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**SANS 10087-6:2023**

Edition 5

## **SOUTH AFRICAN NATIONAL STANDARD**

**The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations**

**Part 6: The application of liquefied petroleum gas as engine fuel for internal combustion engines**

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### Table of changes

Change No.	Date	Scope

### Foreword

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

This document was approved for publication in March 2023.

This document supersedes SANS 10087-6:2006 (edition 4.1).

**This document is referenced in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).**

Reference is made in the introduction to the "relevant national legislation". In South Africa this means the Government, Provincial or Municipal Regulations.

Reference is made in 3.1 and 3.3 to the "relevant national authority". In South Africa this means the Department of Employment and Labour.

Reference is made in 3.10 to the "relevant national legislation". In South Africa this means the Pressure Equipment Regulations.

Reference is made in 6.1.1 to the "relevant national legislation". In South Africa this means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) and National building regulations and Building standards Act, 1977 (Act No. 103 of 1977).

SANS 10087 consists of the following parts, under the general title, *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.*

*Part 2: Installation of LPG systems in mobile units, including but not limited to caravans, motor homes, park homes and mobile kitchens.*

*Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L.*

*Part 4: The transportation of LP gas including the design, construction, inspection, fittings, filling, maintenance and repair of LP gas bulk vehicles and rail tank cars.*

*Part 6: The application of liquefied petroleum gases as engine fuel for internal combustion engines.*

*Part 7: Storage and filling premises for refillable liquefied petroleum gas (LPG) containers of gas capacity not exceeding 19 kg and the storage of individual gas containers not exceeding 48 kg.*

*Part 8: Filling containers for LP gas operated fork lift vehicles in-situ.*

*Part 10: Mobile filling stations for refillable liquefied petroleum gas (LPG) containers of capacity not exceeding 9 kg.*

Annex C forms an integral part of this document. Annexes A, B and D are for information only.

**Compliance with this document cannot confer immunity from legal obligations.**

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## **Introduction**

This part of SANS 10087 represents a minimum standard of good practice and therefore takes the form of guidelines. Compliance with it does not confer immunity from relevant legal requirements (including municipal and other by-laws), and the authority having jurisdiction, i.e. the approving authority (see 3.2) should be approached in circumstances where mandatory requirements are applicable. Should anything in this part of SANS 10087 conflict with the provisions of the relevant national legislation (see foreword), the relevant national legislation (see foreword) take precedence.

Although the standard is based on ECE Regulation 67, it differs slightly from the Regulation in that the standard has been subdivided as follows:

- a) vehicles for LPG;
- b) forklift trucks; and
- c) stationary and portable engines.

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## **The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations**

### **Part 6:**

The application of liquefied petroleum gas as engine fuel for internal combustion engines

## **1 Scope**

**1.1** This part of SANS 10087 covers the safe use of liquefied petroleum gas as a fuel for internal combustion engines and for the safe operation of equipment manufactured for conversions.

**1.2** This part of SANS 10087 does not cover compressed natural gases (CNG) as fuel for internal combustion engines. Refer to SANS 1104.

**1.3** This part of SANS 10087 does not cover the supply of fuel to fixed engine.

**1.4** This part of SANS 10087 does not cover the refuelling of automotive vehicles.

## **2 Normative references**

The following referenced documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 South African Bureau of Standards.

BS 6956-1, *Jointing materials and compounds. Specification for corrugated metal joint rings.*

BS 6956-5, *Jointing materials and compounds. Specification for jointing compounds for use with water, low pressure saturated steam, 1st family gases (excluding coal gas) and 2nd family gases.*

ISO 2928, *Rubber hoses and hose assemblies for liquefied petroleum gas (LPG) in the liquid or gaseous phase and natural gas up to 25 bar (2,5 MPa) – Specification.*

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 1156-2, *Hose for natural gas and liquefied petroleum gas (LPG) – Part 2: Hose and tubing for use in natural gas and liquefied petroleum gas vapour phase.*

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SANS 1253, *Fire-doors and fire-shutters.*

SANS 1825, *Gas cylinder test stations – General requirements for periodic inspection and testing of transportable refillable gas pressure receptacles.*

SANS 10019, *Transportable pressure receptacles for compressed, dissolved and liquefied gases – Basic design, manufacture, use and maintenance.*

SANS 10086-1, *The installation, inspection and maintenance of equipment used in explosive atmospheres – Part 1: Installations including surface installations on mines.*

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 10087-3, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L.*

SANS 10108, *The classification of hazardous locations and the selection of apparatus for use in such locations.*

SANS 20067/ECE R67, *Uniform provisions concerning I. approval of specific equipment of motor vehicles using liquefied petroleum gases in their propulsion system; II. approval of a vehicle fitted with specific equipment for the use of liquefied petroleum gases in its propulsion system with regard to the installation of such equipment.*

### **3 Definitions**

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

#### **3.1**

##### **acceptable**

acceptable to the approving authority

#### **3.2**

##### **approved**

approved by the approving authority or its official representative (see SANS 10019)

#### **3.3**

##### **approving authority**

relevant national authority (see foreword)

#### **3.4**

##### **clearance**

shortest vertical distance between ground level and the bottom of the container or the lowest extremity of the lowest fitting on the container housing

#### **3.5**

##### **confined space**

enclosed, restricted, or limited space in which, because of its construction, location or contents, or any work activity carried on therein, a hazardous substance may accumulate or an oxygen-deficient atmosphere may occur

### **3.6**

#### **container**

gas container that contains gaseous vehicle fuel (LPG) and that:

- a) is permanently secured to a vehicle or to a stationary engine and that is filled while still secured in the permanent position, or
- b) is not permanently secured in the mounted position and that can be readily removed for the purpose of filling

### **3.7**

#### **liquefied petroleum gas**

#### **LPG**

mixture of light hydrocarbons (predominantly propane, propene, butane and butene) that is gaseous under conditions of ambient temperatures and pressure, and that is maintained in the liquid state by an increase of pressure or a lowering of temperature

### **3.8**

#### **motor vehicle**

##### **3.8.1**

##### **category M<sub>1</sub> motor vehicle**

automobile that is used for the carriage of passengers, that has at least four wheels, and that has seating accommodation for not more than eight passengers in addition to the driver of the vehicle

##### **3.8.2**

##### **category M<sub>2</sub> motor vehicle**

automobile that is used for the carriage of passengers, that has at least four wheels, that has seating accommodation for more than eight passengers in addition to the driver of the vehicle, and that has a maximum mass not exceeding 5 t

##### **3.8.3**

##### **category M<sub>3</sub> motor vehicle**

automobile used for the carriage of passengers, that has at least four wheels, that has seating accommodation for more than eight passengers in addition to the driver of the vehicle, and that has a maximum mass exceeding 5 t

##### **3.8.4**

##### **category N motor vehicle**

goods vehicle that has at least four wheels, or that has three wheels and a maximum mass exceeding 1 t

##### **3.8.5**

##### **category N<sub>1</sub> motor vehicle**

automobile that has a maximum mass not exceeding 3,5 t, that has at least four wheels (or provided that the maximum mass exceeds 1 t, at least three wheels), and that is used for the carriage of goods

##### **3.8.6**

##### **category N<sub>2</sub> motor vehicle**

automobile that is used for the carriage of goods and that has a maximum mass of more than 3,5 t but not more than 12 t

##### **3.8.7**

##### **category N<sub>3</sub> motor vehicle**

automobile that is used for the carriage of goods and that has a maximum mass exceeding 12 t

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#### 3.8.8

##### **minibus**

motor vehicle that is designed or modified solely for the conveyance of not more than 13 seated passengers in addition to the driver of the vehicle, and that does not provide for the carriage of standing passengers

#### 3.9

##### **operating pressure**

maximum gauge pressure that is permitted in a container when in use

#### 3.10

##### **registered autogas 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 competent in accordance with the requirements of the relevant national legislation (see foreword)

## 4 Retrofitting of vehicles for LPG

### 4.1 General

**4.1.1** When converting a vehicle to use an alternate fuel, the following points shall be addressed:

- a) when the mass of the vehicle has changed by more than 250 kg, the vehicle shall be reregistered on the eNaTIS system;
- b) the vehicle shall be reregistered with eNaTIS for use with alternate fuel; and
- c) when design changes have been done to the chassis or structure of the vehicle (for example, the mounting positions of the seat brackets), such vehicle shall be re-homologated.

**4.1.2** The exhaust gases from a properly adjusted engine burning LPG are practically odourless and will also not irritate the eyes. Although the quantity of carbon monoxide contained in the exhaust gas from a properly adjusted LPG engine is small, care shall be taken to ensure that when the engine is running, the maximum concentration of carbon monoxide in the air for an 8 h exposure in a confined space does not exceed a volume fraction of  $50 \times 10^{-6}$ .

NOTE Typical conversion is given in annex A.

**4.1.3** A vehicle in transit may draw fuel from its cargo vessel provided that the cargo vessel is mounted immediately onto the vehicle and not on the trailer or semi-trailer.

**4.1.4** Where more than one LPG container is installed in a category

- a) M<sub>1</sub>, N<sub>1</sub> motor vehicle or minibus, the combined water capacity in such containers shall not exceed 150 L,
- b) M<sub>2</sub> or N<sub>2</sub> motor vehicle with a maximum mass not exceeding 5 t, the water capacity of such containers shall not exceed 800 L, and
- c) M<sub>3</sub> or N<sub>2</sub> motor vehicle with a mass exceeding 5 t, and N<sub>3</sub> vehicles, the water capacity of the LPG containers shall not exceed 1 100 L (see SANS 20067).

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**4.1.5** All vehicles equipped with permanently mounted LPG containers shall

- a) be fuelled outdoors, and
- b) have fuelling equipment that is suitable for LPG refuelling of vehicles (see SANS 10087-3).

**4.1.6** A container on category M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub> and N<sub>1</sub> motor vehicle shall be designed for permanent mounting on the vehicle. All gas containers shall be installed in such a way that the outside shape of the vehicle does not change. (For example, place gas containers onto the bumper or build a platform for the containers).

**4.1.7** Proprietary equipment shall not be modified.

**4.1.8** The installation shall be carried out by a registered LPG autogas installer. The periodic inspection and maintenance of the gas system on vehicles shall be undertaken by a registered LPG autogas installer. The inspection and service maintenance intervals for the gas system shall not exceed those recommended by the gas system manufacturer.

**4.1.9** Petrol vehicles with more than one fuel system shall

- a) have a fuel selection system to ensure that not more than one fuel is supplied to the engine at any time, and
- b) have a short overlap time to allow switching-over for carburettor vehicles.

**4.1.10** Vehicles may operate with diesel and LPG as a supplement added to the diesel, i.e. a combination fuel system. This system shall not be operated on LPG only. A combination of a gas fuel mix shall be used when operating diesel vehicles with LPG.

**4.1.11** When an engine is converted for the exclusive use of LPG, the original fuel system (including the fuel tank) shall be removed or otherwise so controlled that it cannot be rendered operative inadvertently and any residual fuel shall be removed.

**4.1.12** Welding operations

- a) on fuel lines shall be carried out only after the lines have been rendered gas-free, and
- b) on non-gas parts of a vehicle and in the vicinity of the fuel system, shall not be carried out until the gas supply has been shut-off completely and vented.

**WARNING: Because of the fire and explosion risk involved when LPG is ignited, extreme care should be taken when welding operations or any other hot work are required to be carried out in the vicinity of LPG.**

**4.1.13** The material used in the system shall be compatible and designed for use with LPG.

**4.1.14** All parts of the system shall be fastened in accordance with manufacturers' specifications. See also annex B.

**4.1.15** The LPG system shall be installed such that it has the best possible protection against damage, such as damage due to moving vehicle components, collision, grit or due to the loading or unloading of the vehicle or the shifting of such loads.

**4.1.16** No appliances or components shall be connected to the LPG system other than those strictly required for the proper operation of the vehicle's engine.

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**4.1.17** An LPG container shall be so positioned as to minimize the possibility of damage to the container and its fittings.

**4.1.18** There shall be no gas conveying connections in the passenger compartment or enclosed luggage compartment with the exception of

- a) the connections on the gas-tight housing, and
- b) the connection between the gas tube or hose and the filling unit if this connection is fitted with a sleeve that is resistant to LPG and installed such that any leaking gas is discharged direct to the outside of the vehicle .

**4.1.19** In all other cases, except for those stated in 4.1.18, where the container is installed inside a passenger-conveying vehicle

- a) the container, connections and associated piping (including the extended filler and relief valve), shall be enclosed in a fixed compartment,
- b) the valves of the container shall be in a gas-tight housing, and
- c) the venting sleeve connection shall be secured and airtight.

**4.1.20** In addition, the compartment (see 4.1.19) shall be vented (at its lowest point) to the outside of the vehicle.

**4.1.21** The compartment shall be constructed of impervious material that is not normally susceptible to physical damage.

**4.1.22** No component of the LPG system shall be located within 100 mm of the exhaust system or similar heat source, unless such components are shielded against heat.

**4.1.23** No component of the LPG system, including any protective materials that form part of such components, shall project beyond the external surface of the vehicle. The LPG unit filling point shall be placed in the same compartment as the fuel filling point if possible.

NOTE Because of the gas-tight design of the housing on the filler container there is no specific need to isolate the container from possible sources of ignition.

**4.1.24** The clearance between an LPG container and ground level shall

- a) be as large as practicable, and
- b) not be less than the minimum road clearance of the lowest part of the main structure of the vehicle under maximum spring deflection.

**4.1.25** A container shall be securely mounted on the vehicle to prevent it from jarring loose, slipping or rotating. It shall be designed and constructed with a minimum safety factor of four, based on applied forces of ten times the mass of the filled container in the longitudinal (along the length of the vehicle) direction and twice the mass of the filled container in all other directions.

**4.1.26** LPG fuelled M<sub>2</sub>, M<sub>3</sub> and N category vehicles shall be identified and marked in accordance with the requirements given in annex C.

## **4.2 Containers for vehicles**

### **4.2.1 General**

Containers intended for use on vehicles shall comply with a standard approved for this purpose (see also SANS 10019 and SANS 20067).

### **4.2.2 Installation of the container**

**4.2.2.1** The container shall not be installed in the engine compartment.

**4.2.2.2** The permanent container shall be installed in the correct operating position, in accordance with the manufacturer's instructions.

**4.2.2.3** Care shall be taken to ensure that there is no metal-to-metal contact between the container and the body of the vehicle other than the fixing points.

**4.2.2.4** The container shall

- a) have permanent fixing points to secure it to the motor vehicle, or
- b) be secured to the motor vehicle by a container frame and container straps.

**4.2.2.5** If more than one LPG container is connected to a single delivery tube,

- a) each container shall be fitted with a non-return valve installed downstream of the remotely controlled service valve,
- b) a tube pressure relief valve shall be installed in the delivery tube, downstream of the non-return valve, and
- c) an approved strainer system shall be placed upstream of the non-return valve(s) to prevent fouling of the non-return valve(s).

**4.2.2.6** A non-return valve and tube pressure relief valve shall not be required if the backflow pressure of the remotely controlled service valve in the closed position exceeds 500 kPa.

In that case the control of the remotely controlled service valve shall be constructed such that it is impossible for more than one remotely controlled valve to be open at any time. The overlap time to allow switching shall not exceed 2 min.

When the system is fitted with a relief valve as part of the multi valve on the tank and a relief valve on the vapour riser/reducer the above non-return valve and tube pressure relief valve is also not required.

**4.2.2.7** The container shall be mounted such that the effectiveness of any vehicle crumple zone is not impaired.

**4.2.2.8** Where possible, the container shall be located centrally in the vehicle to balance the weight distribution of the vehicle.

**4.2.2.9** The container shall be so located as to minimize the possibility of damage to the container and its fittings.

**4.2.2.10** When the container is installed on the back of a light delivery vehicle or truck that might be used for the conveyance of passengers or goods, and whether such a vehicle is fitted with a canopy or not, the container shall be protected by an enclosed fixed compartment to prevent unauthorized access to the container valves or damage to the container.

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### **4.3 Filling operation**

**4.3.1** A container installed inside a passenger-conveying vehicle (i.e. in the luggage compartment of the vehicle or elsewhere) shall be filled only through an extended filler tube.

**4.3.2** The inlet of the filler tube on a passenger vehicle (see 4.3.1) shall be mounted in the same location as the original filler point of the vehicle where possible.

**4.3.3** In all types of vehicle the filling point shall

- a) not protrude more than 10 mm beyond the nominal line of the body panel,
- b) not be in the passenger or enclosed luggage compartment, and
- c) be protected from any dirt and water.

**4.3.4** The volume of liquefied petroleum gas (LPG) filled into any container shall not exceed 80 % of the volume of the container.

**4.3.5** Filling shall be carried out in accordance with the relevant recommendations of SANS 10087-3. Where filling adaptors are to be used, they shall be designed to comply with the filling nozzle as found in the dispensing nozzle. Adaptors shall not be modified and shall not release more than 5 mL amount of gas when disconnected.

### **4.4 Container valves and accessories**

#### **4.4.1 General**

**4.4.1.1** The LPG equipment as installed in the vehicle shall function in such a manner that the maximum operating pressure for which it has been designed and approved cannot be exceeded.

**4.4.1.2** Container valves, connections and piping shall, where reasonably practical, be protected to prevent damage caused by accidental contact with stationary objects or by loose objects thrown up from the road.

**4.4.1.3** All valves shall be safeguarded against damage caused by collision, overturning or any other accident to the vehicle.

**4.4.1.4** Container valves and accessories shall not be manufactured of cast iron.

**4.4.1.5** Safety valves shall comply with the requirements given in 4.8.

**4.4.1.6** All components and fitment procedure shall comply with the relevant requirements of SANS 20067 (LPG) or Underwriters Laboratories (UL) listed components.

#### **4.4.2 Filling connections**

**4.4.2.1** Each filling connection shall be fitted with a double-seated back-pressure check valve or a positive shut-off valve used in conjunction with a back-pressure check valve.

**4.4.2.2** Filling connections shall be used as shown in figure 1.



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**Figure 1 — Recommended LPG filling nozzle**

### **4.4.3 The LPG system**

**4.4.3.1** An LPG system shall contain at least the following components:

- a) a container;
- b) a manual shut-off valve;
- c) an 80 % stop valve (LPG);
- d) a gas level indicator;
- e) a pressure relief valve;
- f) a remotely controlled service valve with an excess flow valve;
- g) a pressure regulator and vaporizer, which may be combined (LPG);
- h) a remotely controlled shut-off valve;
- i) a filling unit;
- j) gas tubes and hoses;
- k) gas carrying connections between the system components;
- l) an injector, gas-injection device or gas-mixing piece;
- m) an electronic control unit for fuel injection systems;
- n) an electric safety protector (fuse); and
- o) a change-over switch.

**4.4.3.2** The system shall include a gas-tight housing that covers the accessories fitted to the container for all installations in enclosed spaces. See also 4.1.19.

**4.4.3.3** Only compatible components that comply with this part of SANS 10087 shall be used when installing, servicing or replacing a gas component on a converted vehicle.

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**4.4.3.4** All components of the gas system shall be fitted in accordance with the manufacturer's recommendations and be compliant with this part of SANS 10087.

#### **4.4.4 Accessories to the container**

##### **4.4.4.1 Remotely controlled service valve with excess flow-valve on the container**

**4.4.4.1.1** The remotely controlled service valve with excess flow valve shall be installed direct to the container, without any intervening fittings.

**4.4.4.1.2** The remotely controlled service valve with excess flow-valve shall be controlled such that

a) it is automatically closed when the engine is not running, irrespective of the position of the ignition switch, and

b) it remains closed as long as the engine is not running.

##### **4.4.4.2 Spring loaded pressure relief valve in the container**

The spring loaded pressure relief valve

a) shall be installed in the container in such a manner that it is connected to the vapour space and can discharge to the surrounding atmosphere, and

b) may discharge into the gas-tight pressure housing if that gas-tight housing complies with the requirements of 4.4.4.5.

##### **4.4.4.3 80 % stop valve (LPG systems)**

The automatic filling level limiter shall be

a) suitable for the container it is fitted to, and

b) installed in the appropriate position to ensure that the container cannot be filled to more than 80 % of its water capacity.

##### **4.4.4.4 Gas level indicator**

The level indicator shall be

a) suitable for the container it is fitted to, and

b) installed in the appropriate position.

##### **4.4.4.5 Gas-tight housing on the container**

**4.4.4.5.1** A gas-tight housing that complies with the requirements of 4.4.4.5.2, 4.4.4.5.3 and 4.4.4.5.6 shall be fitted to the container.

**4.4.4.5.2** The gas-tight housing shall be vented to the atmosphere by the use of two connecting hoses positioned in such a manner that one hose forces air into the housing and the other hose draws air out of the housing.

**4.4.4.5.3** The ventilation opening of the gas-tight housing shall

- a) point downwards at the point of exit from the motor vehicle,
- b) not discharge into a wheel arch, or
- c) not be aimed at the heat source such as the exhaust.

**4.4.4.5.4** Any connecting hose and lead-through in the bottom of the bodywork of the motor vehicle for ventilation of the gas-tight housing shall have a minimum clear opening of 450 mm<sup>2</sup>.

**4.4.4.5.5** If a gas tube, or any other type of tube or any electrical wiring is installed in the connecting hose and hose outlet connections in the bottom of container compartment, the clear opening shall also be at least 450 mm<sup>2</sup>.

**4.4.4.5.6** The gas-tight housing and connecting hoses shall be gas-tight at a pressure of 10 kPa with the apertures closed off, and shall show no permanent deformation.

**4.4.4.5.7** The connecting hose shall be secured in a proper way to the gas-tight housing and the hose outlet connections in the bottom of container compartment to ensure that a gas-tight joint is formed.

## **4.5 Piping, fittings and other components**

### **4.5.1 Materials control**

Materials used in the pipe system shall comply with at least the requirements given in the appropriate clauses of the following standards:

- a) seamless steel pipes and fittings: SANS 62-2;
- b) copper tubes SANS 460;
- c) flexible tubing or hose SANS 1156-2; and
- d) jointing compounds BS 6956-1 and BS 6956-5.

### **4.5.2 Liquid fuel pipeline**

The bore of a liquid fuel pipeline shall be large enough to ensure the effective and continual operation of the relevant excess-flow valve (see 4.4.4.1) in case of fracture or disconnection of the pipeline.

### **4.5.3 Steel tubing**

Steel tubing shall be externally protected against corrosion.

### **4.5.4 Fuel lines installation**

Fuel lines shall

- a) be so installed, braced and supported as to minimize the effects of vibration, strain and wear,
- b) have clearances between them and components of the exhaust system and sources of electrical hazards that are acceptable, and
- c) include a flexible connection between the mountings on the vehicle chassis and the engine.

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### **4.5.5 Length of flexible hose**

Flexible hoses between any parts of the fuel system that are mounted on the body or chassis of a vehicle and parts that are mounted on the engine, shall be as short as possible to allow for vibration of and relative movement between parts.

### **4.5.6 Jointing material and testing for leaks**

**4.5.6.1** A suitable thread sealing compound shall be used on all gas threads. The following are examples of suitable materials:

- a) PTFE-tape;
- b) PTFE-liquid;
- c) Buna-N; and
- d) fluoroelastomer.

**4.5.6.2** All fuel system connections, the container and its valves and fittings shall, when first assembled (and thereafter when deemed necessary), be tested for leaks by using a soap and water (or equivalent) solution while the system is subjected to

- a) equipment at a container pressure of  $1\,400\text{ kPa} \pm 10\text{ kPa}$ , or
- b) equipment at a regulated pressure of 1.25 times normal operating pressure (see annex D).

### **4.5.7 Protection of valves and connections**

In the case of a removable container, the protection for valves and connections shall be

- a) permanently attached to the container, and
- b) so designed and fitted as to protect the valves and connections against damage during removal, filling and re-installation of the container.

## **4.6 Remotely controlled shut-off valve**

**4.6.1** A remotely controlled shut-off valve shall be installed in the gas tube from the LPG container to the pressure regulator, as close as possible to the pressure regulator.

**4.6.2** Notwithstanding the requirements of 4.6.1, the remotely controlled shut-off valve may be installed at a location in the engine bay specified by the manufacturer of the LPG system.

**4.6.3** The remotely controlled shut-off valve shall be installed such that the fuel supply is cut off when the engine is not running or, if the vehicle is also equipped with another fuel system, when the other fuel is selected. A delay of 2 s is permitted for change-over and diagnostic purposes.

## **4.7 Filling connection**

The filling connection shall

- a) be secured against rotation,
- b) be protected against dirt and water,

- c) be fitted away from the crumple zone of the vehicle, and
- d) not be permitted in the passenger or luggage compartment, or the inside of the goods-carrying area of an open-back vehicle.

## **4.8 Safety devices**

**4.8.1** Each liquid discharge type container shall be provided with at least one acceptable spring-loaded internal type safety-relief device.

**4.8.2** A vapour withdrawal type container shall be furnished with an approved safety-relief valve, which shall be mounted on the container or on the container valve.

**4.8.3** Safety-relief devices on containers shall be in accordance with the design requirements of the container.

**4.8.4** When a discharge line from a safety-relief device (other than a gas-tight housing) is used it shall be

- a) of metal or of the flexible metallic type (in both cases, other than aluminium and brass),
- b) of such size and location and so maintained as not to be restricted to below the required minimum flow of gas from the safety-relief device, and
- c) capable of withstanding the pressure resulting from the discharge of vapour when the safety-relief device is fully open.

### **4.8.5 Shut-off valves**

- a) shall be provided in the fuel system at a point between the container and the first-stage regulator, or the inlet of the gas-air mixer,
- b) shall be so designed as to prevent the flow of fuel to the engine when the ignition is off or when the engine has stopped (see 4.6.3), and
- c) shall, in the case of industrial trucks, be controlled by an automatic switch (such as an oil pressure switch or a vacuum switch), which shall be adequate to control the load.

**4.8.6** In the case of a liquid withdrawal system, a suitable hydrostatic-relief valve set to discharge at a pressure not higher than 2 700 kPa and not lower than 2 580 kPa and having its outlet outside the vehicle, shall be installed between the container shut-off valve and the automatic shut-off valve.

## **4.9 Vaporizing, regulating and mixing equipment**

**4.9.1** Vaporizers, regulators, filters and other fuel system components shall be approved and designed for use with LPG fuel and shall be capable of withstanding the maximum pressure likely to be encountered in service.

**4.9.2** Unless the vehicle cooling-system drain serves this purpose, each vaporizer shall have a valve or suitable plug (located at or near the lowest point of the section occupied by water or other heating medium) which will permit complete draining of the vaporizer.

**4.9.3** Each vaporizer shall be issued with a certificate that includes the following information:

- a) the design pressure; and
- b) the number of the standard in accordance with which it was manufactured.

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**4.9.4** Exhaust gases shall not be used as a direct means of heat supply for the vaporization of the fuel.

**4.9.5** Vaporizers shall not be equipped with fusible plugs.

**4.9.6** Automatic pressure-reducing equipment shall be installed in a secure manner between the container and the engine (for the purpose of reducing the pressure of the fuel delivered to the engine).

**4.9.7** All fuel-system components shall be securely fastened to the vehicle in a manner that will prevent displacement or loosening of the components (because of vibration or any other causes).

**4.9.8** The gas-air mixer shall be provided with a backfire deflector that will prevent the emission of hazardous flames under backfire conditions.

**4.9.9** An oil-bath type or a dry element type of air cleaner shall be considered to be a backfire deflector.

**4.9.10** If an oil-bath type of backfire deflector is used, suitable baffles or other means shall be provided to prevent the impingement of the oil on the engine or on components of the electrical or exhaust systems.

**NOTE** The purpose of the backfire deflector is to minimize the propagation of carburettor backfire flames that may ignite combustible materials present in the engine compartment. A backfire deflector should not be interpreted as being a flame arrester, which is a device for preventing ignition of combustible gases on the outside of the vehicle and which is attached to the exhaust system.

**4.9.11** The source of air for combustion shall be completely isolated from the passenger compartment, the ventilating system and (when relevant) the air-conditioning system.

## **4.10 Fuel-selection system and electrical components**

**4.10.1** The electrical components of the LPG-system shall

- a) be protected against overloads, and
- b) have at least one separate fuse provided in the supply cable.

**4.10.2** The fuse (see 4.10.1) shall be installed in a known location where it can be reached without the use of tools.

**4.10.3** The electrical power supply to LPG system components shall not be secured or attached to a gas pipe.

**4.10.4** The electrical connections and components in the gas-tight housing shall be constructed such that no sparks are generated.

## **4.11 Service workshops for LPG-fuelled vehicles**

**NOTE** for additional information, see NFPA 58.

**4.11.1** An LPG-fuelled vehicle may be stored and serviced inside a garage provided that there is cross ventilation at floor level.

**4.11.2** The container shut-off valve of an LPG-fuel vehicle that is being repaired in a garage shall be kept closed except when fuel is required for engine operation.

**4.11.3** A vehicle that has a permanently mounted container shall be refuelled outdoors.

## **4.12 Parking of LPG-fuelled vehicles**

NOTE for additional information see NFPA 58.

LPG-fuelled vehicles shall not be parked near sources of heat, open flames, or similar sources of ignition, or near open pits, unless they are adequately ventilated. These vehicles shall not be parked in basements or underground parking bays.

## **4.13 instructions to users for new installations**

### **4.13.1 Instructions to users**

The registered autogas practitioner or authorized company representative shall supply the user with a printed instruction sheet or booklet describing the correct and safe handling of the LPG systems and appropriate general emergency procedures.

All the details in this subclause and 4.13.2 shall be discussed with the user to ensure that he/she fully understands the intention of these details. His/her attention shall also be drawn to the information and warnings (when relevant) given in the product brochures supplied.

### **4.13.2 Repairs and maintenance**

Service, maintenance or repair work (or both) on autogas systems may only be carried out by a registered autogas practitioner.

## **5 Forklift trucks**

### **5.1 General**

**5.1.1** A container on a fork lift truck and similar vehicle that does not operate on a public road may be permanently mounted or removable.

**5.1.2** A removable container shall be provided with effective valve guards and shall be so designed that it can be secured easily and effectively on a vehicle.

NOTE This requirement does not apply to containers on ordinary domestic or industrial type mobile equipment (for example sweepers).

**5.1.3** Containers with appurtenances attached to the top dished end shall be designed to engage with a positioning pin on the vehicle. This shall apply to LPG containers only.

**5.1.4** Containers with appurtenances attached to the shell shall rest on a cradle.

**5.1.5** When removable containers are used, means shall be provided in the fuel system to minimize the release of fuel when the containers are exchanged. This shall be achieved by the use of an automatic quick closing coupling in the fuel line, i.e. a type in which both halves (portions) close automatically when uncoupled (see also annex D).

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### **5.2 Installation requirements**

**5.2.1** Containers intended for use on forklift trucks shall comply with standards approved for this purpose (see SANS 10019).

**5.2.2** Revalidation and inspection of containers shall be in accordance with SANS 1825.

**5.2.3** On a removable container, the filler valve may be a hand-operated shut-off valve combined with an excess-flow valve.

**5.2.4** A flexible hose between a removable container and any fixed fuel system shall be of sufficient length to allow for vibration of and relative movement between parts and shall comply with the requirements of ISO 2928.

**5.2.5** Components and installation shall also be in accordance with the requirements given in clause 4.

## **6 Stationary and portable engines in buildings**

### **6.1 General**

**6.1.1** All buildings housing a gas driven engine shall comply with the appropriate requirements of the relevant national legislation (see foreword).

**6.1.2** The gas installation supplying such engine shall comply with the appropriate requirements of SANS 10087-1 and SANS 10087-3, as applicable.

**6.1.3** A container from which only vapour is to be withdrawn shall be so installed and equipped with suitable connections as to minimize the danger of the accidental withdrawal of liquid.

**6.1.4** Regulators and safety-relief devices on an engine installed in a building shall, when they include built-in pressure relieve devices, be vented to the outside, and the point of discharge should be at least 1,5 m away from any building opening. Such venting is not necessary in the case of an engine that has a combination of a fuel-vaporizing, fuel-pressure-reducing and fuel-metering device, provided that an automatic shut-off valve is installed immediately ahead of the device.

**6.1.5** Each vent pipe shall be fitted with a captive, loosely fitting rain cap.

**6.1.6** A length of flexible hose (not exceeding 1,0 m) in accordance with ISO 2928, shall be so installed between the engine and the fuel line as to eliminate the possibility of damage to the fuel line caused by engine vibration.

**6.1.7** Electrical installations in a room in which a gas driven engine is used or installed shall comply with the requirements of SANS 10086-1 and SANS 10108.

**6.1.8** Components and installation shall also be in accordance with the requirements given in clause 4.

### **6.2 Separated Structures and Buildings**

**6.2.1** For a structure or building to be considered separated it shall share no wall or roof with another structure or building.

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**6.2.2** The structure or building shall comprise of a single storey only; with walls, roofs, ceilings and floors as the case may be, being non-combustible; and shall either have

- a) lightweight walls, ceilings and roof designed for explosion venting; or
- b) where the walls and roof are of heavy construction, such as solid brick masonry, reinforced concrete, or concrete block, be provided with explosion venting windows of at least 0,1 m<sup>2</sup> for each 1,4m<sup>3</sup> of enclosed volume.

**6.2.3** The floor shall not be below ground level.

**6.2.4** Where a space is created under such floor it shall be filled with solid infill or the perimeter shall be left fully open.

**6.2.5** The structure or building shall be suitably ventilated to prevent an explosive atmosphere from forming by using air inlets and outlets, the bottom of which shall be not more than 150 mm above the floor, and such ventilation shall be provided in accordance with the following:

- a) where mechanical ventilation is used, the rate of air circulation shall be at least 0,3 m<sup>3</sup>/min/m<sup>2</sup> of floor area, and outlets shall discharge at least 1,5 m from any opening into the structure or any other structure; or
- b) where natural ventilation is used, each exterior wall shall be provided with one opening per every 6,1 m of length and each opening shall have a minimum size of 32,25 mm<sup>2</sup> and the total of all openings shall be at least 6900mm<sup>2</sup>/m<sup>2</sup> of the floor area.

### 6.3 attached structures and buildings

**6.3.1** For a structure to be considered attached, it shall share no more than 50 % of its perimeter with another structure or building.

**6.3.2** Attached structures shall be constructed in accordance with 6.2.2 to 6.2.4 (inclusive)

**6.3.3** Any common wall shall comply with the following:

- a) have fire resistance of at least 120 min;
- b) be designed to withstand a static pressure of at least 4,8 kPa; and
- c) any opening into another section of the building shall be protected with an appropriate fire door or shutter complying with SANS 1253.

### 6.4 Rooms within structures and buildings

**6.4.1** Rooms within structures shall be any room where common walls exceed 50 % of the room perimeter.

**6.4.2** Rooms within structures shall only be located on the ground floor and shall have at least one exterior wall with unobstructed free vents for freely releasing explosion pressures.

**6.4.3** Walls, roofs, ceilings and floor as the case may be, shall be non-combustible.

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**6.4.4** Exterior walls and ceilings shall be of lightweight material designed for explosion venting or where the walls and roof are of heavy construction, such as solid brick masonry, reinforced concrete, or concrete block, it shall be provided with explosion venting windows of at least 0,1 m<sup>2</sup> for each 1,4 m<sup>3</sup> of enclosed volume.

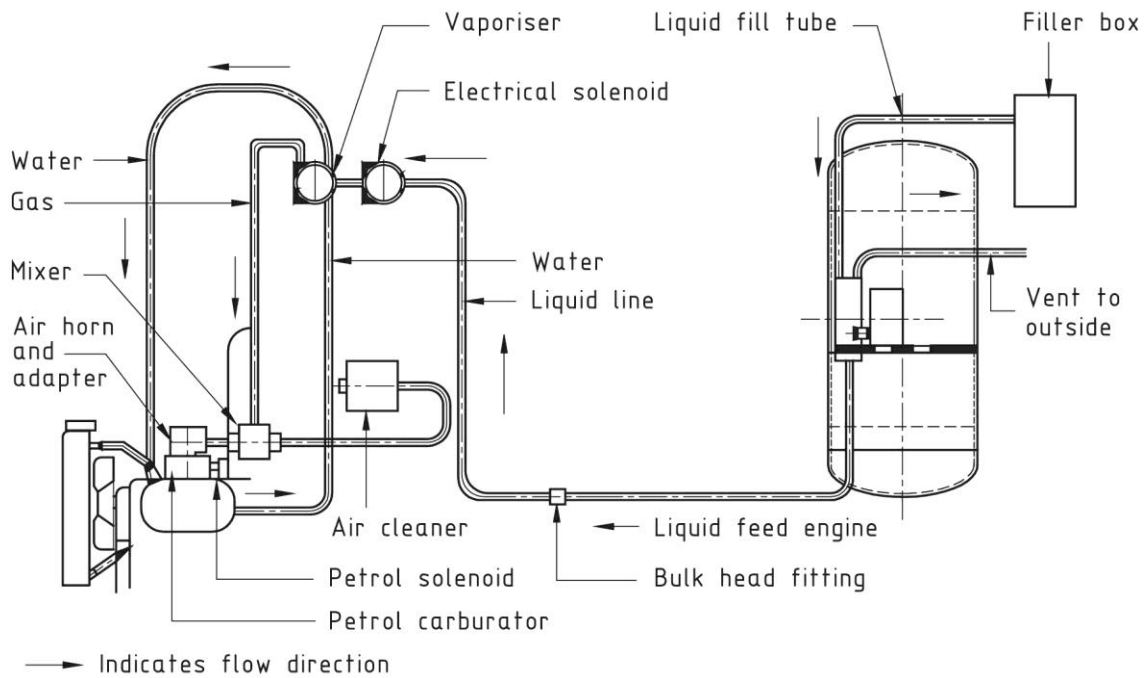
**6.4.5** Walls and ceilings common to the room and the structure in which it is constructed shall comply with the following:

- a) have fire resistance of at least 120 min;
- b) be designed to withstand a static pressure of at least 4,8 kPa; and
- c) any opening into another section of the building shall be protected with an appropriate fire door or shutter complying with SANS 1253.

### Annex A (informative)

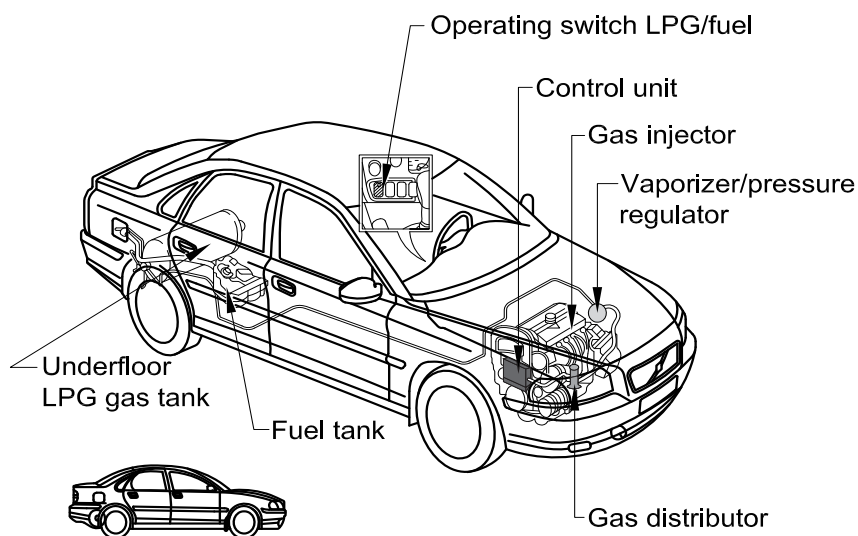
## Typical conversion of a petrol engine

Figures A.1 and A.2 show how to change a petrol-operated engine to operate on LPG fuel.



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Figure A.1 — Typical conversion of a petrol engine (carburetion system)



Drg.954b

Figure A.2 — Typical conversion of a combustion engine using fuel injection system

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### Annex B

(informative)

#### Design guidelines for container mounting

**B.1** Container(s) should be removed for statutory examination without undue dismantling or risk of damage to the vehicle.

**B.2** The mountings should provide location for the containers such that in a survivable accident the containers do not become detached nor have potential to cause injury. This applies to containers mounted internally or externally to the vehicle.

**B.3** At least four points of attachment should be provided for each container, spread as far apart as possible and arranged to give equal loading at each point of attachment.

**B.4** Each mounting point should be reinforced in order to prevent “pull-through” or tearing of the mounting points when the container is subjected to design loads.

**B.5** The guidelines of this annex should be deemed to be met if the container is secured to the motor vehicle by at least

- a) two straps per container,
- b) four bolts,
- c) an appropriate number of washers or plates if the body panels at that location are of single thickness, and
- d) between strapping and container appropriate material should be used to prevent any damage or direct contact between the strapping, bracket and container.

**B.6** When using material of grade Fe 370, the fixing bolts should be of class 8.8 of SANS 1700-5-1 and have the dimensions specified in table B.1.

**Table B.1 — Fixation of LPG containers**

1	2	3	4
Container content L	Minimum dimensions of the washer or plates mm	Minimum dimensions of the container straps mm	Minimum diameter of bolts mm
Up to 85	round: 30 × 1,5 round: 25 × 2,5	20 × 3 30 × 1,5	8
85 to 100	round: 30 × 1,5 round: 25 × 2,5	30 × 3 20 × 3 <sup>1</sup>	10 8 <sup>a</sup>
100 to 150	round: 50 × 2 round: 30 × 3	50 × 6 50 × 3 <sup>2</sup>	12 10 <sup>b</sup>
More than 150	Provisions of SANS 20067 for LPG containers.		
<sup>a</sup> In this case the container should be secured by at least three container straps.			
<sup>b</sup> In this case the container should be secured by at least four container straps.			

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### **B.7** Reinforcements should

- a) spread the loads unto the existing load bearing areas of the vehicle (i.e. the under-frame longitudinal, cross-members, sills, suspension pick-up points and the like), and
- b) be contoured to the vehicle surfaces against which they bear.

**B.8** When fasteners pass through hollow sections, anti-crush tubes should be provided.

**B.9** The materials used for the construction of container mountings should be non-corrodible or coated to current automotive standards with an anti-corrosion treatment, the treatment not being subject to damage during the container installation process.

**B.10** A container should be securely mounted on the vehicle to prevent it from jarring loose, slipping or rotating. The fastenings should be designed and constructed with a minimum safety factor of four, based on applied forces of 10 times the mass of the filled container in the longitudinal (along the length of the vehicle) direction and twice the mass of the filled container in all other directions.

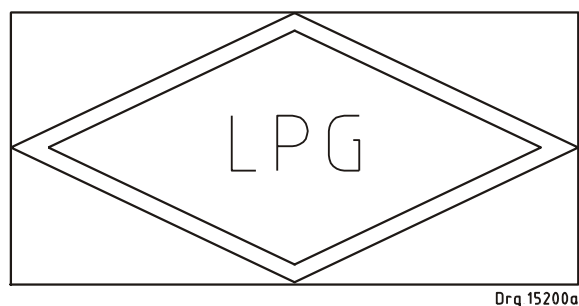
**B.11** Regular checking of the tightness and freedom from corrosion of all container fastenings and reinforcements should be carried out during maintenance procedures.

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**Annex C**  
(normative)

**Provisions regarding LPG identification  
of M<sub>2</sub>, M<sub>3</sub> and N category vehicles**

**C.1** The vehicles shall bear the sign as illustrated in figure C.1.



**Figure C.1 — Vehicle identification sticker**

**C.2** The sign shall consist of a sticker that is weather resistant.

**C.3** The colour and dimensions of the sticker shall comply with the following requirements:

a) Colours:

- 1) Background: green;
- 2) Border: white; and
- 3) Letters: white.

b) Dimensions:

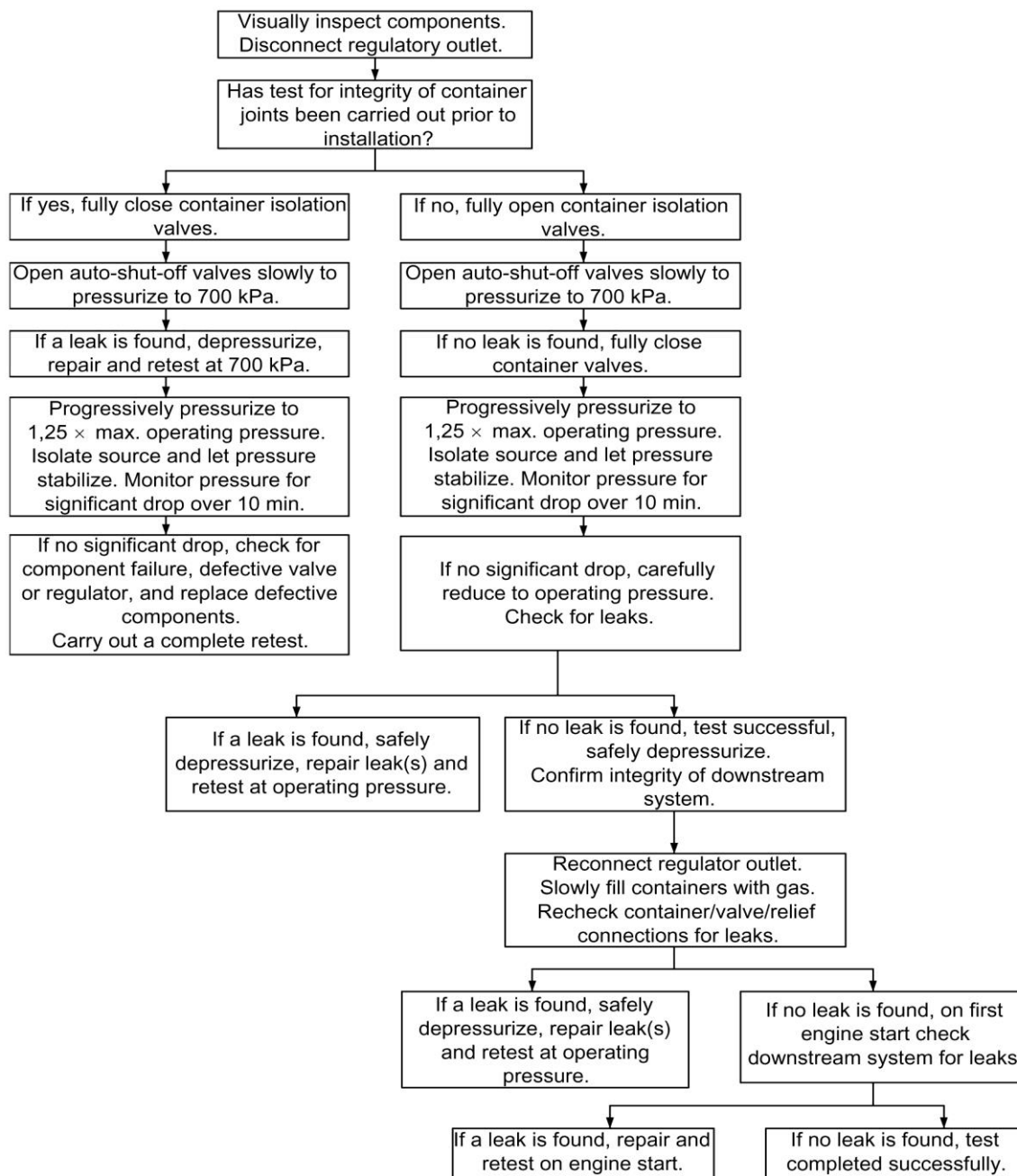
- 1) Border width: 4 mm to 6 mm;
- 2) Character height:  $\geq 25$  mm;
- 3) Character thickness:  $\geq 4$  mm;
- 4) Sticker width: 110 mm to 150 mm; and
- 5) Sticker height: 80 mm to 110 mm.

NOTE The size of the sticker should be relative to the size of the vehicle.

c) The letters “LPG”, shall be centred in the middle of the sticker.

## Annex D (informative)

### Pressure or strength test procedure at a glance



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## **SANS 10087-6:2023**

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*EN 837-1, Pressure gauges – Part 1: Bourdon tube pressure gauges – Dimensions, metrology, requirements and testing.*

*NFPA 58, Liquefied petroleum gas code.*

*SANS 252, Metallic hose assemblies for liquid petroleum gases and liquefied natural gases.*

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