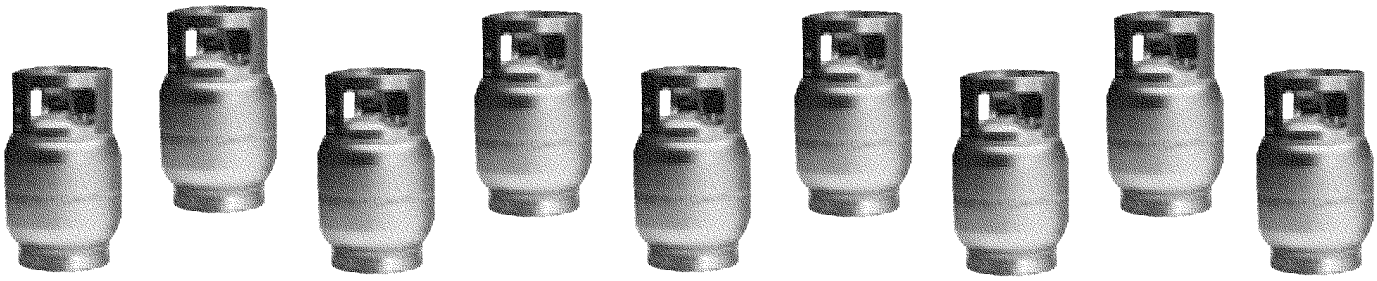
LIQUEFIED PETROLEUM GAS (LPG)



Liquefied petroleum gas (LPG) is a nonrenewable gaseous fossil fuel, which turns to liquid under moderate pressure. LPG, a by-product of natural gas processing and oil refining, includes various mixtures of hydrocarbons. The type of LPG used as a vehicle fuel is a liquid mixture containing at least 90 percent propane, 2.5 percent butane and higher hydrocarbons, and the balance ethane and propylene. The mixture is commonly called "propane."

HISTORY

In 1910, under the direction of Dr. Walter Snelling, the U.S. Bureau of Mines investigated gasoline to see why it evaporated so fast and discovered that the evaporating gases were propane, butane, and other hydrocarbons. Dr. Snelling built a still that could separate the gasoline into its liquid and gaseous components and sold his propane patent to Frank Phillips, the founder of Phillips Petroleum Company.

By 1912, propane gas was cooking food in the home. The first car powered by propane ran in 1913. By 1915 propane was being used in torches to cut through metal. LPG has been used as a transportation fuel around the world for more than 60 years.

CURRENT USES

In the United States, LPG is currently the third most commonly used transportation fuel, ranked behind gasoline and diesel. It is also used for home barbecues, recreational vehicle appliances, and heating and cooking in areas where natural gas is not available.

In the United States, LPG has been used mostly in fleets, including school buses in Kansas and Oregon, taxicabs in Las Vegas, sheriff and police cars, and dozens of fleets throughout California. Many nonroad vehicles, such as industrial forklifts and farm vehicles, use propane. In Tokyo all taxis are required to run on propane to reduce urban smog. Other countries widely using LPG include Australia, Canada, the Netherlands, Italy, and Japan.

SOURCE, AVAILABILITY, AND PRICING

The United States is one of the world's largest producers of LPG. Over 90 percent of the LPG used in the United States originates within the country. Texas is a major producer of LPG. An infrastructure for delivering propane is well established throughout the United States; publicly accessible fueling stations exist in all states. Propane prices are often tied to oil prices and tend to fluctuate widely. In areas where LPG is used as a heating fuel, seasonal rates during the winter season tend to increase LPG prices. Extended periods of unusually cold weather ("cold waves") may cause sudden increases in the price of LPG.

STORAGE AND SAFETY

For storage and transportation, LPG is pressurized and LPG tanks are sealed. Sealed tanks eliminate evaporative emissions or spillage. Using outage valves incorrectly during refueling, however, could cause excess vapor discharge.

The weight of LPG vapors at ambient temperatures is approximately 150 percent the weight of air. If there is a leak, LPG vapors tend to sink to the ground and pool, creating a potentially hazardous situation. An odorant is added to make leaks more detectable. (In some areas in North America, LPG vehicles are not allowed in tunnels or in enclosed parking garages.)

Because LPG vaporizes when released from the tank and is not water soluble, LPG does not pollute underground water sources. LPG is extremely volatile and burns twice as hot as a gasoline fire. Vehicle fuel tanks in LPG vehicles are of relatively thick-wall steel construction. In the event of a vehicle crash, they are much less prone to rupture or to cause fires than gasoline tanks.

PERFORMANCE

Power, acceleration, payload, and cruise speed are comparable to those of an equivalent internal combustion engine. Propane has a high octane rating of 104 (compared with 87 for regular unleaded gasoline).

When introduced into a vehicle engine, LPG turns into a gas. In cold conditions, starting could be a problem because of the low vapor pressure of propane at low temperatures. A properly designed system enables quick starting in cold weather, however.

RANGE AND REFUELING

Refueling a propane vehicle is similar to filling a gas grill tank; the time it takes is comparable with that needed to fill a gasoline or diesel fuel tank. LPG refueling stations consist of a storage tank, a transfer pump, metering and dispensing equipment, and a hose. At the end of the hose is a coupling that connects to the coupling on the vehicle fuel tank. During refueling, the tank should be filled to no more than 80 percent capacity, to allow for liquid expansion as ambient temperature rises.

One gallon of LPG contains less energy than a gallon of gasoline. The driving range of a propane vehicle is about 86 percent that of a gasoline-powered vehicle. It takes 1.4 gallons of propane to provide the same amount of energy as one gallon of gasoline.

MAINTENANCE AND VEHICLE ALTERATIONS

Propane is stored on board in liquefied form under moderate pressure (about 200 pounds per square inch at 100°F). When it is drawn from the tank, it changes back into a gas before it is burned in the engine. Because it combusts in the gaseous phase, propane results in less corrosion and engine wear than does gasoline. Its high octane rating enables it to mix better with air and to burn more completely than does gasoline, generating less carbon. With less carbon buildup, spark plugs often last longer and oil changes are needed less frequently. According to the National Propane Gas Association, spark plugs from a propane vehicle last from 80,000 to 100,000 miles, and propane engines can last two to three times longer than gasoline or diesel engines.

EMISSIONS

Sealed tanks eliminate evaporative emissions or spillage. Refueling can be a source of LPG hydrocarbon emissions, however. Such emissions can be controlled through the use of special refueling valves. Certain toxics, especially benzene and butadiene, as well as regulated emissions, are generally lower than those of gasoline-fueled vehicles. Carbon dioxide emission levels are reduced by up to 40 percent over those of gasoline-fueled vehicles.