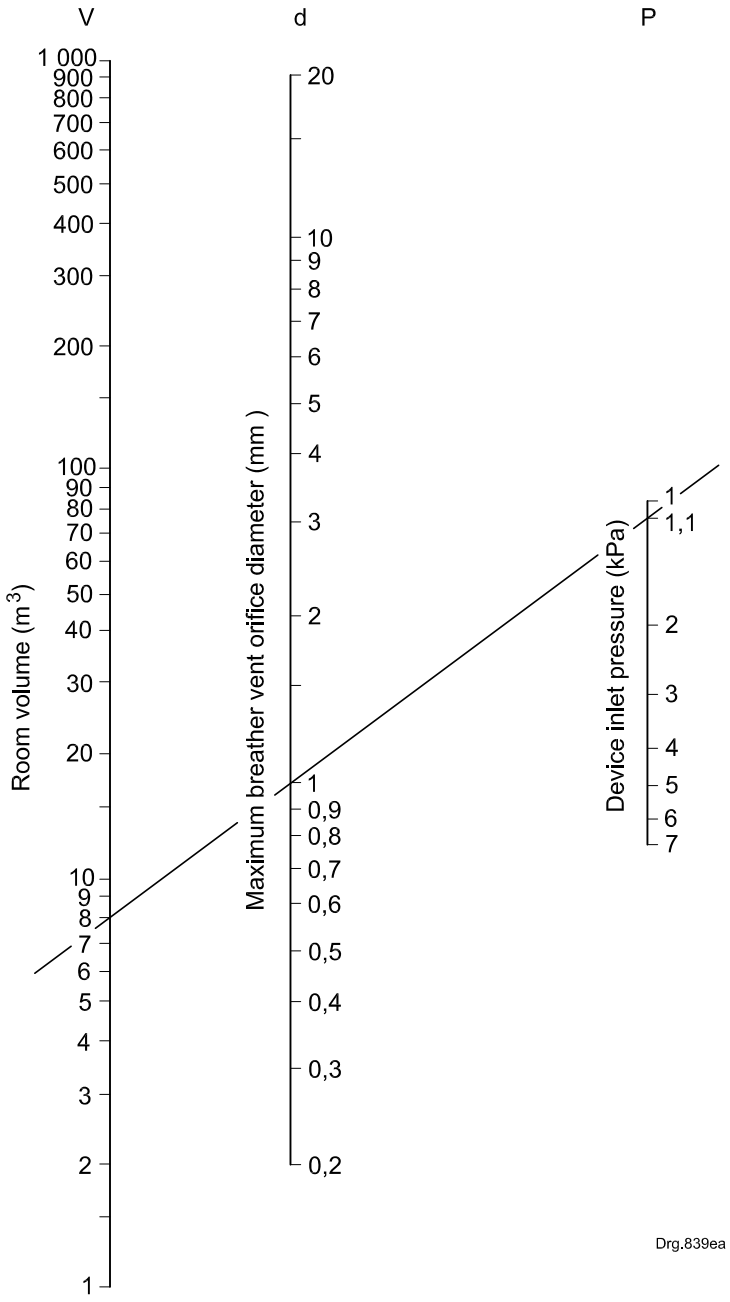


Figure E.1 — Nomogram 1A — Natural gas

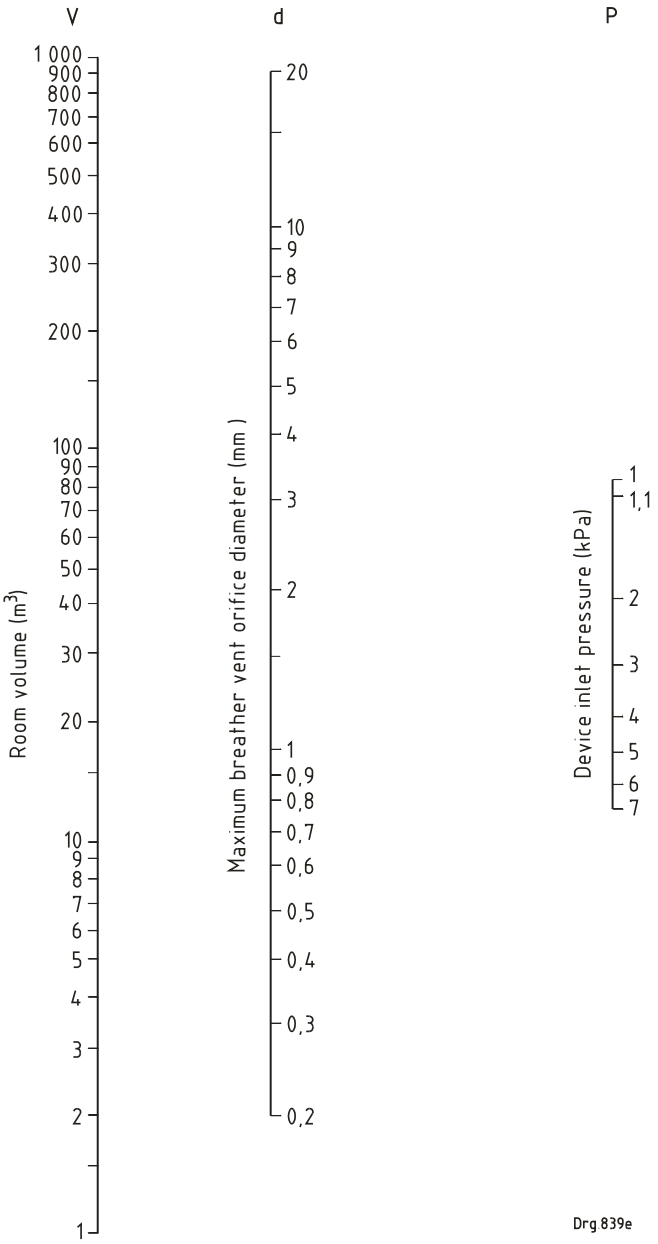


Figure E.2 — Nomogram 1B — Natural gas

Annex F
(normative)

Flue design

NOTE For appliances with atmospheric burners, see F.1. For appliances with power flues, see F.2.

F.1 Flue design for appliances with atmospheric burners

F.1.1 Introduction

The tables relating to this subclause (F.1) 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 are to be designed for the total quantity of flue gas discharge, using sound engineering practice.

Tables F.1 to F.7 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 F.8 shows equivalent sizes for round and rectangular flues.

Table F.8 shows the relationship between percentage carbon dioxide (% CO_2), volume of flue gases and amount of excess air.

F.1.2 Factors influencing flue design

F.1.2.1 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 always 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 can be classified as "low heat loss" in applying the flue tables contained in this standard. The same materials when located outdoors are classified as "high heat loss".

F.1.2.2 Resistance to flow of flue gases

Resistance to the flow of flue gases needs to 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 is to be sized using one of the following methods:

a) A 10 % capacity reduction is 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) Increase the flue diameter from the draught diverter outlet size to one size larger.

NOTE For calculation purposes, the flue capacity will 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 is to 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.

F.1.3 Designing individual appliance flues

F.1.3.1 Design procedure

The procedures for using the tables for individual flues, whether for low heat loss or high heat loss, are identical. Use table F.2 or F.3, as appropriate, based on the type of material selected and the location of the flue in regard to heat loss as follows:

STEP 1 Determine the total flue height (H) of the system and the length of any lateral (see figure F.1.)

STEP 2 Refer to table F.2 for low heat loss situations or table F.3 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 F.1.2.2 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.

F.1.3.2 Example of flue design for individual appliance flue

A water heater is to be installed with a flue configuration as in figure F.1.

Total height is 2,5 m.

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 F.2.

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 F.3 would need to be used. Adopting the former procedure, table F.3 indicates that a 150 mm diameter flue would be required.

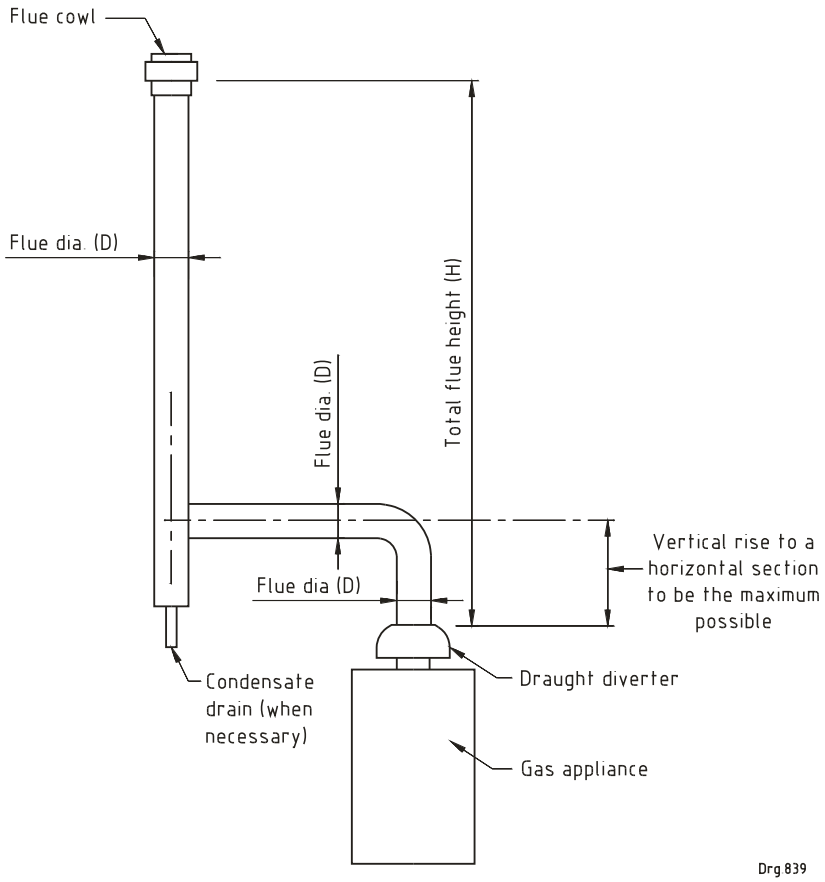


Figure F.1 — Individual appliance flue

F.1.4 Common flues (combined and multiple flues)

NOTE See 7.8.3.4 for common flueing limitations.

F.1.4.1 Design principles

A common flue should 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 (see tables F.4 to F.7), apply when the individual draught diverter outlets from appliances connected to the common flue are within range of table F.1. Use tables F.4 to F.7 as appropriate for low heat loss or high heat loss situations.

If the largest draught diverter outlet exceeds the range in table F.1, then increase the flue connector rise by 300 mm in excess of that shown in tables F.4 and F.6 (see figure F.4).

Table F.1 — Common flue — Maximum draught diverter size

1	2
When the smaller draught diverter diameter is mm	**Larger diverter diameter shall not exceed** mm
75	200
100	250
125	300
150	400
175	450
200	500
250	600

F.1.4.2 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 F.2 and F.3).

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.

F.1.4.3 Flue connector — Change of direction

The flue connector tables (see tables F.4 and F.6), allow for two 90° changes of direction. If a further change of direction is necessary, then

a) provide the next size larger flue connector; or

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.

F.1.4.4 Resistance to flow of flue gases — Manifolds and laterals

Where a common flue has a manifold or lateral at the base (see figure F.3) the design shall allow for additional resistance to flow due to the change of direction.

The (L) lines in table F.5 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 F.2 and F.3. 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 can be designed as an individual appliance flue using tables F.2 or F.3. The manifold is then designed as a lateral length.

F.1.4.5 Design of common flue — Appliances at different levels

F.1.4.5.1 Design factors

The flue from the first or lowest appliance connector to the common flue can be designed as an individual flue to the first interconnection or tee.

The other appliance flues joining the common flue are designed using the common flue tables (tables F.5 and F.7).

In applying the tables to several appliances installed at different levels, the "total height of flue" is the rise in the flue connector plus the vertical height between the connection to the common flue and the next connection above (see figure F.2). The top floor appliance has a total flue height that is the rise in the flue connector plus the vertical height from the connection with the common flue to the flue terminal.

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 is to be increased by 300 mm more than that shown in the tables (see figure F.4).

F.1.4.5.2 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 F.2). 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 F.2 "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 shall have capacity to serve the two appliances i.e., 100 MJ/h, but first the flue connector size is determined.

From table F.4, under "least total height" locate 3,0 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 F.5, under "least total height", locate 3,0 m. As the common flue is vertical, without change of direction and the appliances 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. The following 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.

Reading table F.5, for alternative (a):

Under "least total height" 3,0 m, reading across the table, a 150 mm common flue would be suitable, having capacity up to 188 MJ/h; or

Reading table F.5, for alternative (b):

Under "least total height" 6,0 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.

F.1.4.5.3 Alternative method using oversize common flue

Another 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 F.2). 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.

F.1.4.6 Design of common flue — Appliances at same level

F.1.4.6.1 Total flue height

In applying the tables to several appliances installed at the same level, the "total flue height" is 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 F.3).

F.1.4.6.2 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 F.3).

Each appliance has a 100 mm flue outlet, a gas consumption of 50 MJ/h and will operate independently.

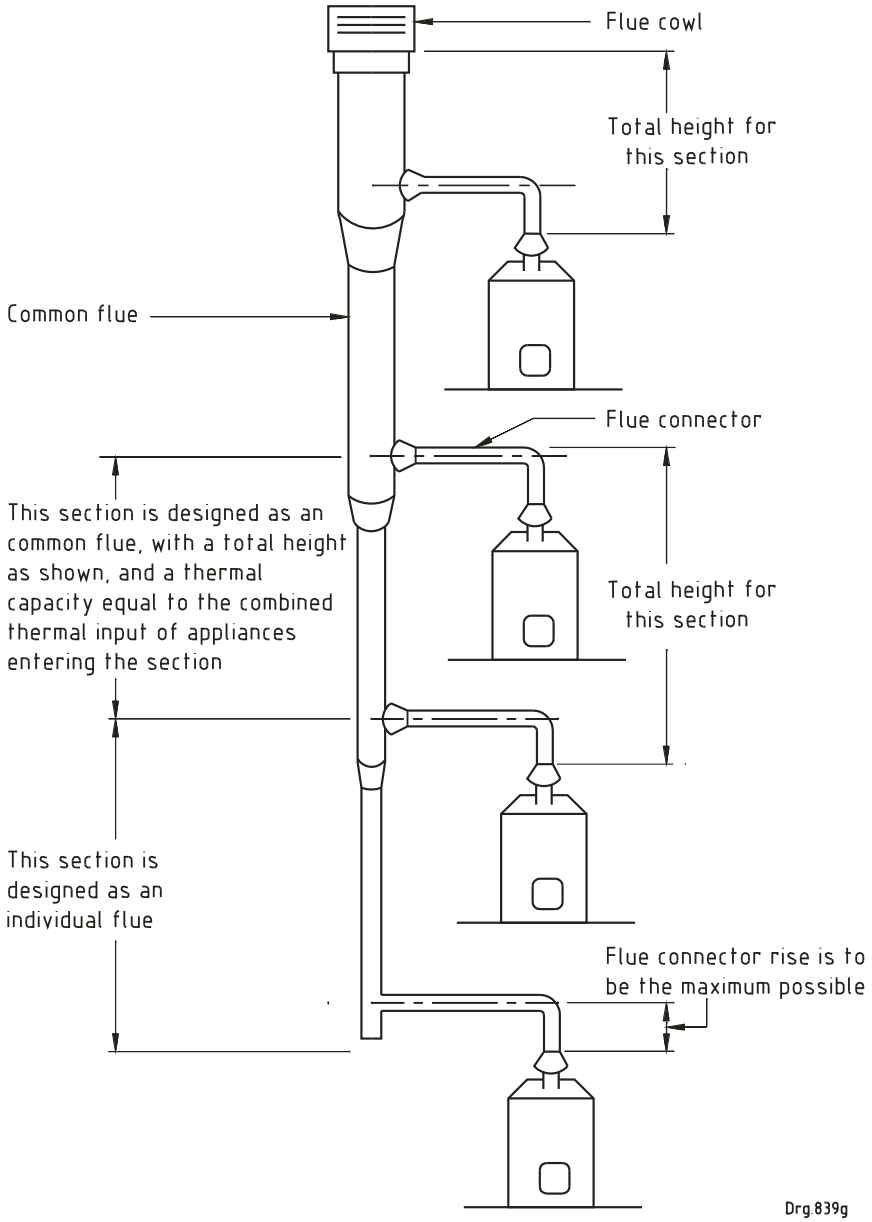
STEP 1 The flue connector size is determined from table F.4. The total height from the appliance draught diverter to the flue terminal is 18 m. In order to have a rise in the manifold it is assumed that the connector rise of the appliance farthest from the common flue is 300 mm.

From table F.4, 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 shall be sized as a common flue since all appliances do not operate simultaneously. Using table F.5, the type L line is used.

For a total height of 18 m, on the 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 F.3) does not exceed 50 % of total flue height.



NOTE A self-venting flue connector does not depend on the common flue for its performance. The minimum connector rise of 1 200 mm is designed so that each flue performs as an individual flue.

Figure F.2 — Common flue for several appliances installed at different levels

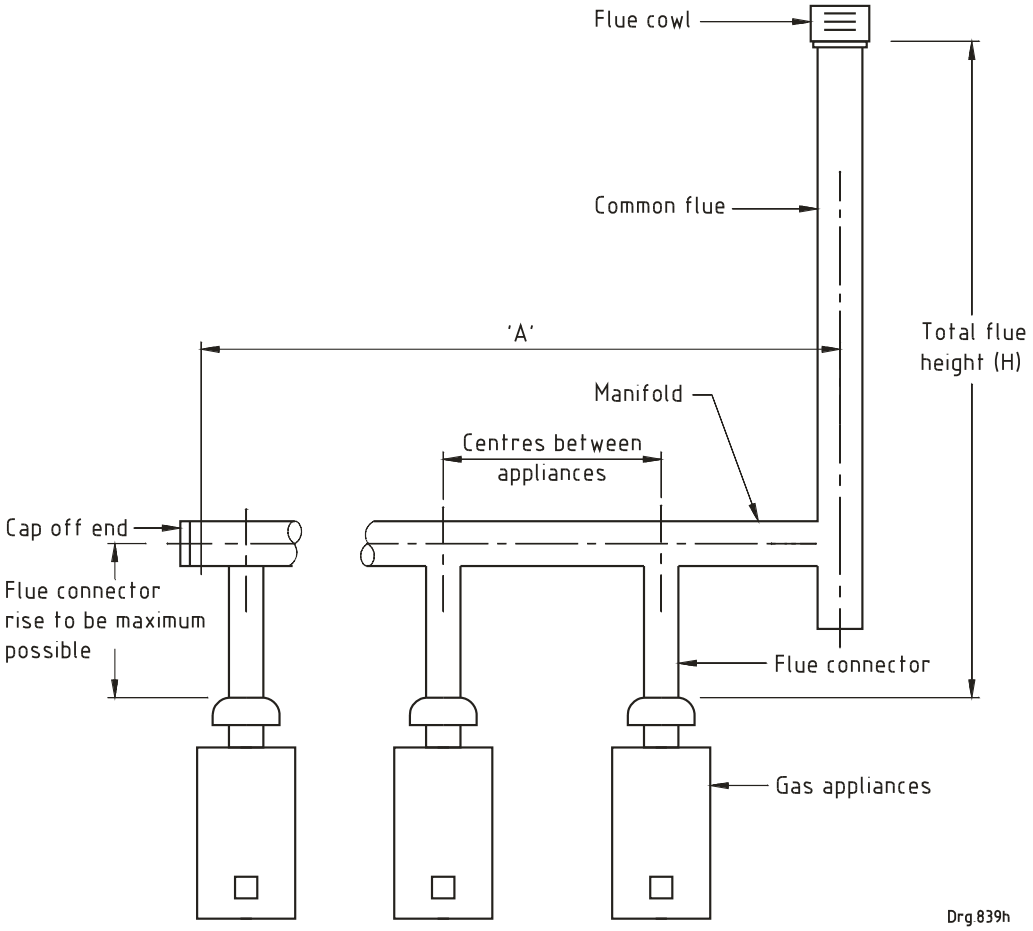


Figure F.3 — Common flue for several appliances installed at the same level

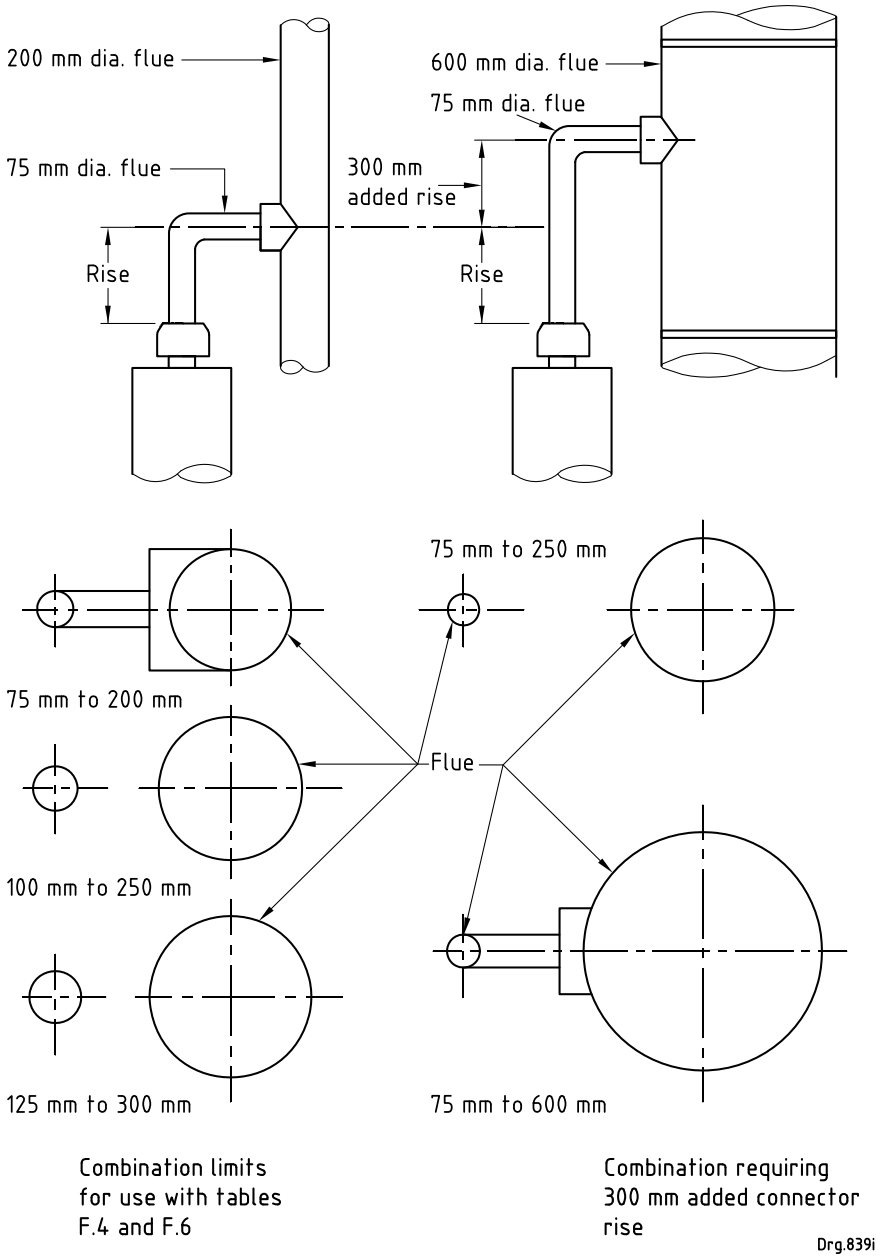


Figure F.4 — Combining a small flue into a large flue

Table F.2 — Individual appliance flues — Low heat loss materials and environments (indoor location or insulated flues)

Total height of flue m	**Length of lateral** m	**Capacity of flue** MJ/h													
		Diameter of flue (D) mm													
H	**L**	**75**	**100**	**125**	**150**	**175**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**550**	**600**
2	0,0	49	91	149	216	301	390	601	897	1 234	1 614	2 068	2 564	3 112	3 714
	0,6	38	71	111	166	229	301	480	686	939	1 234	1 561	1 952	2 342	2 817
	1,5	34	64	106	157	216	288	459	665	918	1 213	1 551	1 920	2 332	2 796
2,5	0,0	53	99	164	248	338	438	696	1 023	1 393	1 836	2 342	2 901	3 545	4 231
	0,6	42	79	127	190	261	340	543	786	1 076	1 414	1 794	2 226	2 701	3 218
	1,5	40	74	121	181	252	329	531	772	1 066	1 403	1 778	2 205	2 685	3 210
3,0	0,0	56	106	175	269	364	475	760	1 118	1 530	2 031	2 585	3 218	3 914	4 695
	0,6	44	85	136	206	288	375	591	897	1 192	1 561	1 994	2 469	2 996	3 576
	1,5	42	81	131	197	279	364	578	879	1 173	1 541	1 974	2 443	2 971	3 556
4,5	0,0	61	118	197	301	411	554	886	1 815	1 308	2 395	3 060	3 819	4 653	5 592
	0,6	51	98	158	237	333	437	712	1 424	1 039	1 867	2 384	2 954	3 598	4 304
	1,5	47	94	154	231	323	422	696	1 029	1 396	1 844	2 358	2 930	3 571	4 280
	3,0	44	87	147	220	307	399	670	1 013	1 359	1 805	2 314	2 889	3 526	4 239
6	0,0	64	126	213	324	454	607	981	1 424	2 005	2 659	3 429	4 283	5 254	6 330
	0,6	54	106	175	263	365	496	797	1 161	1 604	2 110	2 711	3 376	4 125	4 959
	1,5	51	101	169	254	356	482	779	1 142	1 578	2 085	2 683	3 348	4 093	4 919
	3,0	46	94	158	241	339	467	749	1 102	1 540	2 047	2 638	3 302	4 041	4 853
	4,5	41	89	151	230	329	450	728	1 076	1 504	2 018	2 605	3 261	4 010	4 844
9	0,0	68	135	232	354	501	686	1 118	1 635	2 289	2 511	3 218	4 020	4 906	5 908
	0,6	59	118	195	295	416	564	913	1 382	1 899	2 479	3 186	3 991	4 876	5 857
	1,5	55	114	190	288	406	553	898	1 360	1 873	2 427	3 133	3 945	4 826	5 772
	3,0	51	106	180	275	391	536	875	1 323	1 828	2 374	3 081	3 897	4 776	5 686
	4,5	–	100	172	263	377	517	850	1 287	1 785	2 321	3 028	3 851	4 726	5 602
	6,0	–	95	162	250	362	499	827	1 250	1 741	2 511	3 218	4 020	4 906	5 908

Table F.3 — Individual appliance flues — High heat loss materials and environments (outdoor locations with non-insulated flues)

Total height of flue m	**Length of lateral** m	**Capacity of flue** MJ/h													
		Diameter of flue (D) mm													
H	**L**	**75**	**100**	**125**	**150**	**175**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**550**	**600**
2	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	1 224	1 604	–	–	–	–
	0,6	34	64	108	162	222	300	476	717	1 023	1 340	–	–	–	–
	1,5	31	59	100	149	205	279	454	684	995	1 308	–	–	–	–
3,0	0,0	47	89	146	213	294	392	639	962	1 393	1 846	2 279	3 102	–	–
	0,6	37	71	117	177	246	328	563	802	1 161	1 540	2 005	2 585	–	–
	1,5	34	64	110	161	227	305	506	764	1 129	1 505	1 965	2 541	–	–
4,5	0,0	52	96	159	235	329	445	722	1 097	1 530	2 099	2 722	3 418	4 241	5 180
	0,6	41	76	129	196	274	369	601	913	1 277	1 751	2 268	2 849	3 534	4 326
	1,5	37	71	116	179	253	343	570	870	1 242	1 712	2 236	2 801	3 479	4 271
	3,0	32	61	109	167	235	325	542	839	1 182	1 646	2 152	2 722	3 387	4 178
6	0,0	56	107	172	266	361	496	812	1 255	1 772	2 416	3 165	3 988	4 937	6 066
	0,6	44	84	143	222	302	414	676	1 044	1 477	2 015	2 638	3 323	4 115	5 064
	1,5	40	78	130	203	279	384	644	997	1 438	1 973	2 587	3 264	4 051	4 998
	3,0	34	69	121	188	260	364	602	960	1 372	1 899	2 500	3 165	3 946	4 885
	4,5	–	58	110	172	241	344	580	918	1 319	1 825	2 416	3 075	3 890	4 779
9	0,0	59	114	193	291	405	558	926	1 445	2 026	2 775	3 608	4 558	5 697	7 227
	0,6	46	89	156	243	338	665	770	1 203	1 688	2 310	3 007	3 798	4 748	6 014
	1,5	–	82	145	222	312	433	732	1 139	1 646	2 260	2 948	3 735	4 677	5 934
	3,0	–	72	132	207	289	409	692	1 108	1 572	2 173	2 849	3 629	4 558	5 803
	4,5	–	–	119	187	272	386	659	1 055	1 509	2 094	2 754	3 518	4 442	5 676
	6,0	–	–	109	172	253	363	629	1 013	1 445	2 015	2 659	3 408	4 326	5 549

Table F.4 — Maximum flue connector pipe carrying capacity — Low heat loss materials and environments

1	2	3	4	5	6	7	8	9	10
Least total height	**Connector rise**	**Capacity of flue** MJ/h							
		Diameter of flue (D) mm							
m	m								
H	**L**	**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 F.5 — Maximum common flue carrying capacity — Low heat loss materials and environments

1	2	4	5	6	7	8	9	10	11	12	13	14
Least total height m	**Common flue type**	**Capacity of flue** MJ/h										
		Diameter of flue (D) mm										
H	**L or V**	**100**	**125**	**150**	**175**	**200**	**250**	**300**	**350**	**400**	**450**	**500**
1,5	L	51	80	115	157	206	327	480	665	876	1 118	1 403
	V	63	100	145	196	255	404	578	793	1 036	1 308	1 614
1,8	L	55	87	123	169	222	343	494	747	976	1 234	1 524
	V	69	109	155	211	274	433	620	860	1 124	1 419	1 751
2,4	L	61	96	137	188	243	385	549	837	1 092	1 382	1 709
	V	77	120	172	235	306	491	688	962	1 255	1 593	1 962
3,0	L	66	103	150	204	264	417	599	913	1 192	1 509	1 862
	V	83	131	188	255	332	522	751	1 050	1 372	1 735	2 142
4,5	L	77	120	173	236	306	485	692	1 063	1 387	1 757	2 173
	V	96	152	217	295	385	596	870	1 222	1 593	2 015	2 490
6,0	L	85	134	192	264	343	538	768	1 188	1 551	1 962	2 427
	V	108	169	242	327	427	675	966	1 361	1 783	2 258	2 785
9	L	99	155	223	306	396	622	890	1 400	1 830	2 310	2 859
	V	124	195	281	380	496	781	1 081	1 609	2 099	2 659	3 281
12	L	111	173	249	338	443	696	997	1 574	2 057	2 606	3 218
	V	138	214	311	427	554	865	1 245	1 809	2 363	2 986	3 693
18	L	–	188	273	371	485	760	1 161	1 846	2 405	3 049	3 766
	V	–	236	342	464	607	950	1 456	2 121	2 764	3 505	4 326
24	L	–	–	290	395	515	807	1 300	2 057	2 690	3 408	4 199
	V	–	–	363	494	644	1 008	1 625	2 374	3 091	3 914	4 842
30	L	–	–	–	404	528	823	1 408	2 258	2 943	3 724	4 600
	V	–	–	–	505	659	1 029	1 762	2 585	3 376	4 273	5 275

NOTE 1 Type L: Applies to common flues having a manifold at the base or an offset in the common flue.

NOTE 2 Type V: Applies when all connectors are individually attached to a straight vertical common flue.

Table F.6 — Maximum flue connector pipe carrying capacity
High heat loss materials and environments

1	2	3	4	5	6	7	8
Least total height m	**Connector rise** m	**Capacity of flue** MJ/h					
		Diameter of flue (D) mm					
H	**L**	**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 F.7 — Maximum common flue carrying capacity
High heat loss materials and environments

1	3	4	5	6	7	8	9
Least total height m	**Capacity of common flue** MJ/h						
	Diameter of common flue (D) mm						
H	**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
1,0	–	–	–	380	517	855	1 255

F.2 Power flue design

A flue using a fan to remove or assist in removing combustion products from an appliance is known as a "power flue".

F.2.1 Power flue applications

A power flue can be used for one or more appliance(s) 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.

F.2.2 Design requirements

F.2.2.1 Air supply

F.2.2.1.1 General

Air supply to the appliance is to be in accordance with the requirements of 7.4.

F.2.2.1.2 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 F.5). Provision is to be made for supplying a quantity of dilution air equal to the flow through the power flue fan.

F.2.2.2 Flue design requirements

It is recommended that the "equal friction design method" be used when calculating air flow and pressure loss. A velocity of 3 m/s is recommended.

F.2.2.3 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 is to be incorporated in the branch to every appliance in order to achieve correct air flow for the flue system.

F.2.2.4 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 has to be decided.

If discharge is at low level, 1 % CO_2 is used in the design formula. For other situations, values between 4 % and 8 % can 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 is to 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 is given by the following simplified formula, which is sufficiently accurate for most fuel gases currently distributed. A suitable fan can then be selected.

$$Q = \frac{T}{R}$$

where

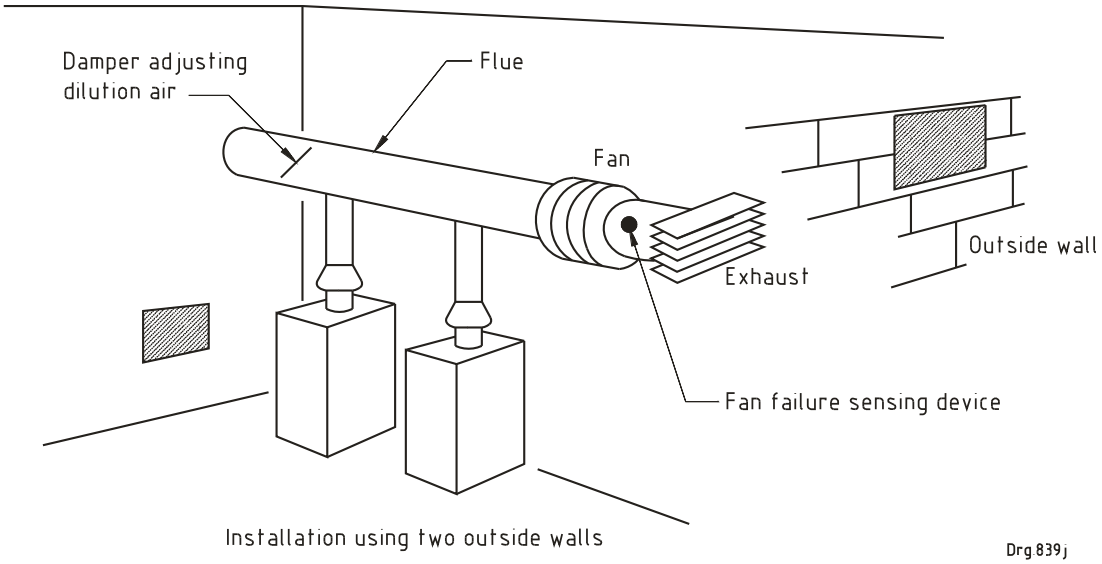
Q is the volume of flue gases (L/s);

T is the total gas consumption of appliances connected to flue (MJ/h); and

R is the desired % CO_2 concentration by volume in the flue gases at the discharge point. Table F.8 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 F.8 — Flue gases — Relationship between % CO_2, volume flow rate and % excess air

CO_2 %	**Volume** L/s/MJ/h	**Excess air** %
10	0,10	33
9	0,11	50
8	0,13	67
7	0,14	90
6,5	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	1 000
1,0	1,00	1 200
0,8	1,20	1 500
0,6	1,60	2 000
0,5	2,00	2 600



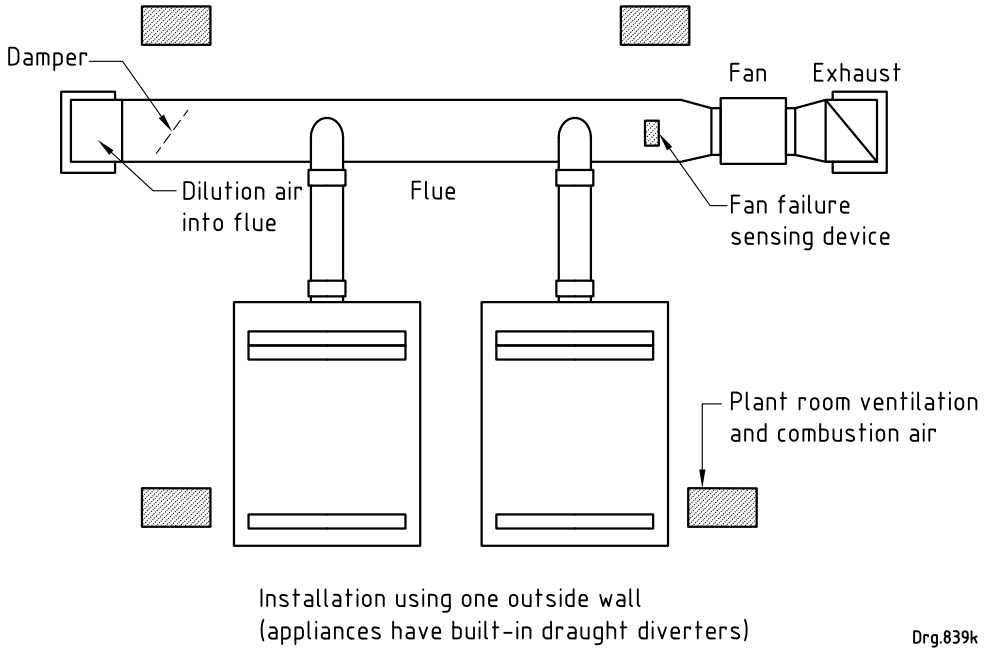


Figure F.5 — Power flue — Low-level discharge

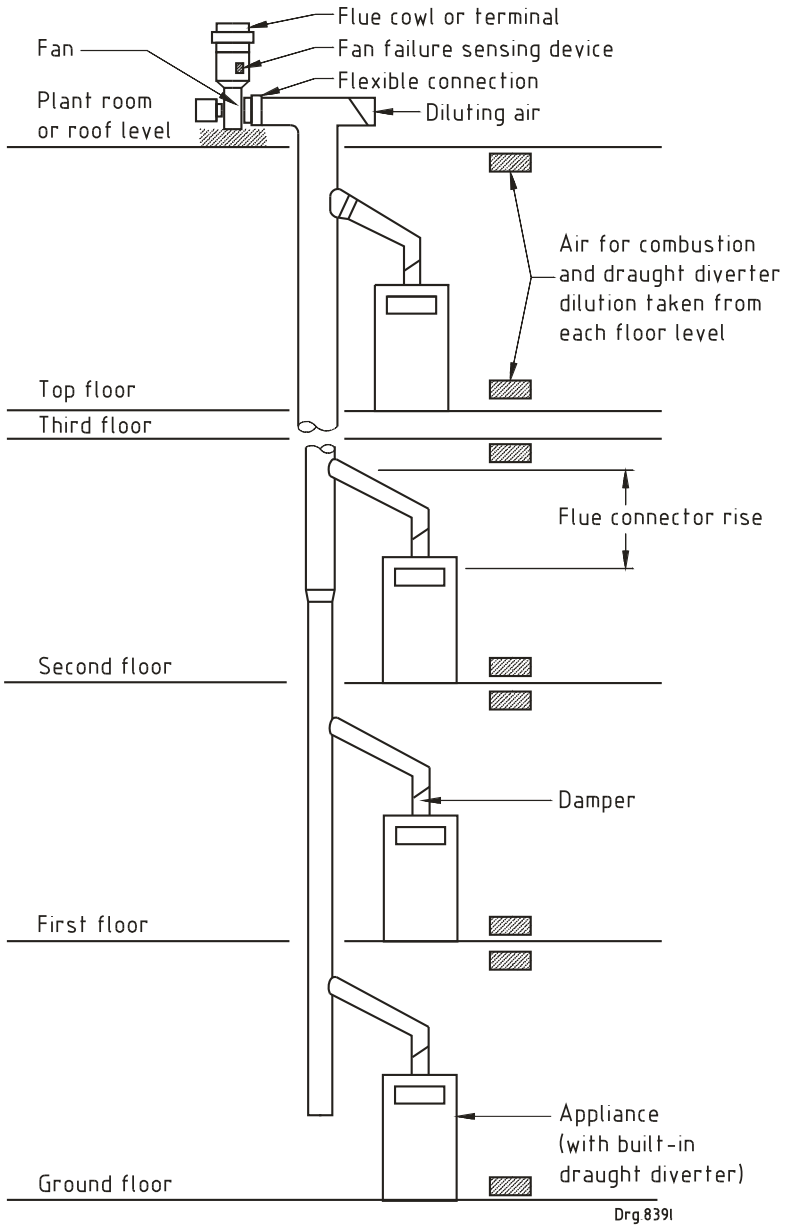


Figure F.6 — Using a common flue to power flue appliances at different levels

F.2.2.5 Fan requirements

When selecting a fan for the power flue, allowance is to 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 is to be rated for continuous operation giving consideration to the maximum design flue temperature. A fan located outside is to have a weatherproof motor.

A fan with an indirect drive is to 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 are to be protected from the weather by a durable and removable cover.

Electrical fan motor shall be suitably protected by a explosion protected method regarding the applicable gas group, temperature class and zone classification as indicated in area classification report

NOTE 1 The fan should preferably be of the backward curved blade type having a non-overloading power characteristic.

NOTE 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.

F.2.2.6 Fan failure sensing devices

A sensing device is to 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 shutdown the main burner gas only and need not have manual reset. Other appliances shall go to lockout when there is a flow failure.

NOTE 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).

NOTE 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.

F.2.2.7 Noise and vibration reduction methods

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:

NOTE 1 Often flue wall resonance, grille noise and burner noise may necessitate acoustic treatment being carried out after the installation has been completed.

NOTE 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.

NOTE 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.

NOTE 4 Flexible connections between fan and flue are desirable, and fans should be separately supported on suitable resilient type mountings.

NOTE 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.

NOTE 6 A suitable sound absorbent material can be used to insulate a flue, which has to be boxed in for good appearance.

NOTE 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 or upstream of the fan (or both).

F.2.2.8 Commissioning the power flue

The correct CO_2 concentration is to be established by adjustment of dampers and checked by flue gas analysis. A check that the controls are operating in the manner specified is to be carried out. This check is to include a simulation of fan failure.

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