

## FIRST RESPONDER SAFETY: GASEOUS FUELS AND GASEOUS FUEL VEHICLES

### GASEOUS FUELS

Compressed natural gas (CNG), liquefied natural gas (LNG), and liquefied petroleum gas (LPG), more commonly referred to as propane, are gaseous alternative fuels, as defined by the Energy Policy Act of 1992.



**Natural Gas.** Natural gas is an odorless, non-toxic, non-corrosive, non-carcinogenic gaseous mixture of hydrocarbons and other gases. Most natural gas is extracted from wells or in conjunction with crude oil production.

Natural gas vehicle emblem. Source: NAFTC

Smaller amounts are derived as biogas, a renewable form of natural gas, from decaying organic materials, such as waste from landfills. Natural gas accounts for approximately 25% of the energy used in the United States. Of this, only about 0.1% is currently used for transportation fuel. Because of the gaseous nature of this fuel, it must be stored on board a vehicle in either a compressed gaseous or liquefied state.



**CNG:** To provide adequate driving range, CNG must be stored onboard a vehicle in tanks at high pressure.



**LNG:** To produce LNG, natural gas is purified and condensed into liquid by cooling it.



**Propane.** Propane is a three-carbon alkane gas produced as a byproduct of natural gas processing and crude oil refining. When stored under pressure in a tank, propane

becomes a colorless, odorless liquid. As pressure is released, the liquid propane vaporizes and turns into gas that is then used for combustion. An odorant is added to propane for leak detection. It accounts for about 2% of the energy used in the United States; however, less than 2% of U.S. propane consumed is used for transportation fuel.

### GASEOUS FUEL VEHICLES

Gaseous fuels are used in passenger vehicles through heavy-duty vehicle applications. Vehicles that run on LNG, CNG, or propane operate in the same way as conventional vehicles, and include an internal combustion engine (ICE), transmission, drive train, and fuel storage system, but require some modification to the engine calibration and fuel management systems (primary fuel storage systems). The ICE converts fuel into mechanical energy and operates in much the same manner as the ones found in conventional gasoline vehicles.

Gaseous fuel vehicles may be configured in one of three ways: dedicated, bi-fuel, or dual-fuel. Dedicated vehicles run on only



Propane vehicle. Source: NAFTC

one alternative fuel. Bi-fuel vehicles can run on either alternative fuel or gasoline. Dual-fuel vehicles run on alternative fuel (natural gas) and use diesel for ignition assist. Light-duty vehicles typically operate in dedicated or bi-fuel modes, and heavy-duty vehicles operate in dedicated or dual-fuel modes.

### VEHICLE SAFETY

As with all fuels, natural gas and propane are flammable, but gaseous fuel vehicles meet the same safety standards as conventional vehicles. First responders must understand the different components that make these vehicles unique in an emergency situation.

**Natural Gas.** Natural gas vehicle (NGV) fuel tanks are strong and extremely puncture resistant. In addition, NGVs must meet the National Fire Protection Association's (NFPA) NFPA 52 Vehicular Fuel System Code.

### U.S. STATISTICS

Alternative Fuel	Number of vehicles in use (2008) <sup>a</sup>	Total annual fuel use in vehicles (2008) <sup>a</sup>	Total fueling stations (May 2010) <sup>b</sup>
CNG	113,973	189,358 GGEs <sup>c</sup>	836
LNG	3,101	25,554 GGEs	38
Propane	151,049	147,784 GGEs	2,403

<sup>a</sup>U.S. Energy Information Administration, Alternatives to Traditional Transportation Fuels 2008.

<sup>b</sup>U.S. Department of Energy, Alternative Fuels & Advanced Vehicles Data Center (AFDC).

<sup>c</sup>GGE: Gasoline gallon equivalent.

<sup>1</sup>Clean Vehicle Education Foundation (2008), Technology Committee Bulletin: How Safe are Natural Gas Vehicles?

Based on a survey of over 8,300 natural gas fleet vehicles that traveled over 175 million miles:

- The NGV injury rate was 37% lower when compared to gasoline fleet vehicles;
- There were no fatalities compared with 1.28 deaths per 100 million miles for gasoline fleet vehicles;
- Vehicles were only involved in seven fire incidents, only one of which was directly attributable to failure of the natural gas fuel system.<sup>1</sup>

**Propane.** Propane tanks are 20 times more puncture resistant than gasoline tanks, and propane in its liquid state has the lowest flammability range of all alternative fuels. Because it becomes a gas when leaked, however, propane is more likely to ignite than other liquid fuels; leaked propane gas can fill a room and form a flammable layer against the ground or floor. If stored in an enclosed space, proper ventilation and leak detection sensors are needed to increase safety, as the gas can displace the air necessary for breathing.

## FIRST RESPONDER INFORMATION

Important considerations when responding to an incident involving a gaseous fuel vehicle include:

- Be sure to identify whether the vehicle is powered by CNG, LNG, or propane.
- Approach the vehicle with caution and only with the appropriate training.
- Eliminate all ignition sources.
- Stay upwind of vapors.
- Look, smell, listen, feel and/or use sensors to detect leaking fuel or a fire.
  - If no fire or leak is detected, isolate the fuel system.

In the case of a vehicle fire:

- If the vehicle is on fire or a leak is detected, do not approach the vehicle.
- Isolate the fire, if possible.
- Extinguish the fire.
- Be aware that, if the flame is extinguished without stopping fuel flow, the fire may re-ignite.

In the case of fuel spill or leak, eliminate all ignition sources and use water spray to reduce vapors or divert vapor cloud drift.

If extrication is necessary:

- Be sure there are no leaks or vapors that could ignite
- Know cribbing points and cut zones before cutting into a vehicle.
- Avoid cutting critical components.



Propane decal on a school bus. Source: NAFTC



Natural gas vehicle refueling. Source: NAFTC

## ADDITIONAL RESOURCES

- U.S. Department of Energy, Alternative Fuels & Advanced Vehicles Data Center:  
<http://www.afdc.energy.gov/afdc/>
- Clean Vehicle Education Foundation:  
<http://www.cleanvehicle.org/>
- Natural Gas Vehicles for America:  
<http://www.ngvc.org/>
- Propane Education & Research Council:  
<http://www.propanecouncil.org/>
- National Fire Protection Association:  
<http://www.nfpa.org/>