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Gas installations on marine craft

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Purpose

This document is concerned with the installation and inspection of gas appliances and gas installations on marine craft. It is written in general terms and should be read in conjunction with the appropriate Australian Standards. Gas installations on marine craft are considered complex installations and therefore ESV must be notified of gasfitting work with the submission of a gas application form. The form can be found on the ESV website at **www.esv.vic.gov.au.**

Australian Standards

Standards applied in this document include:

- Australian and New Zealand Standard **AS/NZS 5601.2: 2013** *LP Gas installations in caravans and boats for non-propulsive purposes.* This Standard provides the mandatory requirements and means of compliance for the design, installation and commissioning of LP Gas installations in caravans and boats for non-propulsive purposes.
- Australian Standard **AS 2030.1: 2009** *Gas cylinders—General requirements.* This Standard covers the design, verification and manufacture of gas cylinders for the storage and transport of compressed gas.

These Standards provide greater detail and specific information for marine craft gasfitting.

LP Gas cylinders

Cylinders

Installation

LP Gas cylinders and all high pressure piping on boats must be protected from impact damage to minimise the risk of LP Gas entering the interior of the boat. It is best to install LP Gas cylinders in a cylinder compartment or LP Gas locker; the design and construction of which must comply with the requirements of AS/NZS 5601.2: 2013.

LP Gas cylinders may be installed externally, on the upper deck or cabin top of a boat, but must not be within 1m of an opening into the boat, or cause a hindrance to movement on board the boat. Clearances around cylinders are to comply with AS/NZS 5601.2: 2013.

Multi-cylinder installations

In multi-cylinder installations, service and reserve cylinders should be connected with a common manifold, fitted with non-return valves or changeover valves. This allows one cylinder to be removed without shutting down the gas system. Suitably rated solenoid valves may be used.

Cylinder orientation and restraint

Always install cylinders in an upright position, unless they are specifically designed for horizontal installation with vapour withdrawal.

Cylinders should not be able to move about. Restrain and restrict their movement, but do not allow the restraint to cause undue stress on the cylinder. Store and restrain unconnected or spare cylinders in the same way as connected cylinders.

Cylinders should not be allowed to:

- fall over
- fall upon one another
- be subjected to mechanical shock
- be unsecured during transport or use.

Figure 1: Cylinder restraint

Corrosion protection

Always protect cylinders from corrosion.

Keep cylinders and valves clean and do not allow them to come into contact with oil or grease. Cylinder corrosion issues are especially important for cylinders manufactured from high strength steel as their relatively thin cylinder walls provide little corrosion allowance.

Corrosion may also occur between metal restraint straps and the cylinder. Avoid this sort of corrosion by placing a rubber strip or a similar material between the cylinder and the metal strap.

Cylinder overheating

There is a possibility that gas cylinders situated near a heat source, for example the engine exhaust outlet, may overheat and cause damage. Therefore cylinders should be kept at a safe distance from all heat sources.

If a gas cylinder is placed less than 200mm from a heat source, the cylinder needs to be protected with a heat shield placed at least 25mm from the shielded surface and from the heat source.

In-situ fill cylinders

As a general rule, in-situ fill cylinders must not be installed in a boat. Refer to AS/NZS 5601.2: 2013 for exceptions.

The fill points of in-situ gas cylinders should only be accessible from the boat's exterior and the filling operation should be able to be supervised from the open deck of the boat.

Where a gas cylinder is installed internally, the cylinder and the attached components and fittings should be enclosed in a compartment. The service valve shall be readily accessible in all installation arrangements.

Cylinder compartments and gas lockers

Cylinder compartments and gas lockers shall:

a) be large enough to house the cylinders and their associated equipment

b) allow the safe removal and reconnection of cylinders, including securing the cylinders

c) have sufficient ventilation to prevent a build-up of LP Gas in case of a gas leak.

Refer to AS/NZS 5601.2: 2013 for a full description of the design and construction requirements for compartments and lockers.

Note: Internal access to a cylinder compartment for the removal or replacement of gas cylinders is allowable where an external access point would penetrate the bodywork and cause structural damage to the craft. No more than two 15kg cylinders shall be stored in the compartment and the bottom of the access door shall be no less than 100mm above the compartment floor.

Identify cylinder compartments or lockers with durable identification indicating the storage of LP Gas.

Figure 2, 3 and 4: LPG cylinder compartments and lockers

Figure 5: Label for cylinder compartment or LP Gas locker

Regulators

Make sure all cylinder regulators are installed in a well-ventilated location and attached directly to the structure of the boat. Regulators must be located so the removal or replacement of gas cylinders is not obstructed and so liquid gas can drain back into the cylinder.

Externally fitted regulators must have the vent positioned in such a way as to avoid blockage by contaminants.

Set the regulator outlet pressure to 3.0 kPa with all gas appliances operating simultaneously. This will ensure sufficient supply pressure to each gas appliance.

Always use cylinder regulators with overpressure protection so downstream pressures will not exceed 14 kPa.

Figure 6: This is an example of a non-compliant installation. Liquid gas can not drain back into the cylinder due to the position of the gas pipes.

Piping in boats

Gas pipes in boats need to be of sufficient size so the operation of appliances won't be affected by a pressure drop in any pipe. Pipe material needs to be suitable for its intended purpose and free of defects and installed so that it won't be damaged.

Full details of the requirements for high and low pressure piping, and an explanation of suitable piping materials, is available in AS/NZS 5601.2: 2013.

Installation

Ensure piping is firmly fastened, protected and that all unions and joints are accessible. Piping should be constructed from continuous lengths, from the regulator to branch points and from those points to the appliance. Piping shall be continuous when passing through an engine room or through sleeping accommodation.

Where piping passes through decks or bulkheads the penetration shall be vapour-proof.

In summary piping shall be:

a) secured against vibration

b) protected where it passes through partitions or bulkheads

c) sufficiently flexible to avoid excessive stresses resulting from movement of the boat

d) at least 25mm from any electrical service

e) protected against abrasion, kinking or permanent deformation.

Where rigid piping is installed it should be protected from direct contact with metallic parts of the structure and be at least 100mm from exposed live parts of electrical fittings.

Do not use jointing compounds to compensate for ill-fitting joints and do not apply to compression joints, union joints or POL fittings.

Pipe supports and fixings

Support piping with prefabricated clips of either the same material as, or of a material compatible with, the pipe and fasten with nuts and bolts, rivets or screws.

Supports shall be provided within 150mm of every bend, elbow, tee or branch fitting, excluding loops, and elsewhere at spacings not greater than specified in AS/NZS 5601.2: 2013.

Figure 7: Flexible hose assembly

Hose assemblies

Hose assemblies should be continuous and as short as practicable.

They should only be used between the regulator and rigid piping or between rigid piping and the appliance. Where there is only one appliance involved, a flexible hose can be used between the regulator and the appliance.

Protect hose assemblies from exposure to ultraviolet light. They should be separated by at least 100mm from any part of an engine exhaust system and not subjected to temperatures above 65°C.

Shut-off valves

Each appliance must have a readily accessible (i.e. without the use of a tool) shut-off valve installed (prior to the inlet connection). Valves shall be of a quarter turn type and clearly indicate whether the valve is open or closed. The purpose of the valve should be labelled.

Cylinder connections

The high pressure piping between the cylinder and the regulator shall allow for vibration, either by including a suitable hose assembly between 500mm and 600mm long (with a nominal size of 6mm), or alternatively by providing loops or U-bends in the connecting piping.

Quick-connect devices

Do not install quick-connect devices inside a boat.

Appliances

Requirements

Install all gas appliances in accordance with the manufacturer's instructions.

Always support and secure gas appliances to prevent stressing gas pipe connections and connected piping. The connection of a gas appliance shall not compromise the safety or effectiveness of any existing connected gas appliance. Ensure the structure is capable of supporting the weight of the gas appliance.

Note: All gas appliance burners must be fitted with a flame safeguard system.

Always make sure the area in which you intend to install your gas appliance is free of flammable vapours and chemicals that may corrode the appliance prematurely.

Gas appliances that can be stowed away while still connected to a gas supply must have a means to stop gas flow in the stowed position.

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

Figure 8: Stowed gas appliance

When installing the appliance locate it such that:

a) it may be easily ignited

b) maintenance and adjustments can be performed

c) there is no hazard to the boat or its contents

d) undue restriction to the movement of persons is avoided

e) the risk of harm to persons is minimised

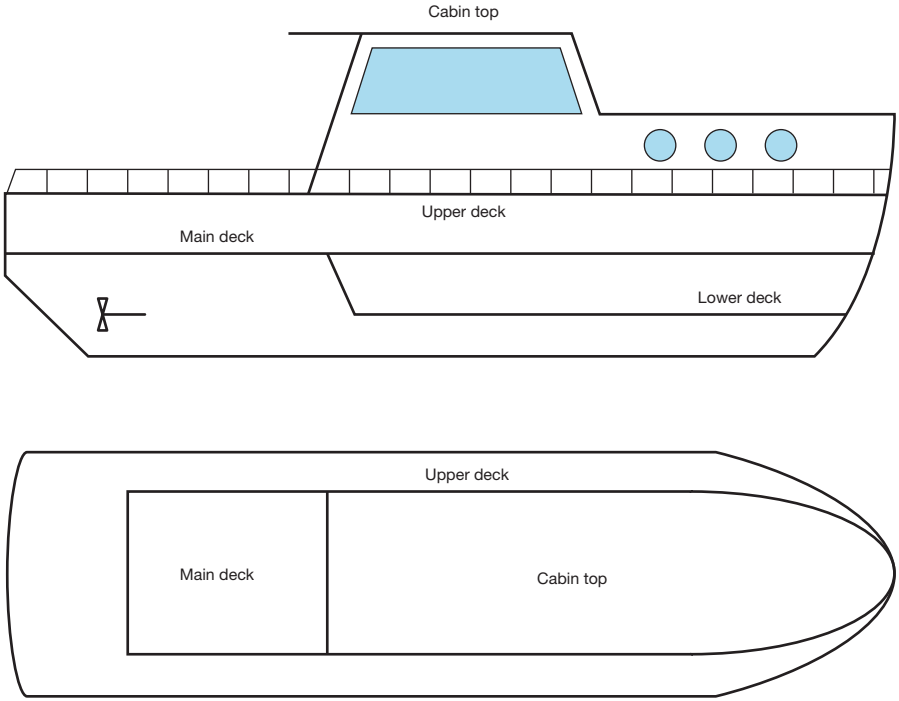
f) risks associated with the storage, use or release of hazardous or flammable substances is minimised.

The electrical supply for gas appliances must have a means of isolation adjacent to the appliance and accessible with the appliance installed. For an appliance exposed to weather the electrical isolation shall be weatherproof or located away from the weather.

Gas appliances fitted with a continuous source of ignition should not be installed within 1m of the fuel filler cap or fuel tank vent, except for boats fuelled by diesel.

Appliances with a continuously burning flame installed below the upper deck of a petrol-fuelled boat must be installed so the air intake to the flame is at least 600mm above the deck on which the appliance is installed. This precaution should be taken wherever there is a possibility of petrol fumes entering the appliance installation area.

Figure 9: Views of a boat showing the various decks



Cooking appliances

Gas cookers should be installed in accordance with the manufacturer's instructions. Refer to AS/NZS 5601.2: 2013 when installation instructions or clearances around gas cooking appliances are not specified.

Always install appliances in an accessible location, with sufficient clearances to allow access to, and removal of, all serviceable components.

Allow sufficient clearance from combustible materials so these surfaces do not exceed 65° C above ambient temperature during operation.

Where a gas cooker is installed on a shelf above a refrigerator the shelf must be sealed so that any leaking cooker gas can't be ignited by the refrigerator.

Gas cooking appliances must have a warning label attached advising users that the appliance should be ventilated when in use and not used for space heating.

If the gas cooking appliance is installed on a gimbal ensure:

- the gas connection is a flexible hose
- limit-stops are fitted to allow movement but minimise hose stresses
- clearances to combustible surfaces are maintained, otherwise a heat deflector will need to be fitted
- the appliance remains within the gimbal at all angles of tilt
- movement is prevented when the appliance is not in use.

Figure 10: LPG cooktop and oven

Figure 11: LPG cooker installed on a gimbal

Space heaters

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

Figure 12: Room-sealed space heater

Refrigerators

Refrigerators should be installed in a sealed recess to stop combustion products from entering the living space. Flues can be inclusive of the venting system supplied by the manufacturer and they must flue to the outside.

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

Figure 13: LPG refrigerator installed in a recess

Instantaneous water heaters

Only install room-sealed type water heaters.

Figure 14: Room-sealed instantaneous water heater

Spa pool water heaters

Pool heaters for boats have a number of specific requirements. They must be installed on a non-combustible base unless otherwise stated in the manufacturer's installation instructions. However, they must not be installed upstream of a filter or pump, downstream of an automatic chlorinator or in an area where pool chemicals or flammable materials are stored.

Where plastic pipes are used for water flow and water return, make sure you connect unlagged metallic water pipe (at least 1m in length) between the plastic pipes and the water heater unless otherwise stated by the heater manufacturer. This will prevent the plastic pipes being affected by residual heat when the pool heater is shut down.

Refer to AS/NZS 5601.2: 2013 for further information including the installation of valves in water flow pipes.

Commercial catering equipment

Australian and New Zealand Standard AS/NZS 5601.2: 2013 does not apply to the installation of commercial catering equipment on boats.

In situations where commercial catering equipment may be installed on a boat refer to Standard AS/NZS 5601.1: 2013 *Gas installations* for installation requirements.

Ventilation

Openings

Boats must have permanent ventilation, comprising at least two openings fitted at the deck head to the underside of the deck or at opposite ends or sides of the cabin. Refer to AS/NZS 5601.2: 2013 for calculating ventilation requirements.

Note: Boat compartments must be adequately ventilated to stop excessive condensation, a build-up of combustion products or other toxic conditions.

Where permanent ventilation cannot be maintained, a carbon monoxide detector with an audible alarm should be installed. Ensure the detector is capable of detecting low concentrations of carbon monoxide (CO).

On recreational boats with a pop-up top, ventilation should be effective whether the top is up or down. Boats with a fully collapsible top need effective ventilation only when the structure is erected.

Ventilation systems

High level and low level ventilation should be provided to ensure adequate air flow. Ventilation assistance may be provided by wind-actuated self-trimming cowls, rotary exhauster heads or by an interlocked fan-assisted ventilation system.

Gas detection

A combustible gas detection system that complies with AS/NZS 5601.2: 2013 should be installed where an appliance with a continuously burning flame is installed below the upper deck and low level ventilation is not available.

Flueing

Flues should be constructed to withstand the effects of the environment. This includes fitting flues with cowls to prevent rain from entering and securing them to withstand boat movement and weather conditions.

Flue materials must comply with the requirements set out in AS/NZS 5601.2: 2013.

Clearances

Flues passing through a wall or a roof must not allow adjacent combustible materials to be heated to temperatures exceeding 50°C above ambient. If this cannot be achieved then fire-resistant material must be fitted and secured to the flue. Where the boat structure includes combustible material, there must be a minimum clearance of 25mm between the flue and the combustible material.

The cross-sectional area of the flue shall be no less than the outlet cross-sectional area of the gas appliance. Flues should not be fitted with dampers.

Flue terminals

Terminal location

Install flue terminals at least 300mm away from an opening window or hatch or an opening port or a ventilator. Flue terminals must not be located within 500mm of a refuelling point or fuel tank vent outlet.

Figure 15 and 16: Flue terminal for IHWS (left) and space heater (right)

Termination under a covered area

Where a flue terminal is installed under a covered area and combustion products may not readily disperse, the covered area should be open on at least two sides with the flue terminal positioned so that air freely flows across it.

For a fan-assisted flue appliance where only one side is open under a covered area, the flue terminal must be within 500mm of that opening and the flue must discharge in the direction of that opening. The flue terminal must be installed so that air will flow across it.

Note: There must be no openings into the boat along the wall within that distance and the terminal shall be located to ensure a free flow of air across it is achieved.

Proprietary flueing systems

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

Testing and commissioning

Gas tightness

A gas tightness test should be carried out on all new installations and modifications to existing installations. Ensure any pressure drop or leakage rate does not exceed a limit specified by the technical regulator.

Commissioning of appliance

Check the appliance is in safe working order by:

- testing and purging the appliance and the installation
- igniting each burner and making adjustments where necessary
- testing the flue's performance
- testing all safety devices
- instructing the consumer on the safe operation of the appliance
- providing the consumer with operating instructions.

When commissioning a gas appliance take into account the appliance's features and safety requirements and the manufacturer's instructions.

Also check that LP Gas locker or cylinder compartment labels are displayed in prominent positions and cylinders and cylinder restraints are in good order.

For further information go to **www.esv.vic.gov.au** or phone the Gas Technical Helpline on **1800 652 563.**

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