

Formerly LPGA Technical Memorandum NO.80 – July 2004

## Work on Vehicle LPG Fuel Tanks

### 1. Introduction

#### 1.1 Scope

This Technical Memorandum gives guidance on the considerations necessary for safe work on vehicle LPG fuel tanks.

Such work includes:

- Change of tank on a vehicle;
- Change of fittings on a tank;
- Storage of a tank which contains or has contained LPG;
- Preparing a tank for transport;
- Scrapping a tank.

To meet duties under the Health and Safety at Work etc Act and supporting Regulations, anyone working on an LPG system or carrying out these activities should be competent to do so and have received appropriate training.

LPG, like petrol, is defined as a “dangerous substance.” Work on LPG systems falls within the scope of, amongst other Health and Safety laws, the Management of Health and Safety at Work Regulations (MHSAW), the Provision and Use of Work Equipment Regulations (PUWER), the Control of Substances Hazardous to Health (COSHH), and the Dangerous Substances and Explosive Atmosphere Regulations (DSEAR). These require that employers (and the self employed) must:

- carry out a risk assessment of any work activities involving dangerous substances;
- provide measures to eliminate or reduce risks as far as is reasonably practicable;
- provide equipment and procedures to deal with accidents and emergencies;
- provide information and training to employees;
- classify places where explosive atmospheres may occur into zones and mark the zones where necessary.
- Autogas in the UK should be considered to be commercial Propane. COSHH Safety Data Sheets are available from LPG suppliers

#### 1.2 Hazards of LPG

- (a) LPG is stored as a liquid under pressure. It is almost colourless and its weight is approximately half that of an equivalent volume of water.

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- (b) Propane gas is about one and a half times as heavy as air. Consequently, the vapour may flow along the ground and into drains, sinking to the lowest level of the surroundings and be ignited at a considerable distance from the source of leakage. In still air vapour will disperse slowly.
- (c) LPG can form a flammable or explosive mixture when mixed with air. The flammable range at ambient temperature and pressure extends between approximately 2 % of the vapour in air at its lower limit and approximately 10 % of the vapour in air at its upper limit. Within this range there is a risk of combustion if there is a source of ignition. Outside this range any mixture is either too weak or too rich to propagate flame. However, overrich mixtures can become hazardous when diluted with air and will also burn at the interface with air.

At pressures greater than atmospheric, the upper limit of flammability is increased but this increase with pressure is not linear.

- (d) Escape of even small quantities of the liquefied gas can give rise to large volumes of vapour / air mixture and thus cause considerable hazard. A suitably calibrated explosimeter may be used for testing the concentration of LPG in air.

**A NAKED FLAME SHOULD NEVER BE USED TO SEARCH FOR A LEAK.**

- (e) At very high concentrations in air, LPG vapour is anaesthetic and subsequently an asphyxiant by diluting or decreasing the available oxygen.
- (f) LPG is normally odorised before distribution by the addition of an odorant, such as ethyl mercaptan or dimethyl sulphide, to enable detection by smell of the gas at concentrations down to one-fifth of the lower limit of flammability (i.e. approximately 0,4 % of the gas in air).
- (g) Escape of LPG may be noticeable other than by smell. When the liquid evaporates, the cooling effect on the surrounding air causes condensation and even freezing of water vapour in the air. This effect may show itself as frost at the point of escape and thus make it easier to detect an escape of LPG. Because the refractive index of LPG differs from air, leaks can sometimes be seen as a 'shimmering'.
- (h) Owing to its rapid vaporisation and consequent lowering of temperature, LPG, particularly liquid, can cause cold burns if brought into contact with unprotected parts of the body. Personal protective equipment (e.g. hand and eye protection) should be worn if this hazard is likely to occur.



- (i) A container which has held LPG and is 'empty' may still contain LPG in vapour form and is thus potentially dangerous. In this state the internal pressure is approximately atmospheric. If a valve is leaking or is left open, air can diffuse into the container forming a flammable mixture and creating a risk of explosion: alternatively, LPG can diffuse to the atmosphere.

## 2. General

A vehicle leaking LPG should never be taken into a building and, where possible, should be kept in a safe place in the open air away from drains (or other openings in the ground), sources of ignition or fuel storage.

LPG tanks and their attachments should never be subjected to welding, brazing, thermal cutting or other operations involving heat.

Where there is any risk of LPG escape (e.g. from disconnection of filler hoses, pipework or other fittings):

- the operation must be undertaken outside buildings, in an open and ventilated location, at least 3 metres from any buildings, ignition point (naked flame, electric spark, etc), drain or fuel storage;
- the operator must be provided with appropriate personal protective equipment such as: gloves, goggles, natural fibre clothing (to reduce the risk of static electricity) and antistatic shoes;
- "NO SMOKING or NAKED LIGHTS" signs should be displayed and enforced;
- Ex signs should be deployed if the Risk Assessment in 1.1 shows them to be necessary;
- a dry powder fire extinguisher with a minimum capacity of 9 kg should be available for immediate use;
- vehicle batteries should be disconnected;
- electrical equipment including mobile phones and pagers, should be isolated, turned off or removed from the vicinity;
- vehicle doors and bonnets should be opened.

## 3. Removal of Components from the LPG System

LPG tanks should be emptied as far as possible by normal running of the engine. This will not remove all the product from the tank but will reduce the time necessary to remove residual LPG and the associated risks. It also reduces the weight of the vessel if this has to be lifted from the vehicle.

- Risk Assessment of manual handling during removal of the tank should be carried out in accordance with the Manual Handling Operations Regulations 1992.

Tank valves should be closed before any filler hose or any pipework is removed.

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## 4. Emptying and Purging LPG Tanks

- Code of Practice 17 gives further guidance on purging of LPG vessels and systems.

Emptying and purging of LPG tanks should only be undertaken in accordance with a written procedure in places which have the necessary equipment and competent personnel.

Where practicable tanks should be emptied and purged whilst still fitted to the vehicle. If they have to be removed first they should be securely chocked in their normal mounting attitude before emptying and purging.

LPG tanks should be emptied as far as possible by normal running of the engine. Residual LPG should be removed using a liquid/vapour recovery system or by flaring or other appropriate means. LPG should not be vented direct to atmosphere.

Whichever system is used, the tank should be connected using armored hose to BSEN1762 or BS4089 with the correct end connection to suit the tank valves

The tank outlet valve includes an Excess Flow Valve (EFV) which restricts the liquid flow rate. To avoid closing this EFV the connection should include a restricting orifice which maintains the flow at a lower rate than the EFV closing flow.

### Vapour/Liquid Recovery System

This is the preferred method of operation.

It involves the use of a vacuum pump/compressor and receiving tank.

Supplier's instructions for the operation of the equipment should be readily available and strictly observed.

Note: Electrical outlet valves on the tank should be opened using a remote power supply connected with the correct electrical connections to ensure no spark at the tank.

Depending on the type of equipment employed, there are three generally three stages to emptying and purging:

#### Stage 1

The outlet valve of the tank to be emptied is connected to the liquid connection of the receiving tank via a Non Return Valve. The fill valve of the tank to be emptied is connected via the compressor to the vapour valve on the receiving tank.

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Vapour is drawn from the receiving tank and compressed into the tank to be emptied, displacing the liquid into the receiving tank. The differential pressure to achieve this needs to be no higher than 1 bar.

## Stage 2

Once all the liquid has been removed and only vapour is left, the compressor/vacuum pump is connected to the outlet of the tank to be emptied, and the remaining vapour removed until a vacuum pressure of 0.5 bar absolute is achieved.

## Stage 3

Nitrogen is now introduced into the tank being emptied to replace the vacuum to a pressure of 0.4 bar gauge.

Tank and nitrogen supply valves should now be closed.

The tank is now purged and may be disconnected from the nitrogen supply.

## Flaring

The flare-off burner design should be capable of accepting liquid phase LPG and include some form of permanent pilot and either incorporate some form of suitable terminal deflagration flame arrester or be of a design which is inherently resistant to flash back.

- See Health and Safety Executive Guidance Booklet HS(G)158 - Flame Arresters.

The flow control orifice in the burner should not be less than 1.25 mm in diameter and there should be no flow restrictors between the tank outlet and the burner so as to allow adequate flow during purging operations.

The flare-off burner should be positioned in an area under suitable control and at least 15 m from:

- the tank/vehicle;
- flammable materials;
- boundaries or buildings.

A flare-off burner should not be left unattended while in use.

Once the pilot flame at the flare off burner is established the tank outlet valve should be opened.

Note: Electrical outlet valves on the tank should be opened using a remote power supply connected with the correct electrical connections to ensure no spark at the tank

To ensure that the LPG in the tank has not auto-refrigerated, when the flame at the flare-off burner goes out the tank outlet valve should be closed and a period of 15 minutes allowed to elapse. The valve

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should then be re-opened. This process should be repeated until no further gas is released when the valve is opened.

Following the emptying of the tank it should be purged with nitrogen.

A nitrogen supply at a pressure of 5 bar gauge should be connected to the tank filler valve and tank outlet valves opened. Nitrogen should be allowed to go through the tank to the flaring device for a duration calculated on the basis of 1 minute per 10 litres of tank capacity (e.g. 6 minutes for a 57 litre tank). The nitrogen supply should be disconnected and the pressure in the tank allowed to fall to 0.4 bar gauge before the outlet valve is closed.

Tank and nitrogen supply valves should now be closed.

The tank is now purged and may be disconnected from the nitrogen supply.

## 5. Replacement of Tank Fittings

Tank fittings should only be replaced in accordance with a written procedure and suppliers instructions on a "like for like" basis by competent personnel. Prepared replacement parts should be available before the part to be exchanged is removed

The tank must be emptied and nitrogen purged before removal of any fitting. Risk Assessments for the procedure should address the possibility of asphyxia.

Particular care should be taken to ensure that alignment sensitive parts (contents gauges, stop fill valves) are correctly fitted.

If tank openings need to remain open for more than 15 minutes the nitrogen purge should be repeated.

A soundness test at a test pressure of 6 bar gauge using nitrogen and leak detection fluid should be satisfactorily completed before the tank is put back into service.

## 6. Storage of Components Containing or which have Contained LPG

Tanks containing or which have contained LPG should be stored outside in accordance with Code of Practice 7. The tank should be kept in its mounting orientation, chocked to prevent rotation, and with its relief valve unobstructed.

Tank should not be stored indoors unless they have been emptied and purged and are clearly identified as such.

Other components which have been in LPG service may have adsorbed the odorant which is added

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to give the gas a distinctive smell. Components should be stored outside or have their inlets and outlets capped or plugged to avoid the inconvenience of reported gas leaks.

Any “used” component should be assumed to contain LPG unless it has been emptied and purged.

## 7. Transport of LPG Tanks

### 7.1 Transport of purged LPG tanks

Wherever practicable tanks should be emptied and purged as in 4 and clearly identified as such before they are transported.

Such tanks should be secured in a manner to avoid movement during transport.

A consignment note should be carried stating that the tanks carried have been emptied and purged.

### 7.2 Transport of non-purged tanks

Where emptying and purging it is not practicable tanks may be transported:

- if nominally empty (ie the contents gauge showing empty when the tank is in its designed fitting orientation); or
- if the sum of the contents of the tanks being transported does not exceed 333 kg.
- The contents of the tank should be calculated from the contents gauge reading on each tank when the tank is in its designed fitting position. For contents gauges reading in %:

$$\text{Content (kg)} = \text{water capacity (litres)} * \text{gauge reading (\%)} * 0.8$$

In these cases:

- smoking should not be permitted during the carriage;
- carriage should not take place in closed or curtain sided vehicles;
- the inlet and outlets (excluding relief valves) should be securely plugged or capped;
- tanks should be secured in their designed fitting orientation and in a manner to avoid movement during transport.

If a tanks contents cannot be established it should be regarded as full.

A consignment note should be carried stating that:

- the tanks carried are nominally empty and carried in accordance with 3.- (6)(a) of the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2004; or
- the sum of the contents of the tanks being transported is \*\*\* kg and carried in accordance with 3.- (6)(a) of the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations.



The driver of a vehicle should have adequate instruction and training to enable him to understand:

- a) the dangers and hazards of LPG and any other dangerous goods on board;
- b) what actions to take in an emergency;
- c) his duties under the Health & Safety at Work Act 1974.
  - Code of Practice 27 gives further information.

Vehicles should carry a minimum of 2 fire extinguishers. One of these is for the use in the cab or for an engine fire and should be 2 kg of dry powder or suitable equivalent. The other is for use on a load or tyre fire, and should be 6 kg (2 kg for vehicles up to 3500 kg permissible maximum weight), of dry powder or suitable equivalent.

All fire extinguishers should be inspected at regular intervals.

For carriage of quantities in excess of 333 kg the full duties under the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations will apply.

## 8. Scrapping of LPG Tanks

Following emptying and purging of the tank it should be rendered unsuitable for further LPG service by:

- Mechanical crushing;
- Piercing holes;
- Cutting the body into two or more pieces.

Only pneumatic or hydraulic power should be used, NOT electrical tools.

- BS 5430 and BSEN 12816 give further guidance.

As tanks are nitrogen purged Risk Assessments should address the possibility of asphyxia.

Once scrapped the parts may be recycled through the recycling/waste disposal system.

