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LPG equipment and accessories — Automotive LPG vehicles workshops

Part 1: Working areas and procedures

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National foreword

This British Standard is the UK implementation of EN 16652-1:2016.

The UK participation in its preparation was entrusted to Technical Committee PVE/19, LPG containers and their associated fittings.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

European foreword

This document (EN 16652-1:2016) has been prepared by Technical Committee CEN/TC 286 “Liquefied petroleum gas equipment and accessories”, the secretariat of which is held by NSAI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2016, and conflicting national standards shall be withdrawn at the latest by November 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard does not purport to address all of the health and safety risks, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national legislative and regulatory obligations.

Users should perform their own full risk assessment to address all of the health and safety risks, as required by national legislation.

Training and competency requirements for personnel involved in the activities are not included in the scope of this standard but are planned to be addressed in a second part to this European Standard.

This European Standard specifies the requirements for working areas and the procedures for the installation of LPG systems on vehicles and for the repairing and maintenance of vehicles equipped with LPG systems.

This European Standard should be used for aspects not covered by the manuals provided by the manufacturers of LPG vehicles and/or retrofit systems.

Protection of the environment is a key political issue in Europe and elsewhere, for CEN/TC 286 this is covered in CEN/TS 16765 [2] *LPG equipment and accessories - Environmental considerations for CEN/TC 286 standards*, and this Technical Specification should be read in conjunction with this standard.

It is recommended that users develop an environmental management policy. For guidance see EN ISO 14021[3], EN ISO 14024 [4] and EN ISO 14025 [5]. It has been assumed in the drafting of this European Standard that execution of its provisions is entrusted to appropriately qualified and experienced people.

1 Scope

This European Standard sets out the requirements for automotive LPG working areas and procedures, aimed at reducing the risk of fire and explosion of LPG when the following types of work or activity are carried out:

a) equipping vehicles with an LPG system to use LPG for propulsion purposes;

b) maintenance, servicing and repairs to the LPG system;

c) any other LPG vehicle maintenance, servicing or repairs not involving the LPG system.

The operations described in items a) and b) above are undertaken in dedicated LPG working areas, whereas item c) is undertaken in general service working areas.

This Standard does not address how to equip a vehicle with an LPG retrofit system or how to repair or maintain an LPG vehicle.

NOTE Such provisions are normally provided in the instruction manuals issued by the relevant manufacturers.

2 Normative references

Not applicable.

3 Terms and definitions

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

3.1
liquefied petroleum gas
LPG
low pressure liquefied gas composed of one or more light hydrocarbons which are assigned to UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only and which consists mainly of propane, propene, butane, butane isomers, butene with traces of other hydrocarbon gases

Note 1 to entry: For automotive LPG specification, see EN 589 [6].

3.2
competent person
person which by combination of appropriate qualification, training, experience, and resources, is able to make objective judgments on the subject

3.3
contents gauge
device to indicate the liquid level or contents in a pressure vessel

3.4
remote-controlled service valve
device that allows or interrupts the LPG supply to the vaporizer/pressure regulator

3.5
service valve
valve for fluid off-take which is manually operated to provide a leak-tight seal

3.6
gas-free
less than 20 % of the lower explosive limit of LPG in air

3.7
disposal
gas-freeing and discarding LPG pressure vessels either in the form of scrap metal or for use in non-pressure applications

3.8
purging
displacing LPG with a non-flammable gas, steam or water or the reverse procedure

3.9
container
pressure vessel used for the storage of automotive LPG

3.10
service container
pressure vessel used for the storage within a workshop of automotive LPG unloaded from a container

3.11
LPG system
installation for propulsion purposes consisting of an arrangement of container(s), safety device(s), pressure regulator(s), vaporiser(s), connection(s), valve(s), piping, tubing, hose, fitting(s) and devices intended to store, supply, monitor or control the flow of LPG excluding the engine

3.12
overfill protection device
OPD
device designed to automatically reduce the filling rate to a minimal flow when the fill level reaches a predetermined amount

Note 1 to entry: In automotive applications, the predetermined amount is 80 % of the water capacity.

3.13
hazardous area
area in which an explosive atmosphere is or may be present, in a quantity such as to require special precautions for the construction and installation of equipment and use of apparatus

3.14
ignition source
source of energy sufficient to ignite a flammable atmosphere

Note 1 to entry: Includes naked flames, exposed incandescent material, sparks, electric welding arcs, and electrical or mechanical equipment not approved for use in hazardous locations.

3.15
service pit
hole in the ground providing standing access to the underside of a vehicle

3.16
electronic control unit
ECU
device that controls the electrical power supply to the remote-controlled service valves

3.17
on board diagnostic
OBD
system for emission control of the vehicle which has the capability of identifying the likely area of malfunction by means of fault codes stored in a computer memory

3.18
fixed liquid level gauge
control device, such as a dip tube in combination with a vent valve to indicate when a predetermined liquid level has been reached or surpassed

4 Working areas

4.1 General service working areas

This subclause applies to automotive working areas and servicing workshops which may be required to do work on any vehicle equipped with an LPG system but not on the LPG system itself (e.g. service station and lubrication bays, premises specializing in engine tuning, suspension, tyres or brakes and body repairs).

The presence of a vehicle equipped with a normally operating LPG system within the workshop shall not require any special extension of the normal ventilation, working space, and access to open space outside.

4.2 Dedicated LPG working areas

4.2.1 General

4.2.1.1 The requirements of this subclause apply to working areas where the equipping of vehicles with LPG systems, or the repairing and the maintenance of LPG systems are carried out.

The atmosphere within the working area shall be maintained within occupational exposure limits during and after the operations are completed.

4.2.1.2 Subclauses 4.2.1.3 to 4.2.1.8 apply when:

— the components of the LPG system involved in any of the following operations contain gas at a pressure above atmospheric pressure; or

— the components of the LPG system involved in any of the following operations contain gas at a pressure less than or equal to atmospheric pressure and are not isolated from other parts of the system; or

— an increased hazard, as defined in 5.1.1, exists.

4.2.1.3 Where the equipping of vehicles to operate on LPG, or the repairing and the maintenance of LPG system are carried out, a working area shall be identified through a risk assessment. The risk assessment will include hazardous zone classification in accordance with ATEX requirements and any necessary ventilation requirements.

NOTE For ATEX requirements see the relevant EU Directives (e.g. Directive 1999/92/EC [7] and 2014/34/EU [9]) and their transposition in national legislation.

4.2.1.4 If the working area does not encompass the entire workshop, it is advisable to clearly mark the designated working area(s) on the workshop floor.

4.2.1.5 In the working area, appropriate signage addressing the risks shall be displayed in accordance with national rules.

4.2.1.6 The floor level of the working area shall not constitute a depression in relation to the surrounding ground contours and levels unless appropriate extraction arrangements and gas detection systems are in place.

4.2.1.7 The working area shall not include or provide access to lower areas such as depressions, sumps, basements, unventilated pits, descending stairs, ramps or openings into drainage systems unless effectively sealed to prevent the ingress of LPG liquid or vapour.

4.2.1.8 The working area shall not be above any work space other than a properly ventilated service pit in accordance with provisions set out in 4.2.2.

4.2.2 Service pits

In dedicated LPG working areas where service pits are used, the following requirements shall also apply:

a) the pit shall be provided with a mechanical dilution ventilation system with the air flow sourced from the pit bottom and with the whole of the pit bottom being evenly air swept and without significant dead spots;

b) the location and direction of entry and discharge of airstreams for fans and duct systems shall be selected to minimize contamination and hazard;

c) the power supply to the service pit shall be configured in such a way that power is only available when the ventilation system is operational;

d) electric equipment and lights used in pits shall be suitable for use in explosive atmospheres with LPG;

e) the ventilation shall be suitable for use in explosive atmospheres with LPG; and

f) the atmosphere at the pit bottom shall be monitored for explosive conditions and breathable air with an acoustic and visual alarm system.

4.2.3 Equipment

The dedicated LPG working area should be provided with appropriate equipment, to ensure that the operators will be safe and the vehicle will be safe. A list of recommended equipment is provided in Annex A.

5 Procedures

5.1 Procedures in case of an increased hazard

5.1.1 An increased hazard exists if the LPG system contains gas and any of the following circumstances applies:

a) the LPG system fittings have been disturbed and are not confirmed to be leak free, e.g. by one of the methods described in Annex F;

b) a gas leak is suspected or known (e.g. smell, noise, pressure drop); or

c) the vehicle has suspected damage to the LPG system (e.g. after accidents, after filling station drive-off).

5.1.2 In case of an increased hazard, the remote-controlled service valve and the service valve, if present, shall be closed and the hazard eliminated in a dedicated LPG working areas before any further work is done.

5.1.3 In case of an increased hazard, the following requirements apply:

a) air compressor intakes shall be kept out of the working area;

b) the explosive atmosphere monitoring system and the ventilation system of the service pits shall be active;

c) the remote-controlled service valve and the service valve, if present, shall be turned off;

d) under no circumstances shall heating, welding, or flame cutting be carried out;

e) no ignition source shall be activated (e.g. the engine shall not be started, no electric switch shall be operated, either to switch it on or off); and

f) every possible source of ignition shall be identified before any attempt is made to open up the vehicle as sparks may be caused by courtesy light switches, boot lights, by the action of disconnecting the battery, or may be introduced by the towing vehicle.

5.2 Prevention of overheating

5.2.1 General

When vehicles are undergoing repairs involving welding or the application of heat to any part within 1 m of a LPG system component, the component shall be shielded from the source of heat.

The shielding shall prevent heat transfer to the LPG system component and prevent welding arcs or weld splatter coming into contact with the component.

When arc welding, a non-conducting shield shall be used to prevent welding currents passing through the LPG system components.

5.2.2 Treatment of an LPG vehicle in the paint booth

5.2.2.1 In case of paint booths with ambient temperatures equal to or higher than 50 °C, the LPG container shall be removed from the vehicle and stored outdoors in a fenced and well-ventilated space, with the remote-controlled service valve and the service valve, if present, closed and caps shall be applied to seal the inlet and outlet valves. This procedure shall also be followed if a drying treatment such as infrared light is applied near the container and/or components containing LPG,

5.2.2.2 In case of paint booths with ambient temperatures lower than 50 °C, no specific provisions shall apply and the LPG container may be left in the vehicle during the treatment.

5.3 Fuel unloading

5.3.1 Liquid LPG shall be safely removed from the LPG container by a competent person when:

— a leak exists which cannot be stopped by shutting off the remote-controlled service valve or by closing the service valve, if present;

— any container accessory is removed for service or replacement; or

— the container is taken out of service.

WARNING — It cannot be assumed that because the contents gauge shows empty or there is no indication of gas pressure in the container, that no fuel is present. Refrigeration effects from rapid blowing-down can leave a residue of unvaporized cold liquid LPG in the container. The container will contain gaseous LPG unless it has been made gas-free.

5.3.2 Liquid LPG shall be unloaded through the outlet connection of the container either by:

— returning to a service container, or

— flaring, or

— venting in a controlled and safe manner, or

— a combination of any of these options.

The LPG container should be removed from the vehicle before unloading unless this is considered dangerous due to the condition of the container.

NOTE Annex B gives examples of such methods.

5.3.3 When it is impossible to unload the fuel through the outlet connection of the container due to fault(s) of any of the outlet valves these valves shall be repaired or replaced after having depressurized the container.

NOTE Annex C gives an example of a depressurizing method.

5.3.4 For environmental protection reasons:

— LPG should be returned to a service container; and

— a container containing more than 5 l of liquid LPG should not be unloaded by venting or flaring.

5.3.5 The service container is not an automotive container and shall:

— be equipped with a contents gauge;

— be equipped with an overfill protection device (OPD);

— be equipped with a pressure gauge; and

— be of the liquid off-take type, if it is intended for carrying out the transfer of LPG back to the container.

NOTE See Directive 2010/35/EU[9] or Directive 97/23/EC[10] and national law for additional requirements.

5.4 Gas-freeing

5.4.1 When the container is to be inspected or scrapped, the container shall be made gas-free or purged with inert gas.

5.4.2 Containers shall be made gas-free by a method chosen and controlled by a competent person.

The method of gas-freeing should be selected so that it is technically effective and the environmental impact is reduced to a minimum. After selecting the appropriate method, all technical measures should be implemented in order to minimize the loss of energy, the emissions to air and raw material consumption and waste (e.g. inert gas, water, steam).

Noise levels from additional equipment (e.g. compressor or vacuum pump) should be evaluated and measures put in place to minimize the impact upon the external environment.

NOTE Annex D gives examples of such methods.

5.4.3 Containers shall be properly labelled e.g. “gas-free” or “N2 purged”.

5.5 Work on the LPG system

5.5.1 Before commencing any work on any component that contains or may contain gas other than the container, the remote-controlled service valve shall be turned off or the service valve, if present, closed and the fuel shall be drained from the service line preferably by running the engine until the fuel is consumed.

WARNING — There will still be a small amount of LPG left in the pipes after the engine stops

5.5.2 Where a connection for piping or a component has been disturbed, the LPG system shall be tested for leakage and confirmed to be leak free before the system is returned to service.

NOTE Annex F gives examples of leak detection methods.

5.5.3 A new LPG system installation shall be tested for leakage and confirmed to be leak free before putting it into service.

5.5.4 After any servicing or repairs, any joints or connections shall be leak-tested before the container is returned to service.

5.5.5 After completion of any operations involving the LPG system, the vehicle doors and boot lid should be left open until the interior of the vehicle has been confirmed to be free of gas.

5.6 Storage of unpurged containers

Where a container has been removed from a vehicle and has not been gas-freed, the container shall be stored in accordance with the following requirements:

a) in accordance with national standards and regulations concerning the storage of LPG containers or cylinders;

b) in the normal orientation as it would be installed in a vehicle, with the safety valve in communication with the vapour space and with the outlet connection capped with a pressure-proof fitting;

c) the safety valve shall be provided with a means of protection (such as a disc or cap) to prevent the ingress of foreign matter and shall not interfere with the proper operation of the valve.

5.7 LPG system decommissioning

For decommissioning of LPG systems, the following procedure shall apply:

a) unload the liquid LPG in accordance with the provisions of 5.3;

b) make the container gas-free or purge it with inert gas in accordance with the provisions of 5.4;

c) remove the components, including the container, filling connection and service line.

5.8 Scrapping

5.8.1 Scrapping operations shall only be carried out by authorized centres.

5.8.2 Where an LPG-fuelled vehicle is to be scrapped, the LPG shall be removed in accordance with 5.3 and the container shall be made gas-free in accordance with 5.4 or the LPG container shall be removed, before disposal of the vehicle.

5.8.3 Where a container is to be scrapped, it shall be gas-freed in accordance with the provisions of 5.4 and disposed of in accordance with EN 12816 or equivalent standard.

WARNING — it should not be assumed that there is no LPG in the container because it is depressurized. It is necessary to ensure that purging has in fact been completed.

5.9 Emergency measures

5.9.1 The workshop shall be provided with emergency procedures written by a competent person.

5.9.2 A competent person shall make sure that all the personnel are well informed and trained in the emergency procedures.

5.9.3 The workshop shall be provided with appropriate equipment and work instructions for emergency situations.

NOTE Annex E gives guidelines for the definition of some possible emergency measures.

Annex A
(informative)

Dedicated LPG working area equipment

A.1 Dedicated LPG working areas should be provided with the following equipment:

— portable explosive atmosphere detector and breathable air analyser;

— LPG unloading equipment (see Annex B) or access to this equipment when required; the equipment may be hired or the services of a specialized contractor may be used;

— container depressurizing equipment (see Annex C);

— gas-freeing equipment (see Annex D); and

— leak detection equipment (Annex F gives examples of leak detection equipment).

A.2 Suitable procedures for identifying, checking, calibrating and maintaining the efficiency of the equipment indicated above shall be provided. Records of these checks shall be stored, updated and made available, when necessary.

Annex B
(informative)

Fuel unloading methods

B.1 General

The main methods of fuel unloading are pumping out, decanting, flaring and venting. The most appropriate method for fuel unloading shall be determined by a risk assessment.

These methods shall only be carried out under the supervision of a competent person and in accordance with the following provisions.

The competent person shall ensure that:

— there are written procedures to ensure safe working practices; and

— all the personnel involved in the process are well informed and trained to working practices, associated risks, and emergency procedures.

The container should be removed from the vehicle before unloading the LPG unless this is considered dangerous due to the condition of the container.

Due to the potential for creating a significant hazard, fuel unloading by venting directly to atmosphere should be used only as a last resort procedure.

In the case of pumping out (B.2) and decanting (B.3), after repairing or servicing, the fuel should be transferred from the service container to the container in order to minimize LPG storage at the workshop.

For environmental protection reasons, containers containing more than 5 l of liquid LPG should not be unloaded by venting or flaring.

B.2 Pumping out

B.2.1 General

Pumping out is a procedure whereby LPG is transferred from the container into a service container by a differential pressure created either by a pump or by the application of high pressure inert gas.

The pumping out method is the best means of emptying containers because it minimises gas releases which makes it ideal for use in confined spaces.

At least one operator shall remain in attendance during the entire procedure.

The LPG container should be removed from the vehicle before the pumping put procedure unless this is considered dangerous due to the condition of the container.

When pumping out is carried out indoors, a dedicated area should be identified and properly marked out and the need for forced ventilation should be assessed.

Before commencing the pumping out procedure the operator shall make sure that the service container has a free capacity larger than the LPG container maximum net capacity.

The operator shall stop the pumping out as soon as the OPD of the service container operates.

At the end of the pumping out procedure, the operator shall confirm that the service container has not been overfilled.

B.2.2 By inert gas

A high-pressure inert gas, such as carbon dioxide or nitrogen, is applied, through a pressure regulator, to the container through the filling connection, thus pressurizing the vapour space above the liquid and forcing liquid out into the service container.

Adequate pressure control of the applied pressurizing gas is of the utmost importance to the safety of the operators and a safety valve shall be installed downstream of the regulator in case of regulator failure. The setting of the regulator shall not exceed 2,5 MPa, which is just below the design pressure of the container, i.e. 3,0 MPa. At this point the pressure relief valve should lift, but it is highly dangerous to depend on this valve for pressure limitation.

B.2.3 By vacuum pump

The LPG container can be unloaded using a vacuum pump in accordance with the following procedure:

a) connect the remote-controlled service valve of the container to be unloaded to the inlet valve of the transfer pump. The pump shall be suitable for LPG and explosion-proof;

b) connect the outlet valve of the pump to the filling valve of the service container;

c) open the remote-controlled service valve by connecting it to a battery or preferably by an appropriate magnet; and

d) once the container has been completely emptied (low vacuum reached), disconnect the remote-controlled service valve and the fuel transfer hoses. Fuel transfer hoses should have an adequate inside diameter so as to avoid excessive loading that could close the excess flow valve of the container to be unloaded.

B.3 Decanting

B.3.1 General

Decanting is a procedure whereby LPG is transferred from the container to a service container using the differential pressure between the two containers to drive the liquid from one to the other. To ensure adequate differential pressure, the vapour is vented from the service container through its fixed liquid level gauge.

The advantage of this method is that, as it is not essential that the vented gas be flared, it introduces no ignition source into the area and thus can be used when there is a leak in the container.

The disadvantage is that it is moderately slow, and vapour is released, so precautions for eliminating ignition sources and for vapour dispersal are necessary.

Decanting is not recommended for completely emptying containers above 160 l capacity. The method should be limited to transfers in the order of 40 l.

B.3.2 Area

B.3.2.1 Decanting shall only be carried out outdoors in a large and controlled area.

B.3.2.2 The controlled area shall be clearly identified and marked with appropriate signage

B.3.2.3 The following minimum separation distances from the decanting point, and in particular from the discharge from the vent, shall be determined by a competent person, taking into account all

the relevant factors (e.g. wind movements, temperatures, weather conditions, product composition, volume of expected release, topography, number of trained attendees):

a) to neighbouring property boundaries;

b) to an opening into a building and to any depression or sewage;

c) to an ignition source (e.g. high voltage power lines, cellular phones, static electricity);

d) to public buildings and spaces, with consideration of their use (e.g. school, hospitals, restaurants, roads, filling stations); and

e) to any flammable materials stored above ground.

B.3.2.4 An adequate number of dry powder type extinguishers with a suitable capacity and rating shall be located in the controlled area.

B.3.3 Equipment

The equipment shall be made up of:

a) a service container, suitable for filling by decanting; and

b) a pressure hose with the appropriate connections.

B.3.4 Procedure

At least one operator shall remain in attendance for the whole decanting period.

The following procedure shall apply:

a) remove the container from the vehicle;

b) connect a flexible line between the container outlet valve and the service container;

c) open the container remote-controlled service valve and the service valve, if present, and test that the hose connections are leak free;

d) open the service container inlet valve and the vent valve of the fixed liquid level gauge allowing liquid phase LPG to flow into the service container; and

e) as each service container is filled, as indicated by the liquid level gauge, connect other service containers until the operation is complete.

B.4 Flaring

B.4.1 General

Flaring is a procedure for burning off LPG in a gas burner. Its main advantage is that burning is one of the most reliable methods of rendering a gas harmless. The disadvantages are that it cannot be used if there is any suspicion of a leak around the vehicle, thorough operator training is required, and there can be a noise nuisance.

B.4.2 Area

B.4.2.1 Flaring shall only be carried out outdoors in a large and controlled area.

B.4.2.2 The controlled area shall be clearly identified and marked with appropriate signage.

B.4.2.3 The following minimum separation distances from the LPG container and the gas burner shall be determined by a competent person, taking into account all the relevant factors (e.g. wind movements, temperatures, weather conditions, product composition, volume of expected release, topography, number of trained attendees):

a) to neighbouring property boundaries;

b) to an opening into a building and to any depression or sewage;

c) to an ignition source (e.g. high voltage power lines, cellular phones, static electricity);

d) to public buildings and spaces, with consideration of their use (e.g. school, hospitals, restaurants, roads, filling stations); and

e) to any flammable materials stored aboveground.

B.4.2.4 An adequate number of dry powder type extinguishers with a suitable capacity and rating shall be located in the controlled area.

B.4.3 Equipment

The equipment used for flaring shall be made up of:

a) a burner;

b) a flexible high pressure LPG hose with suitable connections for the service valve and the burner;

c) a hand torch for lighting the burner;

d) personal hearing protection; and

e) a service valve in the flexible line, close but not immediately adjacent, to the burner to facilitate control by the flare operator when igniting the flare.

B.4.4 Procedure

At least two people shall be in attendance when the burner is started up, one controlling the remote-controlled service valve and the service valve, if present, and the other attending the burner and igniting the flare.

At least one operator shall remain present during the entire flaring operation.

The following procedure shall apply:

a) if the container is still in the vehicle,

   — check for any leaks on the LPG system and rectify any leaks found, before proceeding;

   — empty the service line and vaporizer by turning off the remote-controlled service valve and running the engine until it stops for lack of fuel; and

   — disconnect the service line from the container outlet valve;

b) connect the flare burner hose to the container outlet;

c) open the service valve of the flexible line slightly, energize the remote-controlled service valve and light the gas at the burner head;

d) adjust the LPG flow rate by means of the service valve of the flexible line, to achieve the maximum practical burn off rate while ensuring that:

— the excess-flow valve does not shut;

— excessive unvaporized LPG is not ejected from the burner; and

— the burner capacity is not exceeded, causing the flame to blow itself out;

If the excess-flow valve closes, shut off the service valve of the flexible line to allow the excess-flow valve to re-set itself, allow enough time for any escaped unburnt gas to dissipate, then follow the whole start-up procedure;

e) close the service valve of the flexible line and turn off the remote–controlled service valve of the container when the flaring is completed or discontinued.

B.5 Venting

B.5.1 General

Due to its high expansion factor, LPG creates a very large volume of flammable gas/air mixture: so venting is potentially hazardous and should only be used in an emergency situation where no other option is available.

Venting is a procedure whereby the LPG fuel is discharged directly to atmosphere, depending on natural dissipation to dilute the LPG to below the lower explosive limit.

Better control is obtained by attaching a hose to the outlet valve of the container for transferring LPG, so that the discharge point is removed from the vicinity of the container and the discharge stream can be aimed in the most favourable direction.

The discharge end of the flexible hose shall be firmly anchored to prevent whipping.

B.5.2 Equipment

The vent outlet should not normally be greater than DN 50 and shall terminate with a flame arrestor.

B.5.3 Area

B.5.3.1 Venting shall only be carried out outdoors in a large and controlled area.

B.5.3.2 The controlled area shall be clearly identified and marked with appropriate signage.

B.5.3.3 The following minimum separation distances from the LPG container and the vent outlet shall be determined by a competent person, taking into account all the relevant factors (e.g. wind movements, temperatures, weather conditions, product composition, volume of expected release, topography, number of trained attendees):

a) to neighbouring property boundaries;

b) to an opening into a building and to any depression or sewage;

c) to an ignition source (e.g. high voltage power lines, cellular phones, static electricity);

d) to public buildings and spaces, with consideration of their use (e.g. school, hospitals, restaurants, roads, filling stations); and

e) to any flammable materials stored above ground.

B.5.3.4 An adequate number of dry powder type extinguishers with a suitable capacity and rating shall be located in the controlled area.

B.5.4 Procedure

The following procedure shall apply:

a) connect the discharge pipe to the outlet valve of the container, choosing the most suitable direction of discharge, and commence the discharge;

b) after venting the vent pipes shall be purged of LPG vapour; and

c) during venting the gas concentration shall be regularly checked downwind at the edge of the controlled area to ensure that it is below 20 % of the lower explosive limit.

Precautions shall be taken to guard against the freezing of valves and the loss of vapour pressure due to product chilling.

Annex C
(informative)

Container depressurising method

C.1 General

a) Depressurising shall only be carried out when there is a need to replace faulty outlet valves.

b) Depressurising is only possible when LPG vapour contained in the container can be vented by partially loosening the bolts of a fitting on the container (e.g. entire multivalve or the level indicator), in a gradual and controlled way.

c) Risks associated with this procedure are related to the formation of a large explosive atmosphere because of the significant volume of vapour released and to the possible blow out of the outlet valve that can severely injure the operators.

d) This method shall only be carried out under the supervision of a competent person and in accordance with the following provisions.

e) The competent person shall ensure that:

— there are written procedures to ensure safe working practices; and

— all the personnel involved in the process are well informed and trained on working practices, associated risks, and emergency procedures.

C.2 Area

C.2.1 Depressurising shall only be carried out outdoors in a large and controlled area.

C.2.2 The controlled area shall be clearly identified and marked with appropriate signage.

C.2.3 The following minimum separation distances from the automotive container shall be determined by a competent person, taking into account all the relevant factors (e.g. wind movements, temperatures, weather conditions, product composition, volume of expected release, topography, number of trained attendees):

a) to neighbouring property boundaries;

b) to an opening into a building and to any depression or sewage;

c) to an ignition source (e.g. high voltage power lines, cellular phones, static electricity);

d) to public buildings and spaces, with consideration of their use (e.g. school, hospitals, restaurants, roads, filling stations); and

e) to any flammable materials stored above ground.

C.2.4 An adequate number of dry powder fire extinguishers of suitable capacity and rating shall be present in the controlled area.

C.2.5 During depressurising the gas concentration shall be regularly checked, downwind at the edge of the controlled area, to ensure that it is below 20 % of the lower flammable limit.

C.3 Equipment

C.3.1 This procedure shall be carried out with anti-spark tools.

C.3.2 Operators shall wear the following minimum personal protective equipment:

— suitable gloves to protect hands from cryogenic burns; and

— safety spectacles or face shields;

C.4 Procedure

C.4.1 At least two people shall remain in attendance during the entire procedure.

C.4.2 The following procedure shall apply:

a) locate a replacement valve suitable for LPG unloading close to the container;

b) ensure that the container is securely held in a suitable restraint device or secured to a suitable surface. The type of surface under the container shall prevent any leaking gas from permeating into the ground;

c) replace an adequate number of the bolts with longer ones to be used as safe blocks and guides;

d) unscrew the remaining original bolts very slowly and gradually;

e) after the depressurization is completed (no noise), unscrew all the bolts and remove the faulty valve;

f) until the replacement valve is completely installed, the remote-controlled service valve and the service valve, if present, shall be kept open to prevent pressure build up. The remote-controlled service valve should be kept open by means of a magnet.

Annex D
(informative)

Gas-freeing methods

D.1 Preparation for gas-freeing

In each of the methods described below, containers shall be nominally free of liquid LPG before gas-freeing.

Once liquid free, containers should be depressurised e.g. piping LPG vapour from a suitable container connection to a safely located flare burner, which should be fitted with a permanent pilot flame.

The internal pressure of the container should be reduced to a suitable level to enable one of the following methods to be used to gas-free the container.

The competent person shall ensure that:

— there are written procedures to ensure safe working practices; and

— all the personnel involved in the process are well informed and trained to working practices, associated risks, and emergency procedures.

D.2 Methods of gas-freeing

D.2.1 By water

Care should be taken to ensure that the container is capable of safely supporting the extra weight of water.

Water is progressively introduced and LPG vapour expelled via suitable container connections, selected so that as far as possible no vapour space is left in the container when the procedure is completed, i.e. when the container is full of water.

The vapour shall be vented or flared in accordance with the applicable provisions set out in Annex B.

Once the water has been drained, the container shall be checked by a competent person to be gas-free and suitably labelled.

In order to reduce water consumption, wastewater would be preferably recycled for gas-freeing other containers.

NOTE Hydrates can form in the container. Hydrates will release LPG vapour when they melt.

D.2.2 By inert gas

A suitable inert gas, e.g. nitrogen or carbon dioxide, is used to displace and dilute the LPG vapour to a gas-free level.

Care should be taken to avoid:

— over pressurization of the container;

— hazards associated with inert gases;

— electrostatic hazards; and

— hazards associated with low temperatures e.g. if the inert gas is generated from a liquid phase.

When the internal pressure reduction as described in D.1 is approached, the inert gas can be introduced via a container connection. The connections shall be chosen considering the relative properties of LPG and the inert gas. The exhaust mixture shall be sent to a flare with a pilot burner in accordance with the provisions set out in B.4.

When a non-flammable mixture reaches the flare burner, the inert gas shall continue being introduced and vented until a gas-free condition is reached. Container orifices shall then be plugged.

The container shall be certified as being gas-free and suitably labelled.

D.2.3 By steam

The procedure is similar to that described in D.2.2 but the use of steam requires the following additional precautions:

— comparatively high temperatures should be taken into account, as this may cause container expansion. Care should be exercised to ensure this expansion does not cause instability of container supports;

— any oily residues in the container will be made more volatile. Care should be exercised when confirming that the container is gas-free; and

— oily residues should be disposed of properly.

A positive pressure shall be maintained throughout the procedure to avoid air being introduced into the container leading to the formation of a flammable mixture. Care should be taken to avoid rapid condensation of steam which could cause negative internal pressures.

D.2.4 By vacuum pump or compressor

It shall be established that the container is rated for the negative pressure to be generated during the procedure.

Vapour is removed from the container through a vacuum pump/compressor and discharged through a flare fitted with a permanent pilot flame, safely located, or to a safe location, in accordance with the applicable provisions set out in B.4, respective B.5.

Following evacuation of the LPG vapour, the vacuum shall be broken and the container flushed through the vacuum pump/compressor keeping the inlet and outlet valves temporarily open.

The container shall be certified as being gas-free and suitably labelled.

Annex E
(informative)

Emergency measures guidelines

E.1 General

The purpose of this Annex is to provide, for each hazard, guidelines to help establish an adequate emergency response.

LPG leakages can occur from a number of places in an LPG system; particularly in areas such as joints and regulators.

Since leaks can create hazards, a proper assessment of the associated risks shall be performed to establish an adequate emergency response.

The emergency response shall comprise of procedures (including corrective and preventative actions) emergency equipment, training of personnel and clear identification of roles and responsibilities (e.g. identification of an emergency team).

Training of personnel shall be regularly evaluated.

Emergency equipment shall be regularly checked and inspected.

The emergency responses shall be approved by a competent person.

The procedure for raising the alarm and clear communications channels shall be identified in the emergency responses.

The premises shall be kept adequately clean so as not to interfere with emergency responses.

E.2 Emergency scenario

E.2.1 General

Any emergency response shall be controlled by appropriately trained and competent personnel.

E.2.2 Leakages

E.2.2.1 Emergency measures in case of leakages shall take into account the following:

a) spillage can be detected by the smell of the odorizing agent;

b) liquid will immediately vaporize creating a gas volume of about 250 times the initial liquid volume. Mixed with air, it will create an explosive atmosphere between 2 500 times and 12 500 times the initial liquid volume;

c) a high concentration of LPG in air can induce anoxia and contact of the liquid LPG with skin or eyes can cause burns;

d) as LPG gas is heavier than air, it can accumulate in any depression, such as drains, sewers or pits, but since it is a gas it will easily mix with air over time; and

e) switching on or off any electrical equipment can activate sources of ignition, unless they are explosion proof.

E.2.2.2 Emergency measures in case of leakages shall include adequate procedures to:

a) promptly and safely contact emergency authorities and advise of the nature of hazard;

b) evacuate personnel quickly via pre-defined paths leading to an assembly point;

c) remove ignition sources if safely accessible;

d) find safe areas using a combustible gas detector;

e) carry out regular monitoring until the area is free of dispersed gas.

Emergency phone numbers should be available in a visible place.

E.2.3 Fire or explosion hazard

E.2.3.1 Emergency measures in the case of fire or an explosion hazard shall take into account the following:

a) LPG is a highly flammable gas. It can create an invisible explosive air/vapour mixture, more at floor level than in the upper part of the workshop; and

b) extinguishing burning gas before the gas supply has been cut off can create new risks of explosion.

E.2.3.2 Emergency measures in case of fire or explosion hazard shall include adequate procedures to:

a) shut off LPG leaks, if any, and if it is safe to do so;

b) use adequate fire equipment and make it available, accessible and operational for properly trained people;

c) remove cool LPG containers from the endangered area or to protect them, when possible and safe to do so;

d) cool LPG containers, e.g. by directing water spray;

e) evacuate personnel quickly via pre-defined paths leading to an assembly point; and

f) contact competent authorities (e.g. fire brigade) and advice of the nature of the hazard;

g) Emergency phone numbers should be available in a visible place.

After the gas supply has been isolated it will be necessary to evaluate, depending on the local circumstances, whether to extinguish the remaining fire (with the subsequent risk of re-ignition and explosion), or to allow the fire to burn out (risk of heat radiation and fire spreading to other materials).

E.3 First aid for LPG cryogenic burns

E.3.1 General

In the situation where a sudden spillage of LPG liquid comes in contact with a person, it may lead to him/her receiving cryogenic burns.

LPG vaporizes quickly and will cause extreme frostbite if it touches the body. Contact temperatures are usually below −30 °C and contact with body tissues at these temperatures results in snap-freezing of the affected area, causing damage similar to a heat burn. These are called cryogenic burns.

E.3.2 Immediate treatment

Emergency measures shall include procedures and means to prevent cryogenic burns and provide medical assistance in case of an accident.

Measures to provide medical assistance shall be established with the advice of a competent medical service. Designated first aid personnel shall be trained to provide medical assistance.

Annex F
(informative)

Leak detection methods

F.1General

This Annex describes a variety of leak detection methods for LPG and indicates significant advantages or disadvantages.

Equipment involved in the following methods shall be used in accordance with the manufacturer's instructions.

F.2Combustible-gas detectors

Combustible-gas detectors are suitable for testing for leaks after LPG has been introduced to the system, and are particularly useful for checking assembly joints after installation.

Care in interpretation is necessary, as the detectors can respond to the presence of any of several vapours that are combustible, some of which may not be LPG, such as oil smears and jointing compounds. Detectors can also detect residual LPG vapour that is present for reasons other than leakage.

Residual LPG vapour detected shall be cleared before a valid test for leakage is made. If a leak is present, a detector could signal its existence, but not its size, and will indicate a general location, but may not be able to locate it exactly, so a follow-up or proving check with foam is often essential.

The system under test shall be purged of LPG, and all likely leak points shall be checked. It is important to keep the sensing element in contact with the surface of the part being tested, and that the test is carried out under still air conditions.

F.3Trace-gas detectors

Trace-gas detectors are suitable for checking the gas tightness of the construction joints in a compartment or sub-compartment, conduit connections or similar, particularly when it is impracticable to apply higher internal pressures.

The basic method is to plug or blank off openings such as vents, and inject a trace gas under pressure. The gas used may be any convenient gas for which a suitable gas detector is obtainable, e.g. halogenated hydrocarbons, carbon dioxide, or the like.

F.4Foaming agents

Foaming agents are more effective for the detection of small leaks; large leaks tend to blow the solution away from the leak without forming a bubble. Care should be taken to apply the solution slowly with a brush, which will provide easier detection of large leaks.

The foaming agent shall be formulated specifically for the purpose. The whole of the surface to be tested shall be covered and sufficient time allowed for bubbles to form. All areas under test shall be able to be observed during the test.

F.5Total immersion

Total immersion may not always indicate very small leaks, or leaks which may be inhibited by the hydrostatic pressure. Good illumination and an ability to manipulate the item while submerged are important. A wetting agent is desirable, provided that foaming does not result.

F.6Visual inspection

Since LPG is a refrigerant, a leak, particularly of liquid, will often cause a frost to form on surrounding surfaces, even when the rate of leakage is too small to be readily detectable by immersion or foam methods. Visual checks for signs of such frost patches are particularly appropriate for the welded seams of containers.

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