

Australian Transport Council

National Standard
for
Commercial Vessels

PART C
DESIGN AND CONSTRUCTION

SECTION 5
ENGINEERING

SUBSECTION 5C
LPG SYSTEMS FOR APPLIANCES

Edition 1

First Published — August 2002 (on CD)

Second Publication — April 2005 (on CD)

Draft for public comment issued — 22 December 2000

Endorsed by the Australian Transport Council — July 2002

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CHAPTER 1 PRELIMINARY

1.1 SCOPE

This Subsection of the NSCV specifies requirements for the design, manufacture, installation and operation of systems on vessels for appliances using liquefied petroleum gas (LPG) as the source of fuel.

1.2 APPLICATION

This Subsection of the NSCV applies to appliances using liquefied petroleum gas (LPG).

It does not apply to LPG systems for the following:

- a) Main or auxiliary internal combustion engines using LPG as the fuel source.

NOTE: Part C Subsection 5D (LPG Systems for Engines) of the NSCV specifies requirements for the above engines.

- b) Portable, self-contained appliances where the LPG cylinder is connected directly to the appliance.

This Subsection of the NSCV shall be read in conjunction with Part B—General Requirements of the NSCV.

1.3 OBJECTIVE

The objective of this Subsection of the NSCV is to protect against hazards arising from a liquefied petroleum gas (LPG) installation used with reasonable care and under normal conditions, having regard to the purpose for which the installation is intended.

1.4 REFERENCED DOCUMENTS

The following documents are referred to in this Subsection of the NSCV. Any documents referenced in this Subsection shall be considered to be the latest revision of the document, including amendments and supplements.

NATIONAL MARINE SAFETY COMMITTEE

National Standard for Commercial Vessels

Part B—General Requirements

Part C—Design and Construction

Section 2: Watertight and Weathertight Integrity

Subsection 2A—Loadline Vessels

Section 5: Engineering

Subsection 5D—LPG Systems for Engines

Section 6: Stability

Subsection 6B—Intact Stability

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

AS 1432—*Copper tubes for plumbing, gasfitting and drainage applications*

AS 1697 *Gas transmission and distribution systems* (known as the SAA Gas Pipeline Code)

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

AS 4041 *Pressure piping*

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

AS 5601—*Gas Installations (AG 601)*

THE AUSTRALIAN GAS ASSOCIATION

AG 601: *Gas Installation Code*

1.5 DEFINITIONS

For the purposes of this Subsection of the NSCV—

- a) the definitions provided in Part B of the NSCV, in addition to those in this Clause, shall apply; and
- b) where there is any duplication in the terms defined between this Clause and Part B, the definitions in this Clause shall apply.

readily accessible—

capable of being reached, under normal conditions of operation or in an emergency, for inspection, removal or maintenance

- a) without removal of a permanent part of the vessel's structure; and
- b) without the use of tools.

appliance shut-off valve—

a valve, fitted either on or in the vicinity of an appliance, for the purpose of isolating the appliance from its LPG supply.

attended appliance—

an appliance designed for use only in the presence of an operator (e.g. cooking stoves and ovens).

cylinder locker—

an enclosure designed for the storage of one or more LPG supply cylinders.

Flame lift-off—

A phenomenon characterised by the partial or total movement of the base of the flame away from the burner port.

flame supervision device—

a device incorporating a sensing element, which is activated by the presence or absence of flame and which causes the LPG supply to a burner to be opened or closed.

high-pressure side—

the part of the LPG system exposed to the pressure within the LPG supply cylinder (i.e. upstream of the pressure regulator).

Liquefied petroleum gas (LPG)—

a hydrocarbon fluid composed predominantly of any of the following hydrocarbons, or mixtures of all, or any of them:

- a) Propane.
- b) Propylene.
- c) Butane.
- d) Butylene.

Unless specifically stated otherwise, any reference to propane, propylene, butane or butylene means the commercial grade of that product.

LPG supply line—

the line in the low-pressure side, comprising piping or hose or a combination of both, which connects the pressure regulator (or solenoid, if fitted) to the appliance shut-off valve or the appliance itself.

LPG system—

an arrangement of components used for supplying LPG from one or more LPG supply cylinders to one or more appliances, including all monitoring and flow-control devices on both the supply cylinder(s) and the appliance(s) themselves.

low-pressure side—

the part of the LPG system exposed to the working pressure of the appliance(s) (i.e. downstream of the pressure regulator).

lain shut-off valve—

a device for isolating the entire LPG system from the LPG supply cylinder pressure.

pressure regulator—

a device that

- a) reduces the pressure in the LPG supply cylinder to the working pressure of the consuming appliance; and
- b) maintains that working pressure to the appliance while the appliance is being used.

room sealed appliance—

an appliance having a combustion system in which incoming combustion air and outgoing products of combustion pass through sealed ducting, which is connected to the enclosed combustion chamber and which terminates outside the vessel.

unattended appliance—

an appliance designed to function without requiring constant attendance by an operator.

NOTE: Such appliances may operate in automatically controlled cycles, e.g. water heaters, refrigerators and cabin heaters.

working pressure—

the pressure at which all appliances in the LPG system are designed to operate.

1.6 ABBREVIATIONS

LPG—

liquid petroleum gas

CHAPTER 2 SYSTEM DESIGN AND INSTALLATION

2.1 SCOPE

This Chapter sets out requirements and specifications for the design and installation of an LPG system for appliances and for any associated accessories. LPG supply cylinders are included, together with ventilation and marking requirements.

2.2 OBJECTIVE

The objective of this Chapter is to ensure the system design, installation and accessories for liquefied petroleum gas (LPG) systems are suitable for their intended service.

REQUIRED OUTCOMES

2.3 OPERATION AND MAINTENANCE

LPG systems for appliances must be designed, constructed and installed to facilitate their identification, safe use, inspection and maintenance.

2.4 CONTAINMENT OF FUEL

LPG supply cylinders and distribution systems must be designed, constructed and installed to prevent the leakage of gas in both normal and abnormal conditions of operation.

2.5 MINIMISING THE RISK OF IGNITION

LPG systems for appliances must be designed, constructed and installed to prevent the build-up of explosive gases and to avoid potential sources of ignition.

2.6 ENVIRONMENTAL FIRE HAZARDS

LPG systems for appliances must be designed, constructed and installed to minimise and, where possible, eliminate risks associated with potential fire hazards in proximity to the system.

DEEMED-TO-SATISFY SOLUTIONS

2.7 COMPLIANCE

For the purposes of this National Standard, the system design, installation and operating characteristics of an LPG system for appliances shall be deemed to have satisfied the required outcomes in Clauses 2.3 to 2.6 if it complies with Clauses 2.8 to 2.10, and 3.5 to 3.7.

2.8 DESIGN AND INSTALLATION

2.8.1 Design

An LPG system shall be of the vapour withdrawal type (i.e. fuel is released only under gas phase conditions) and designed to be capable of withstanding—

- a) storage at -20°C to +60°C;
- b) the vibration encountered during operation of the vessel; and
- c) exposure to the climatic conditions encountered in a marine environment.

2.8.2 Installation

No part of an LPG system shall be installed in or pass through any space containing machinery, explosives, highly combustible substances or berthed accommodation.

All LPG appliances installed on a vessel shall be designed for operation at the same working pressure.

2.8.3 Over-pressure device

An over-pressure device shall be fitted on the low-pressure side. The over-pressure device shall be set to discharge at not less than twice and not more than three (3) times the working pressure of the consuming appliance(s). The discharge of the over-pressure device shall be located inside the cylinder locker, and shall be vented outside the vessel.

NOTE: The over-pressure device may be a pressure relief governor or an automatic safety shut-off valve.

2.9 PRESSURE REGULATORS

2.9.1 General

An LPG system shall incorporate a pressure regulator designed to provide a fixed working pressure suitable for the consuming appliances. This fixed working pressure shall not exceed 3 kPa.

2.9.2 Manufacture

Pressure regulators and their fasteners shall be manufactured from corrosion-resistant metal or shall have a corrosion-resistant plating or coating.

NOTE: AS 4267 specifies requirements for pressure regulators for use with industrial compressed gas cylinders.

2.9.3 Location

The pressure regulator for an LPG system shall be located within the cylinder locker.

2.9.4 Capacity

The pressure regulator shall have a minimum capacity at least equal to the total connected appliance load at the working pressure.

2.9.5 Fitting

The pressure regulator should be fitted close to the LPG supply cylinder outlet via rigid connections. Where the pressure regulator is not rigidly connected to and supported by the LPG supply cylinder connection, it shall be secured separately and protected from mechanical damage.

2.9.6 Information and marking

The working pressure of the consuming appliance(s) shall be legibly and permanently marked on a label, which shall be affixed to the pressure regulator.

2.10 LPG SYSTEM—LOW-PRESSURE SIDE

2.10.1 General

The piping and hoses used as LPG supply lines in the low-pressure side shall have an internal diameter sufficient

- a) for the maximum gas consumption of the appliance(s); and
- b) to ensure that any pressure drop across the system due to friction does not reduce the working pressure at any appliance below that required by the appliance manufacturer when all appliances are under full load.

2.10.2 Protection

Unless adequate protection is provided, LPG supply lines shall not be routed in any location where there is a risk of mechanical damage to the supply line.

2.10.3 Routing restrictions

LPG supply lines and components shall be installed above the bilge, and shall not be routed to within 50 mm of electrical conductors unless the conductors are either sheathed or contained in conduit or trunking.

LPG supply lines shall be at least 100 mm from components of the engine exhaust system.

Piping shall be at least 100 mm from exposed terminals of electrical devices or accessories.

2.10.4 Support

LPG supply lines shall be adequately supported (e.g. by clips or straps, or by being routed within non-metallic conduit or piping) to prevent the risk of damage due to chafing or vibration.

For piping, supporting devices shall be spaced at intervals not exceeding 0.5 m. For hose, supporting devices shall be spaced at intervals not exceeding 1 m.

Supporting devices shall be

- a) corrosion-resistant;
- b) designed to prevent cutting or other damage to the supply line; and

- c) compatible with the supply line material.

2.10.5 Connections

The number of joints and connections in the LPG supply lines shall be minimised. All joints and connections shall be made such that no undue stress is created at the fitting, or in the LPG supply line on either side of the connection.

All threaded connections required to ensure gas tightness of the system shall be of the taper pipe thread type. Such fittings shall be used for connections at appliances, manifolds, pressure regulators, valves and bulkhead flanges.

All LPG supply line end fittings not connected to an appliance shall be fitted with a gas-tight cap or plug.

Throughout the system all connections shall be readily accessible.

NOTE: Sealant should be applied to the male thread only.

2.10.6 Supply lines passing through bulkheads

LPG supply lines passing through bulkheads intended to maintain watertight integrity in the vessel shall be

- a) sealed by suitable material or fittings at the point of penetration; and
- b) protected from abrasion or chafing at the point where they pass through the bulkheads.

2.10.7 Gimballed stoves

Gimballed stoves shall be connected to the LPG system via hose.

2.10.8 Piping Specific requirements

2.10.8.1 *Pipe material*

Piping used in LPG systems shall comply with AS 1432 or AS 4041, and shall be manufactured from either of the following materials:

- a) Solid drawn copper.
- b) Drawn stainless steel.

Where pipe material is not galvanically compatible with the vessel's structure (e.g. copper piping on an aluminium vessel), it shall be pacified or isolated.

2.10.8.2 *Installation*

Piping shall not come into direct contact with metallic parts of the vessel's structure.

2.10.8.3 *Bends in piping*

Bends and offsets in piping shall be free from buckles, cracks or other evidence of mechanical damage to the piping or its protective coating.

2.10.8.4 *Welding*

Welding procedures and testing shall be in accordance with AS 1697 and AS 4041. The melting point of materials at welded or brazed connections shall not be less than 500°C.

2.10.8.5 *Fittings*

Fittings shall be galvanically compatible with the piping to which they are connected. Fittings for connections and joints in piping shall be of the following types:

- a) Compression fittings, with solid or thick-walled copper rings on copper piping.
- b) Stainless steel rings on stainless steel piping.

The wall thickness of rings shall be at least 0.5 mm. Jointing compound shall not be used on compression or flared fittings.

End connecting fittings shall be manufactured from corrosion-resistant material (e.g. brass or stainless steel).

NOTE: To ensure adequate resistance to corrosion from seawater, end connecting fittings and cutting rings manufactured from brass should not contain more than 15 per cent zinc.

Where cutting ring fittings are used in conjunction with copper piping, a brass insertion sleeve and brass cutting ring shall be fitted, and all components shall be matched (i.e. of the same galvanic series).

2.10.9 Hose and hose assemblies specific requirements

2.10.9.1 *Hose assemblies*

Hose assemblies for LPG installations shall comply with AS/NZS 1869.

2.10.9.2 *Hoses*

Hoses shall comply with the following:

a) *Hose connecting piping to an appliance*

Where hose is used in an LPG supply line to connect piping to an appliance, it shall not exceed 1.2 m in length for fixed appliances (e.g. gimbaled stoves), or 3 m in length for portable appliances (e.g. space heaters). Supply hose shall have no joints or fittings between the piping connection and the shut-off valve on the appliance itself.

b) *Hose used solely as LPG supply line*

Where hose is solely used as the LPG supply line, the following restrictions apply:

- i) The installation shall have one appliance only.
- ii) The hose shall be in one continuous length, with no joints or fittings between the outlet of the pressure regulator (or solenoid, if fitted) and the appliance shut-off valve.

c) *Fittings*

Hoses shall have permanently attached end fittings (e.g. swaged sleeve fittings or sleeve fittings with threaded inserts).

2.10.10 Main shut-off valves

2.10.10.1 *General*

Each LPG system shall be equipped with a readily accessible, manually-operated main shut-off valve.

2.10.10.2 *Multi-cylinder systems*

Where two or more LPG supply cylinders are used in an LPG system, a selector valve shall be fitted between each cylinder shut-off valve and the pressure regulator, to enable the piping on the high-pressure side to be isolated when a cylinder is disconnected.

2.10.11 Appliance shut-off valves

2.10.11.1 *General*

Unless otherwise provided for in Clause 2.10.11.5, an appliance shut-off valve shall be installed for each appliance. The valve, or its control, shall be readily accessible and operable

- a) from within the vicinity of the appliance; and
- b) without the operator having to reach over the top of open flame appliances (e.g. stoves).

2.10.11.2 *Location*

Appliance shut-off valves shall be located such that the risk of inadvertent or accidental operation is minimised.

2.10.11.3 *Open and closed positions*

The open and closed positions of appliance shut-off valves shall be clearly and permanently indicated on or immediately adjacent to the valve.

2.10.11.4 *Valves not located on or adjacent to the appliance*

Where an appliance shut-off valve is not located on or immediately adjacent to the appliance that it controls, means to identify the appliance controlled shall be clearly and permanently indicated on or immediately adjacent to the valve. If a valve is not visible, its location shall be clearly and permanently indicated with appropriate signs.

2.10.11.5 *Use of main shut-off valve as the appliance shut-off valve*

Where there is only one appliance in the LPG system, and the main shut-off valve at the LPG supply cylinder is readily accessible from the vicinity of the appliance, an appliance shut-off valve need not be fitted.

2.10.11.6 *Valves not connected to an appliance*

Any shut-off valve not connected to an appliance shall be fitted with a gas-tight cap or plug.

2.10.11.7 *Types of valves*

Needle valves and gate valves shall not be used as appliance shut-off valves. If taper plug cocks are used, they shall be of the spring-loaded type and shall only be used on the low-pressure side of the system.

2.10.12 *LPG appliances*

2.10.12.1 *General*

An LPG appliance shall be installed in accordance with the manufacturer's instructions and AG 601, with sufficient clearance provided around the appliance to prevent overheating of adjacent surfaces and to permit inspection and servicing.

An LPG appliance shall be located such that a fire at the appliance shall not hinder the exit of persons from the space.

2.10.12.2 *Gimballed stoves*

The heeling angles sustained during operation of the vessel shall be taken into account when installing gimballed or half-gimballed stoves. The installation of such stoves shall be in accordance with the following:

- a) The stove shall be connected by a hose assembly.
- b) Limits shall be fitted to minimise the stress imparted onto the hose assembly.
- c) The clearance to combustible surfaces required by Item 2.10.12.2 f) shall be maintained at all positions of the stove.
- d) Means shall be provided to positively retain the stove within the gimbals at all angles of tilt.
- e) Means shall be provided to prevent movement of the stove when not in use.
- f) Non-flammable cladding material (e.g. stainless steel) shall be installed on all surfaces adjacent to the stove for a distance of 300 mm from the stove. The minimum clearance above the stove shall not be less than 600 mm.

2.10.12.3 *Securing*

An LPG appliance shall be secured in place so as to eliminate undue stress on piping, hose and fittings.

2.10.12.4 *Flame supervision and gas detection*

All LPG appliances (including gas lamps) shall either be fitted with flame supervision devices controlling all burners and pilot lights, or the installation shall be fitted with a gas detection system in accordance with Annex A.

2.10.12.5 *Unattended appliances*

All unattended appliances shall be room sealed appliances.

2.10.12.6 *Labelling and marking*

LPG appliances shall be clearly and permanently labelled or marked in accordance with the following:

- a) A label shall be attached to each appliance to indicate that the appliance is suitable for use with LPG. This label shall also refer to the owner's manual.
- b) In addition to the requirements in 2.10.12.6 a), cooking appliances shall also be marked with the following warning, in letters not less than 4 mm in height, which shall be placed in a conspicuous position on or adjacent to the cooking appliance:

WARNING: AVOID ASPHYXIATION. PROVIDE VENTILATION WHEN THE STOVE IS IN USE. DO NOT USE FOR SPACE HEATING.

2.10.12.7 *Heaters installed in exposed positions*

Space heaters and water heaters installed in exposed positions in accommodation spaces shall be installed such that the risk to persons of inadvertent contact with hot surfaces is minimised.

2.10.12.8 *Continuous burning pilot flames*

Appliances with continuous burning pilot flames shall be mounted securely, and shall not be installed below the weather deck.

2.10.12.9 *Gas lamps*

Gas lamps shall be fixed installations.

2.10.13 *LPG supply cylinders*

2.10.13.1 *Design, manufacture and installation*

LPG supply cylinders, cylinder valves, the high-pressure side and the pressure regulator shall, as a complete system, be

- a) designed, manufactured and installed to be readily accessible and capable of withstanding a load on the securing device in any direction equal to four times the weight of the cylinder when full; and
- b) installed with the cylinder valve and outlet uppermost and the pressure regulator fitted as close as practicable to the cylinder.

2.10.13.2 *Pressure regulator*

The pressure regulator shall be mounted directly on the cylinder valve, and—

- a) securely fitted to the cylinder supports; or
- b) securely fitted to the vessel's structure.

Where the pressure regulator is fitted to the cylinder supports [as in Item 2.10.13.2 a)], there shall be ample flexibility in the line connecting the pressure regulator to the vessel's structure. Where the pressure regulator is fitted to the vessel's structure [as in Item 2.10.13.2 b)], there shall be

ample flexibility in the line connecting the cylinder to the pressure regulator.

In both cases, this flexibility shall be achieved either by using hose or by providing a loop or loops in the connecting piping.

2.10.13.3 *Installation and storage of LPG supply cylinders*

LPG supply cylinders shall be stored in one of the following

- a) in a locker;
- b) on the open deck;
- c) on the deckhouse top; or
- d) outside of a locker.

In any event, LPG supply cylinders shall be stored at a distance of at least 1 m from any openings into the vessel.

An LPG supply cylinder shall not, under any circumstances, be installed or stored inside a deckhouse or below deck, unless the cylinder is an integral part of a portable appliance and the total gas storage capacity of the appliance is not greater than 4.5 kg.

2.10.14 Lockers for LPG supply cylinders

2.10.14.1 *Design and construction*

The design, construction and location of lockers for LPG supply cylinders shall be in accordance with the following:

- a) They shall be vapour-tight to the interior of the vessel, and located above the waterline. They shall not be located inside a deckhouse or below decks.
- b) They shall be provided with a vapour-tight cover that can be quickly opened for operation of cylinder valves and testing of the system for leakage. Where the access to the locker is other than at the top, a lower coaming or lip of at least 100 mm deep shall be provided along the full length of the opening.
- c) They shall be vented at the bottom by a drain of at least 25 mm inside diameter, and which shall be led directly overboard to a point lower than the locker but not closer than 230 mm to the designed waterline in the loaded condition. For sailing vessels, the drain outlet shall be located 230 mm above the anticipated sustained heeled waterline.
- d) They shall not have electrical connections or wiring within them. They shall not be used for any purpose other than housing LPG supply cylinders, pressure regulators and safety devices.
- e) In houseboat-type vessels the locker may be inside the deckhouse provided
 - i) it is vapour-tight from the inside accommodation;
 - ii) it has external openings outboard to either the sides or the stern, which shall in turn be fitted with grille- or louvre-type doors; and

- iii) the bottom of the compartment is vented through the floor to the atmosphere.
- f) All hoses or piping penetrating the locker wall shall be sealed so as to maintain vapour tightness to the vessel interior.
- g) The locker drain opening shall be located at least 500 mm from any hull opening to the interior of the vessel.

2.10.15 Ventilation

2.10.15.1 *General*

Ventilation shall be provided in accommodation spaces where open flame appliances without flues are used, or where compartments containing such appliances are connected by open passageways. The design of such ventilation shall take into account the air consumption of the appliance and occupants of the space, and shall allow outside air to pass through fixed openings.

2.10.15.2 *Requirements for ventilation openings*

Any area in a vessel where an appliance other than a room sealed appliance is to be installed shall have at least two openings to the outside.

The openings shall

- a) provide permanent and unrestricted ventilation;
- b) be located on opposite sides or ends of the vessel; and
- c) each have a minimum free ventilation area calculated using the following formula, but in no case shall this area be less than 250 mm²:

$$A = 3 T$$

where:

A = minimum free ventilation area, in square centimetres (cm²)

T = total gas consumption of all appliances in the area, in megajoules per hour (MJ/h)

Ventilation should be supplied by at least two fixed openings of equal size in the compartment. One opening should be located as high as practicable and one should be located as low as practicable. Neither opening shall be fitted with a closing device, and both openings shall be positioned such that they cannot be inadvertently obstructed.

NOTE: Part C Subsection 2A (Loadline Vessels) and Part C Subsection 6B (Intact Stability) of the NSCV specify requirements for openings and should be read in conjunction with this Subsection.

2.10.16 Ducts and flues for air intake and combustion product discharge

2.10.16.1 *General*

Flue components, including ductwork and terminals, shall be of an appropriate size for the appliance. The flue system and air intake duct

system shall be continuous and sealed from the appliance to its terminal outside the vessel.

2.10.16.2 *Installation*

Flue components, ductwork and terminals shall be installed in accordance with the manufacturer's instructions. The entire flue system shall be accessible for inspection.

2.10.16.3 *Location of flue terminals*

Flue terminals for exhaust discharges shall not be positioned within 500 mm of a ventilator, opening port, hatch, window, refuelling fitting or fuel tank vent outlet.

2.10.16.4 *Routing*

Flues shall be routed to ensure all products of combustion are discharged outside the vessel.

NOTE: "Outside the vessel" includes outside any areas that can be enclosed by canopies, as the accumulation of water on a canopy can present a risk of obstruction of the flue.

2.10.16.5 *Shut-off valves*

Shut-off valves (also known as dampers) shall not be installed in flue systems.

2.10.16.6 *Guarding*

Where necessary, flue terminals and exhaust discharge outlets shall be fitted with guards to prevent inadvertent contact by persons. Protective sleeves shall be fitted where a flue passes through combustible material.

2.10.16.7 *Instruction plate*

An instruction plate shall be affixed in a conspicuous position near one of the LPG appliances. The instructions on the plate shall be as follows:

- a) Turn off all appliance shut-off valves and LPG supply cylinder valves during refuelling operations and when the vessel is not in operation.
- b) In the event of an emergency, close all LPG supply cylinder valves immediately.
- c) Close appliance shut-off valves before opening the LPG supply cylinder valves.
- d) Check connections at appliance, pressure regulator and LPG supply cylinders periodically for leaks with soapy water or equivalent.

NOTE: The ammonia present in some soaps and detergents can react with brass fittings and cause such fittings to crack after a period of time. Caution should therefore be exercised when using soap solutions on brass fittings, and all connections should be rinsed thoroughly with fresh water as soon as possible after application of the solution.
- e) Never use matches or naked flames when checking for leaks.
- f) in the event of a gas leak, stop all engines immediately, close all appliance shut-off valves and close LPG supply cylinder valves. Then ventilate the vessel until the air is clear.
- g) Do not stow empty cylinders in the machinery space.
- h) In the event of fire, close the LPG cylinder valves immediately.
- i) Close cylinder valves and fit sealing plugs to all spare cylinders (full or empty) that are not connected.

- j) Permission from the authority must be obtained prior to carrying out additions or alterations to the LPG system.
- k) Additions and alterations should only be carried out by appropriately qualified persons.

NOTE: Refer to legislation for details of licensing requirements for appropriately qualified persons.

- l) Check all permanent ventilators, flues and vents regularly for obstructions.

2.10.17 Compliance certificates and plates

2.10.17.1 *Compliance certificate*

Upon completion of the installation, the installer of the LPG system shall supply the owner of the vessel with a certificate of compliance.

2.10.17.2 *Compliance plate*

A compliance plate shall be attached adjacent to the cylinder installation, and shall contain the following information:

- a) Serial number of plate.
- b) Installer's licence number and date of installation.
- c) Appliance(s) fitted.

CHAPTER 3 LPG SYSTEM TESTS

3.1 SCOPE

This Chapter sets out the criteria and methods for testing the low and high-pressure sides and the burner functions of the LPG installation.

3.2 OBJECTIVE

The Objective of this Chapter is to prove the distribution system integrity for strength and pressure is adequate and suitable for the intended service.

REQUIRED OUTCOMES

3.3 REQUIRED OUTCOMES

The required outcomes in Clauses 2.3 to 2.6 apply to this Chapter.

DEEMED-TO-SATISFY SOLUTIONS

3.4 COMPLIANCE

For the purposes of this National Standard, the requirements for LPG system tests shall be deemed to have satisfied the required outcome in Clause 3.3 if they comply with Clauses 3.5 to 3.7.

3.5 SYSTEM PRESSURE TEST—LOW-PRESSURE SIDE

3.5.1 General

This test shall be conducted prior to charging the system with LPG.

3.5.2 Procedure

The entire low-pressure side, from the pressure regulator connection to the closed burner valves, shall be subjected to an air pressure equivalent to three times the working pressure of the system, but in no case shall this pressure exceed 15 kPa. This test shall be carried out with all appliance shut-off valves open.

3.5.3 Pass criteria

The system shall be deemed sound if, after a period of five minutes (to allow for pressure equilibrium), the pressure remains constant ± 0.5 kPa during the following fifteen minutes.

NOTE: A soap solution may be applied to connections to assist in locating sources of leakage, however it should be remembered that the ammonia present in some soaps and detergents can react with brass fittings and cause such fittings to crack after a period of time. Caution should therefore be exercised when using soap solutions on brass fittings, and all connections should be rinsed thoroughly with fresh water as soon as possible after application of the solution.

3.6 BURNER FUNCTION TEST

3.6.1 General

This test shall be carried out after the system pressure test described in Clause 3.5, but prior to commissioning the LPG system.

3.6.2 Procedure

The system shall be fully charged with LPG. All connected appliances shall be operated simultaneously. Visual checks shall be made to ensure flame lift-off at each burner when all appliance burners in the system are operating. The flame supervision devices at the burners and pilot lights shall also be checked for correct operation.

3.6.3 Pass criteria

The system shall be deemed operable if—

- a) there is flame lift-off at each burner when all appliance burners in the system are operating (this ensures adequate working pressure at each appliance); and
- b) either all flame supervision devices at the burners and pilot lights are functioning properly, or the gas detection system is operating in accordance with Annex A.

3.7 SYSTEM PRESSURE TEST—HIGH-PRESSURE SIDE

3.7.1 General

This test shall be conducted where—

- a) the system is an initial installation; or
- b) the high-pressure side has been repaired or modified.

3.7.2 Procedure

The piping, fittings and joints between the main shut-off valve and the regulator shall be checked for leakage at tank or cylinder pressure using a soap and water solution or other suitable leakage detection method.

NOTE: The ammonia present in some soaps and detergents can react with brass fittings and cause such fittings to crack after a period of time. Caution should therefore be exercised when using soap solutions on brass fittings, and all connections should be rinsed thoroughly with fresh water as soon as possible after application of the solution.

ANNEX A GAS DETECTION SYSTEM

A1 SCOPE

This Annex A provides requirements for the detection of gas. It forms a normative (mandatory) part of this document.

This Annex is referenced in Clauses 2.10.12.4 and 3.6.3 b).

A2 DESIGN

The gas detection system shall

- a) be suitable for use in a marine environment;
- b) be waterproof;
- c) be resistant to corrosion; and
- d) have at least two outlets for connection of external equipment (e.g. gas solenoid valve, audible alarm, bilge blowers, etc.).

A3 PERFORMANCE REQUIREMENTS

The gas detection system must

- a) be capable of continuous operation from a low voltage source (i.e. battery), and shall indicate the operational status of the system within 30 seconds of power being supplied;
- b) activate the alarm function and cause a solenoid valve to close off the LPG supply whenever the concentration of LPG in air exceeds 25 per cent of the lower explosive limit;
- c) incorporate a latching system, which continues to indicate an alarm condition until cancelled;
- d) have fully-serviceable units; and
- e) be self-checking and shall indicate both normal and fault conditions.

A4 INSTALLATION

A gas detection system shall be supplied with full installation and operating instructions. The installation of a gas detection system shall be in accordance with the following:

- a) The system shall be wired directly to a battery via fuses, and shall be protected from exposure to dust.
- b) The solenoid valve shall be suitable for the pressure rating and shall be installed between the LPG supply cylinder and the pressure regulator. In LPG systems where the working pressure is achieved over more than one stage (i.e. the system is fitted with more than one pressure regulator), the solenoid valve shall be installed between the LPG supply cylinder and the first stage pressure regulator.
- c) The alarm shall be positioned to ensure that it is audible from a control station or wheelhouse under normal operating conditions.

- d) A minimum of two sensors shall be fitted. One sensor shall be fitted in the bilge or at the lowest level where leaked LPG would be likely to accumulate, and one shall be fitted in the vicinity of the appliance but below the level of the lowest flame. Each sensor shall have two separate indications at the control panel, as follows:
 - i) A visual indication of whether or not the sensor is operational.
 - ii) A visual indication of an alarm condition.

A5 SYSTEM OPERATION

When gas is detected at or above the minimum set level, the system shall operate as follows:

- a) The LPG supply shall be automatically shut off by the solenoid valve and shall not be able to be reopened until the alarm has been cancelled manually and the system reset.
- b) The audible alarm shall sound.
- c) The visual alarm shall be activated.

A6 MARKING

The gas detection system shall be marked as follows:

- a) All switches in the system shall be clearly and permanently marked to indicate their operational position.
- b) The manufacturer's name and address shall be permanently marked on the fascia of the unit.

NOTE: Adhesive labelling is not considered to be permanent marking.