

# A guide for attending vehicles converted to run on LPG autogas

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Liquefied Petroleum Gas commonly known as LPG, or LPG autogas when used as a road fuel, has been used as an internal combustion engine fuel for many years.

Most LPG autogas vehicle conversions from petrol retain the petrol system as it is used when starting the engine and is also an alternative if the vehicle runs out of LPG autogas.

LPG autogas is colourless and has a sulphur based odorant added to give it a strong and distinctive "rotten cabbage" smell. Autogas may be noticeable other than by smell. When LPG autogas escapes the cooling effect on the surrounding area may cause frost at the point of escape and thus make it easier to detect. Because the refractive index of autogas differs from that of air, escaping LPG autogas vapour can sometimes be seen as shimmering.

As with petrol, inadequate or poor air-gas mixture due to lack of servicing can result in the production of toxic carbon monoxide.

Worldwide there are over 13 million vehicles running on LPG autogas and in the UK at the end of 2008 there were over 150,000. These vehicles are primarily cars and small vans up to Transit size. The majority of conversions are undertaken by installers in the LPGA Approved Installer Scheme operated by UKLPG. However, conversions can be undertaken by anyone and the safety standards set by UKLPG may not always be adhered to.

The availability of LPG autogas is also on the increase with over 1,500 autogas filling stations in the UK.

### **Typical Characteristics of LPG autogas**

LPG autogas is stored as a liquid at a pressure of about 7 bar (100 psi). In vapour form it expands to around 250 times the volume of its liquid form.

LPG autogas is flammable when mixed with air in range between 2% and 10%, in this range the gas can be ignited in the same way as petrol vapour.

LPG autogas vapour is heavier than air and may therefore flow along the ground and through drains and will sink to the lowest level of the surroundings.

## Safety features of an LPG autogas vehicle

Vehicles converted to run on LPG autogas may be considered safer than petrol vehicles as

- The fuel tank is made of steel and is substantially stronger than a petrol tank, this means that it can withstand higher impacts than normal petrol tanks.
- In the event of a vehicle fire which causes the tank to be heated, the pressure relief valve which is fitted to the tank will prevent over pressurisation of the tank and possible explosion.
- Non return valves are fitted to the tank and the filler that stops the gas escaping from the filler connection.
- The tank also incorporates an 80% stop fill valve which prevents the tank from being overfilled and to provide a margin of 20% space in the tank to allow for heat expansion of the LPG autogas.
- Since 2001 all LPG autogas tanks on the fuel feed to the engine outlet have had to be fitted with an automatic shut off solenoid on or as close as possible to the tank. This device shuts off the supply of fuel from the tank automatically when the vehicle is switched off, stalls, or is switched to petrol supply. Many conversions before this date also had this safety feature and on conversions without the automatic solenoid a manual shut off valve may be found in its place.
- There is an excess flow valve fitted on the tank at the fuel feed pipe to the engine. In the event of a fracture in the pipe line to the engine, this valve automatically closes down the supply to a minimum even if the engine is still running.
- Where the tank is located on the inside of the vehicle, the valves on the tank are covered by an air tight box with a sealed vent to the outside of the vehicle to prevent LPG autogas entering the vehicle.
- There is a safety shut off solenoid located as near as possible to the vaporizer which is normally situated in the engine compartment. This valve along with the shut off solenoid on the LPG tank shuts down the fuel supply when the engine is not running.

### Safe handling of LPG autogas

Because the LPG autogas system is sealed then there is no reason to come into contact with LPG autogas unless the system is broken into for some reason and a leak occurs, in which case precautions must be taken to ensure your safety and that of others. (See also Chapter 6)

LPG is extremely flammable, if a leak is suspected or detected, ensure there are no naked flames or smoking in the area, and make sure there are no sources of ignition. Beware, as with petrol vapour, even opening the vehicle door or boot can trigger a light switch which is a potential source of ignition.

Avoid coming into contact with the LPG in the liquid form as it can cause severe cold burns and saturate clothing which may subsequently be ignited.

In the event of a cold burn seek medical advice.

Although LPG autogas is not toxic, inhalation of high concentrations will produce anaesthesia and prolonged such inhalation can cause asphyxiation – a particular risk if it is in an enclosed structure like a garage.

There is no legal requirement for LPG autogas conversions to display any identification on the vehicle; however, they may be identified by:

- The easiest and quickest way to discover if a vehicle is converted to LPG autogas is to ask the owner / driver.

If this is not possible then the following may help.

- An LPG autogas conversion will have an additional filler for the LPG autogas as well as the original petrol filler. The autogas filler is usually found at the rear of the vehicle behind the petrol filler, but can also be found at different locations including on the tow bar or the bumper at the rear of the vehicle.



A typical LPG filler connection

- Open the bonnet and look for signs of LPG autogas system components, such as LPG injector block, vaporizer, or additional wiring and control units.



LPG injectors and pipe work

- A marketing sticker from the installer possibly on the windscreen, rear window or both.



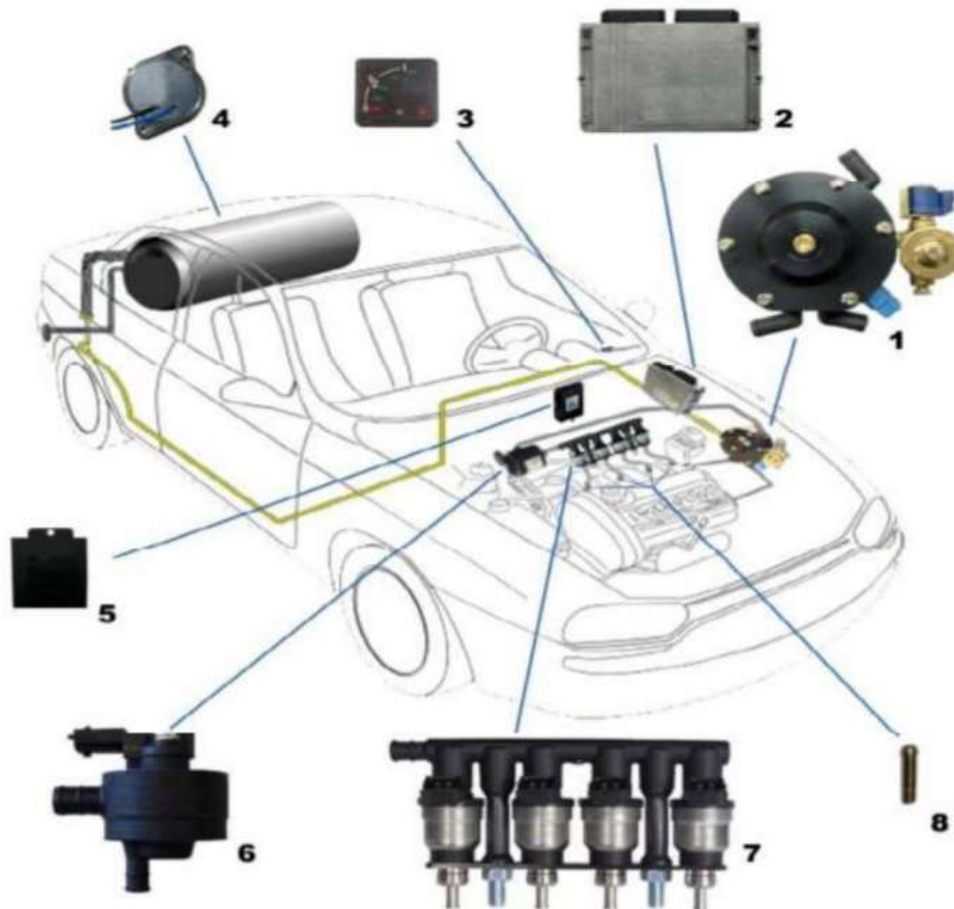
Typical marketing stickers

OEM vehicles could have badges such as Dual Fuel or Bi-Fuel attached to the rear.

## A typical LPG autogas layout

- 1- Vaporizer
- 2- Control unit (LPG ECU)
- 3- Changer over switch
- 4- LPG tank and fuel gauge sender
- 5- Injector module
- 6- Inline filter
- 7- LPG injector rail
- 8- Inlet manifold coupling

All LPG components should be marked with ECE 67-01



The high pressure components consist of

- 1) The filler pipe / hose
- 2) The tank
- 3) The fuel feed pipe to the engine

### **The filler pipe / hose**

The filler pipe / hose transfers fuel from the filler connection to the tank.

The filler pipe / hose is located between the fill connection and the tank. It should be made of either seamless copper pipe or suitable high pressure rubber hose.

Non-return valves are fitted to both the fill connection and to the inlet valve situated within the top of the tank.

The non-return valve situated within the fill connection seals the LPG system when the filler gun is removed.

Should the filler pipe / hose fracture or a leak occur then the non-return valve situated within the tank will lock off and shut down any escape of gas from within the tank. The amount of any gas leakage will therefore depend on the length of the filler pipe / hose.

### **NOTE.**

Leakage from the filler pipe is high pressure - see chapter 6

### **The tank**

The tank is usually located in the rear of the vehicle. This can be in the boot, in the spare wheel well or on brackets underneath the vehicle. There are various sizes of tanks and they are either cylindrical or Toroidal (dough-nut shaped) as shown below:



CYLINDER TANK



TOROIDAL TANK

There are three safety valves fitted to the LPG tank (these can be individual valves in a line or combined in one large circular "multivalve". These are: -

- 1) An automatic stop fill shut-off device designed to limit the maximum quantity of LPG which can be put into the tank to 80% of its capacity.
- 2) A pressure relief valve, designed to relieve any over pressure which may built up within the LPG tank due to collision damage or overheating.
- 3) A double check valve which incorporates an automatic excess flow valve.

An automatic solenoid shut off is fitted on the fuel feed pipe from the tank to the engine as close as possible to the tank. This is in the closed position. This valve opens when the engine is running and the LPG ECU senses sufficient gas pressure for the valve to open.

In the event that the engine is switched off or stalls, then this valve automatically closes and shuts off the LPG supply.

**Note.**

Older type tanks may be fitted with a manual shut off valve attached to the double check valve. These have to be manually closed and can be located within the tank box.

Leakage from this area is at high pressure - see chapter 6

**The fuel feed pipe**

The fuel feed pipe carries LPG autogas from the tank to the vaporizer in the engine compartment and is located from the tank underneath the vehicle to the engine compartment.

The fuel feed pipe can be made of either copper or a plastic type material.

Should this pipe fracture, then the excess flow valve attached to the LPG tank will automatically restrict the flow of gas to a minimum, lowering the gas pressure and reverting the engine back to petrol. This in turn will shut off the LPG autogas supply at the tank and stop the pipe from leaking.

**NOTE**

Leakage from the fuel feed pipe is at high pressure - see chapter 6



**The LOW pressure components**

These are found in the engine compartment. The most common type of system is vapour injection system which consists of:

- a. The vaporizer
- b. The injector / mixer vapour feed pipe
- c. The injectors with feed pipes to the inlet manifold / mixer

In addition, some vehicles are fitted with liquid injection systems which are totally HIGH PRESSURE components (see below for differences). These Systems are normally found on LDV vans as well as some factory fitted Fords and Subaru's.

**The Vaporiser**

The vaporiser is not always easy to locate but is usually situated within the engine space of the vehicle and can vary in shape and size. Connections to the vaporizer are normally: -

- The high pressure fuel feed pipe which delivers liquid LPG autogas from the tank.
- An electronic lock off solenoid which is activated by both the ignition switch and LPG pressure switch. This is usually located on the vaporiser between the fuel feed pipe from the tank and ahead of the vaporizer, but can sometimes be separate
- Water inlet and outlet connections - hot water is fed into the vaporizer to provide the heat to turn liquid LPG autogas into the vapour which is required by the injectors / mixer.
- A low pressure feed pipe to the injectors / mixer.

**NOTE**

LPG autogas leaks from the vaporiser can be either at high and low pressure – see Chapter 6

**The injector / mixer vapour feed pipe**

This is located between the vaporizer and injectors / mixer, this pipe transfers low pressure LPG in vapour form from the vaporizer to the injectors.

The vapour feed pipe is normally rubber. It should be clipped at either end for security and to prevent leakage.

**NOTE**

Leakage from this area is at low pressure vapour – see Chapter 6

The injectors / mixer Most modern engines with injection systems should have LPG injection systems fitted. The injectors will either be in a separate block with pipes to the inlet manifold or with the injectors located on the manifold itself.

On older conversions, especially those with carburettors, the fuel is fed into the engine by a mixer inserted into the air intake close to the carburettor.

Feed pipes from the injector to the inlet manifold should be clipped at either end for security and to prevent leakage.

**NOTE**

Leakage from this area is low pressure vapour – see Chapter 6.

**Liquid Injection Systems**

These systems can be identified by the lack of a vaporizer. The fuel feed pipe from the tank goes into a distributor which in turn feeds into the injectors.

The system is pressurized by a pump located inside the LPG tank and the whole system is HIGH PRESSURE.

## Identifying an LPG autogas leak

LPG autogas is colourless and has a sulphur based odorant added to give it a strong and distinctive “rotten cabbage” smell.

LPG autogas may be noticeable other than by smell. When LPG autogas escapes the cooling effect on the surrounding area may cause frost at the point of escape and thus make it easier to detect. Because the refractive index of autogas differs from that of air, escaping LPG autogas vapour can sometimes be seen as shimmering.

Caution must be taken where high pressure leaks are detected such as on tanks or high pressure pipe work as the leaking area can ice over for a short period giving the impression that the leak has stopped.

Note: LPG autogas is heavier than air and will therefore sink to the lowest point available. How to deal with an LPG autogas leak.

- Make sure the engine is switched off if not already done so; this will normally shut down the LPG autogas system and lock off any gas leaks. (Note - some tanks have manual shut off valves which may need to be turned off manually)
- If the leak cannot be shut off by the above, ensure you are wearing the correct level of protective clothing whilst trying to establish its location. It is recommended that this includes wearing suitable gloves (e.g. Nitride rubber) and goggles to protect from cold burns particularly in the high pressure areas.
- Ensure no naked flames or smoking is permitted within the area, and make sure there are no other sources of ignition. Beware, as with petrol vapour, even opening the vehicle door or boot can trigger a light switch which is a potential source of ignition.
- Should the leak persist specialist help should be sought (for example from a local Approved Installer or fire service) and the vehicle should be moved (without starting the engine) to a well ventilated open space which is well away (where possible at least 20m) from sources of ignition, drains, buildings, plant and equipment where the LPG autogas can safely disperse to the atmosphere. The vehicle should be isolated from general access by creating an exclusion zone (for example by barriers or cones) and smoking and naked lights should be prohibited.
- If a fire should occur, then the exclusion zone should be increased to a radius of at least 150 metres.

If the leak has stopped, check that there is no residual LPG within the area.

Make sure that the LPG switch within the vehicle is in the petrol position before attempting to start the engine.

The engine should now run safely on petrol with no leakage of LPG autogas but checks should be undertaken to ensure that the leak has not re-appeared.

Providing that all the LPG components such as tank and pipe work are still secure then the vehicle is now safe to drive in petrol mode.

It is recommended that the LPG switch is taped over and or a notice stating "Not to be used or switched to LPG".

LGUK is the voice on LPG in the UK, representing companies who are producers, distributors, equipment and service providers, and vehicle converters.

LGUK was formed by the merger of the LP Gas Association (LPGA) and the Association for Liquid Gas Equipment and Distributors (ALGED) in January 2008. Its roots are firmly established, with LPGA and ALGED established in 1947 and 1975 respectively. It is dedicated to the safe and effective development of LPG and takes a leading role in the consultation and negotiation with legislators and policy makers.

LGUK consults with Government Agencies and Departments such as the Health and Safety Executive, Department for Business, Enterprise and Regulatory Reform, Department for Transport, Department for the Environment, Food and Rural Affairs, Department of Energy and Climate Change, Department for Communities and Local Government etc. It is also a leading participant in the activities of the European LP Gas Association (AEGPL) which is a vital organisation in the consultation process of European legislation.

LGUK publishes a large suite of Codes of Practice covering most aspects of the storage, transportation and utilisation of LPG. These have been carefully developed by practicing experts from the Industry and other interested parties such as the HSE.

Code of Practice 11 covers the full requirements for autogas installations on a vehicle and is available direct from LGUK.

Further information on LPG autogas and vehicle conversions is available on our consumer website [www.drivelpg.co.uk](http://www.drivelpg.co.uk) or direct from the Association as below.

The information in this guide is given in good faith and belief in its accuracy at the time of publication, but it does not imply any legal liability or responsibility by LGUK.

Users of this document should pay regard to any relevant legislation or authoritative recommendations.

LGUK Guidance is not an authoritative interpretation of the Law, but if you do follow the Guidance, you will normally be doing enough to comply with the Law. Similarly, Health and Safety Inspectors seeking to secure compliance with the Law may refer to this Guidance as illustrating good practice.

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