GO WITH NATURAL GAS

A smart choice for transportation

NATURAL GAS AS A VEHICLE FUEL –

CNG & LNG

What You Need to Know

GENERAL

Natural gas is mostly made up of methane. It has a simple structure that contributes to its cleaner-burning properties. Methane consists of one carbon atom and four hydrogen atoms. Natural gas has about 27 per cent less carbon than diesel fuel or gasoline. A fuel composition comparison with diesel can be found on the Go With Natural Gas website.

Several other properties also set natural gas apart from diesel or gasoline. For example:

- **Natural gas is lighter than air. In its compressed form (CNG), natural gas will rise if released and will not pool on the ground. In its liquid form (LNG), a small spill of natural gas will evaporate and will rise if released. A larger spill of LNG may run to the ground or pool in low points.**
- **Natural gas requires a much higher temperature to ignite than liquid fuels.**
- **Natural gas will only burn when there is the right mixture of air and gas. If there is less than five per cent or more than 15 per cent natural gas mixed with air, the gas will not burn.**
- **Natural gas will not corrode other materials or contaminate soil or groundwater.**

In addition, natural gas has less energy by volume than diesel or gasoline. It must be compressed or liquefied to store enough energy on board a vehicle for adequate driving range.

Both forms of natural gas have the potential to offer an affordable, lower emission alternative, but there are many key differences to be aware of between compressed and liquefied natural gas as vehicle fuels.

Compressed Natural Gas (CNG)	Liquefied Natural Gas (LNG)
CNG is natural gas that is compressed at high pressure in order to reduce its volume and tank size. CNG remains in gas form and is stored in durable cylinders at pressures of up to 3,600 pounds per square inch. CNG is lighter than air. It will rise if released and will not pool on the ground. CNG is the most commonly-used form of natural gas for transportation. It has been in widespread use since the 1960's as a vehicle fuel. As the ambient outdoor temperature increases or decreases, the pressure in a CNG fuel storage cylinder also correspondingly increases or decreases. CNG cylinders are designed to accommodate these changes in temperature and pressure. CNG cylinders are required to have pressure relief devices that are activated by elevated levels of heat in the event of an emergency. This design requirement ensures that there is no risk of cylinder breakage in extreme conditions.	LNG is natural gas that has been cooled to its liquid state at -162 degrees Celsius in order to reduce volume. LNG is stored in insulated, thermos-like tanks and, as it warms up, it returns to its gaseous state. Regardless of the type of engine used in an LNG vehicle, the fuel is always delivered to the engine as a gas, rather than as a liquid. There are two forms of LNG vehicle fuel – *saturated* LNG and *unsaturated* LNG. The difference between these forms is temperature. Saturated LNG is warmer, which results in a higher tank pressure. LNG vehicle fuel systems that do not include an internal pump in the LNG tank need to use saturated LNG. LNG vehicles equipped with fuel systems that include an internal pump in the LNG tank or a pressure booster can operate on either saturated or unsaturated LNG. Vehicle range and tank hold times increase with the use of unsaturated or cold LNG.

This product is made possible by a financial contribution from Natural Resources Canada.

ODOUR

Natural gas is colourless, odourless, and non-toxic. Regulations require that a substance be added to local natural gas networks to give the natural gas a distinct odour so that it can be detected in the event of a leak.

CNG	LNG
CNG is infused with mercaptan, the same substance used in local gas networks to give the natural gas a distinct rotten egg smell.	LNG cannot use mercaptan because of the low temperature of the fuel, so methane detectors must be used on LNG vehicles.

ENERGY CONTENT & VOLUME

A megajoule is a unit of energy. One litre of diesel fuel contains 36 megajoules of energy.

CNG	LNG
CNG has 7.5 megajoules of energy per litre. Compression reduces the volume by 300 times or more compared with natural gas at normal pressure.	LNG has 21 megajoules of energy per litre. Liquefying the gas reduces the volume 620 times compared with natural gas at normal pressure. To match the energy of a litre of diesel, 1.7 litres of LNG is needed.

CHOICE OF FUEL

Available fuel options and daily driving requirements are the two most important factors in selecting a CNG or LNG fuel system.

CNG	LNG
CNG fuel systems can be used for any type of vehicle, but as fuel storage increases, so does vehicle weight. CNG is particularly well-suited for return-to-base urban fleets including transit bus and refuse truck fleets.	LNG fuel systems typically are only used on heavy-duty vehicles requiring greater driving range such as highway tractors. LNG must be used within a certain timeframe or it will start to warm and return to its gaseous state.

STORAGE

Natural gas used as a vehicle fuel is stored in strong, puncture resistant cylinders or tanks. More space is needed to hold the same amount of energy compared to diesel fuel.

CNG	LNG
CNG is stored on a vehicle in cylinders at high pressure. CNG cylinders are made of durable materials with built-in pressure relief devices to act as safety controls. There are four types of cylinders available for storing CNG on a vehicle: • Type 1 – all metal (aluminum or steel) • Type 2 – metal liner reinforced by composite wrap (glass or carbon fibre) around middle ("hoop wrapped") • Type 3 – metal liner reinforced by composite wrap around cylinder ("full wrapped") • Type 4 – plastic gas-tight liner reinforced by composite wrap around cylinder ("full wrapped") **Type 3 and 4 cylinders weigh less than half of what a Type 1 steel cylinder weighs.*	LNG is stored in insulated, thermos-like, double-walled tanks on vehicles. The tanks are made of durable materials and must comply with recognized standards for pressure vessels and for LNG fuel storage on vehicles. As part of the design requirements, the tanks must be capable of withstanding extreme conditions. Drop tests and bonfire tests are two of the types of durability tests that are required to show that the tanks are safe even in emergency conditions. LNG tanks are designed to minimize heat transfer. The tank designs also incorporate pressure relief strategies so that any pressure build up can be safely managed.

FUELING STATION EQUIPMENT

Natural gas fueling station equipment and regulations differ for CNG and LNG fuel.

CNG	LNG
As of March 2014, public and private CNG stations in Canada can dispense fuel to a settled pressure of 3,600 pounds per square inch (psi). Prior to this time, public CNG stations were limited to 3,000 psi refueling. An update to Canada's CSA B108 CNG station code means that Canada now aligns with the U.S. on fill pressure.	LNG refueling stations rely on bulk delivery of fuel via tanker trucks similar to other liquid fuels. As LNG needs to be stored at -162 degrees Celsius to stay in a liquid state, the fuel is delivered and stored in an insulated cryogenic vessel at the station and then pumped from the storage tank and dispensed similar to liquid fuels.