THE LINDE GROUP

Safety Advice.
14 – Handling liquefied petroleum gas.

1. Introduction

Liquified Petroleum Gas (LPG) UN number 1965, refers to the normal qualities of propane, butane, propene, butene and their mixtures. This safety advice describes the most important technical safety properties of LPG and offer advice from practical experience for handling LPG safety. This advice does not replace binding safety stipulations, it merely supplements them.

2. Properties

2.1. Chemical properties

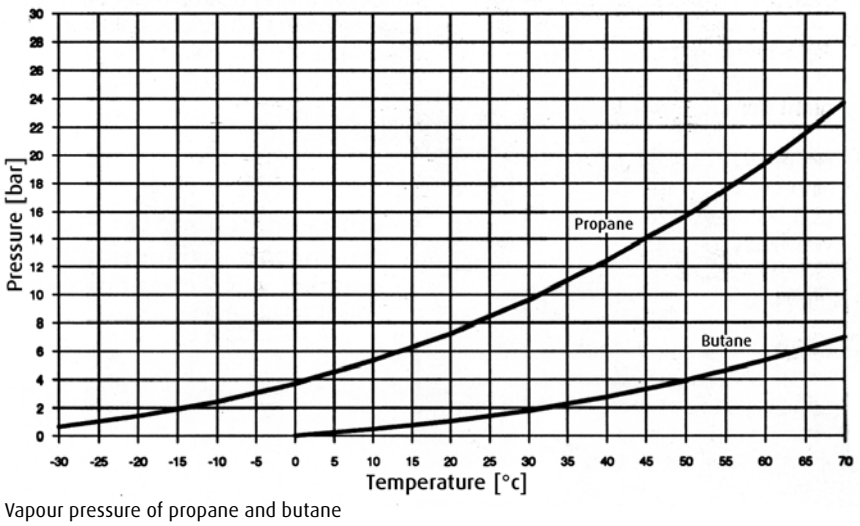
LPG is a flammable gas which, like any other flammable gas, can from explosive mixtures with air or oxygen as well as with other oxidising substances such as chlorine, fluorine and nitrous oxide. Mixtures of LPG and air are explosive at a vapour content of approximately 2–10 vol. % and can be ignited by a relatively low igniting energy, e.g. sparks.

2.2. Physical properties

In a gaseous state under atmospheric conditions, LPG is significantly heavier than air. This means that LPG mainly flows downwards and can accumulate in, for exam-ple, mines, cellars, sewers or depressions in the ground. Where there is little air movement, such LPG accumulations can remain for several hours.

LPG owes its name to the fact that it liquefies under relatively low pressure. In this state – "liquefied under pressure" – LPG is stored in cylinders and tanks.

The pressure in the vessel is dependent on the temperature and on the proportions of components. The pressure at 20°C is between approximately 2 bar (butane) and 8 bar (propane).



Vapour pressure of propane and butane
The pressure in a vessel containing liquid gas mixtures lies in between the two curves, depending on the composition and the temperature.

The pressure is no measure of the quantity of LPG in the vessel. This can only be determined by deter-ming the weight. When the pressure on LPG is relieved, e.g. by removing it from the cylinder, it transforms into its gaseous state.

Depending on the composition of the LPG, 1 litre of liquid produces approximately 260 to 350 litres of gas.
LPG requires heat in order to va-porise. This is taken from the immediate environment.

This results in cooling down of the vessel and the remaining LPG. Every surface which comes into contact with the vaporising LPG is also cooled in the same way.

2.3. Physiological effects

LPG is colourless and almost odourless, which makes it undetectable to the human sensory organs. So that outflowing LPG can be detected, it is odorised, i.e. a small amount of an odorising agent is added to the LPG.

LPG is non-toxic, but in high concentrations it can cause suffocation as it displaces air. In extreme cases it may act as an anaesthetic.

Vaporising LPG can be harmful due to its cooling effect. As LPG consumes significant amounts of heat during vaporising, it can cause painful cold burns if it comes into contact with human skin and vapor-ises there. Sensitive body tissue such as the eye are particularly susceptible. Large-scale cold burns are potentially fatal. (For details, see Linde Safety Advice 1 „Handling of cryogenic liquefied gases").

3. Safety measures

LPG flowing out into the atmosphere gives rise to fire and explosion hazards. The following safety measures are appropriate to eliminate these risks:

- As long as no LPG is being taken out, keep vessel valves closed.
- Rooms with LPG systems must have natural or technical ventilation in order to sufficiently dilute any escaping gas.
- When handling LPG directly (e.g. connecting / disconnecting cylinder) smoking is prohibited.

Extremely flammable

- When there is a major escape of LPG, it is especially important to vacate low-lying rooms immediately (e.g. mines, cellars) as this is where the danger of LPG accumulations is particularly great.
- The installation between the vessel and the consumption point must be gastight. LPG systems must be regularly checked for leaks, e.g. with foaming agents. Leaks on vessels, valves, lines and consumer units must be remedied immediately. Particular attention must be paid to hose lines which can develop leaks through ageing and damage.
- Gas flowing out at the consump-tion point (e.g. at the burner) must be ignited immediately, as delayed igniting always results in a more or less strong explosion.

The danger of cold burns when handling LPG can be eliminated by preventing LPG coming into contact with the body. By exercising suitable caution and attentiveness, personal safety equipment (gloves, goggles) can also prevent cold burns.

Another hazard can arise when using LPG. The combustion exhaust gas contains a small amount of toxic carbon monoxide and this must therefore be kept out of the inhaled air. On correctly installed LPG systems, this is done by appropriately conducting the waste gas and / or ventilating the room where the LPG system is installed.

4. Transfilling LPG

Important information on this sub-ject can be found in the Linde Safety Advice no. 8 „(Re-)filling gases". The following must also be observed in the case of LPG cylinders.

LPG cylinders should only be filled in authorised filling companies. Only such companies can safely evaluate the filling capability of the cylinder and have the necessary equipment for maintaining the stipulated filling quantity. The correct filling quantity guarantees that still no hazardous pressure arises in the LPG cylinder at temperatures up to 65°C. If a LPG cylinder is overfilled and even slightly heated, e.g. by sun-light, it can burst as a result of the increasing liquid pressure.

5. Withdrawal of LPG from the gas phase without dip tube

LPG is taken from the gas phase from the head of the LPG cylinder.

Uninterrupted and steady gas dis-pensing is guaranteed by the amount of gas being taken constantly being replaced by the va-porisation of the liquid phase. The heat required for the vaporisation is taken from the environment, which is why the gas volumetric flow which can be achieved is restricted from LPG cylinders without dip tube. Taking gas too quickly, which can be recognised by the heavy formation of hoarfrost on the outside of the cylinder, can result in the gas flow being stopped, even though liquid phase is still in the cylinder. In addition, the cylinder valve can ice up during this process, with the result that it can no longer be closed. If larger amounts of LPG are required, several gas cylinders must therefore be operated in parallel or the gas cylinder must be heated slowly with warm water (not more than 50°C). In all cases, local overheating must be prevented, e.g. a gas cylinder must not be heated by a flame under any circumstances.

LPG cylinders normally are fitted with a safety valve integrated in the cylinder valve, identifiable e.g. by a pressed-in red plastic disk. The safety valve reacts at an over-pressure of 25.5 bar and closes automatically below this pressure. This prevents a LPG cylinder bursting at high temperatures, e.g. in the event of a fire. The safety valve must not be tampered with in any way whatsoever.

For extracting gas, LPG cylinders must have a pressure reducer in order to reduce the pressure to the permissible amount for the application. Most appliances operate in the range 0,35 to 2 bar. LPG cylinders without a dip tube must be standing vertically when gas is being extracted, so that hazardous penetration of the liquid phase into the consumer units is prevented.

6. Withdrawal of LPG from the liquid phase with dip tube

A special variant of LPG cylinders have an inside dip tube. It extends from the cylinder valve down to the bottom, so that LPG is inevitably extracted in liquid form. In this way LPG is used e.g. as fuel for vehicles.

The following special characteristics must be taken into account when using such "fuel gas cylinders":

- Fuel gas cylinders may only be used if it is intended to extract LPG from the liquid phase. The flow from a fuel gas cylinder is significantly greater than that from a LPG cylinder without a dip tube. It would be potentially lethal to connect a fuel gas cylinder to a consumer unit that is intended only for LPG flowing in gaseous form. Some fuel gas cylinder valves have an integrated excess flow check valve, which limits the flow of liquid.
- The user must be fully aware hat he is handling a fuel gas cylinder. The filling company therefore clearly identifies fuel gas cylinders as such with a special label. The fuel gas cylinders also have a cylinder collar.

- Fuel gas cylinder must be operated in horizontal position so that the opening of the dip tube remains under the liquid level. Only if this condition is met can almost the entire content be extracted from the cylinder in line with the intended application.
- LPG is extracted from a fuel gas cylinder from the liquid phase at the full cylinder pressure without using a pressure reducer. The extraction device must be suitable for LPG in the liquid phase.
- Pipe sections for LPG in the liquid phase which can be shut off must be fitted with a safety valve.

7. What to do in the event of a gas release or a fire

If LPG escapes through a leak, the flow to the leak must be shut off by closing valves. Attempts to directly seal off the leak should not be made due to the risk of igniting the gas.

In the event of LPG escaping in a fire, the fire must be extinguished by shutting off the gas supply. If the fire is in a room and the gas flow cannot be shut off, the fire must be allowed to burn until the gas supply is exhausted.

Attempting to put out the fire with powder or water may be successful, but afterwards there would be a significant explosion hazard due to the LPG still flowing out.

LPG cylinders in the vicinity of a fire source must be removed or cooled down intensively with water from a safe distance.

8. Final observations

LPG can be used for a variety of applications. It depends on correctly utilising its properties in order to obtain the desired results and to eliminate the possible hazards. Our gas specialists can tell you how to do that.

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