CNG Fuel System

First Responder Guide

labrie
Labrie Enviroquip Group

LABRIE LEACH WITTKE

Table of Contents

Preface

This document has been designed to assist first responders in the event of an accident or fire involving a compressed natural gas (CNG) vehicle.

This document has two objectives:

1) to allow first responders to familiarize themselves with the compressed natural gas (or CNG) system that many Labrie vehicles use for residential and commercial waste collection or recyclable material collection;

2) to guide first responders in responding to accidents and fires involving natural gas-powered waste vehicles.

NOTE:

This document is not intended to replace formal training on response techniques or procedures, but to provide additional information and clarification that may help first responders to better deal with sensitive situations caused by the presence of a burning or damaged natural gas vehicle following an accident.

Additional information can be obtained from the National Fire Protection Association (NFPA). In addition, often refer to your training programs for the most up-to-date information and best practices in emergency response to fires or accidents involving a CNG-powered vehicle.

We sincerely hope that this document will answer your questions and concerns about Labrie natural gas vehicles.

NOTE: Please keep this document readily available for reference at all times.

Responsibility

Labrie Enviroquip Group assumes no liability for any incidental, consequential, or other liability that might result from the use of the information contained in this document.

All risks and damages, incidental or otherwise, arising from the use or misuse of the information contained herein are entirely the responsibility of the user.

Although careful precaution has been taken in the preparation of this document, Labrie Enviroquip Group assumes no responsibility for errors or omissions.

May 2018 Part# 177741 (Rev. 0)

Conventions

DANGER!

Indicates a hazardous situation which, if not avoided, ***will*** result in serious injury or death.

WARNING!

Indicates a hazardous situation which, if not avoided, ***could*** result in serious injury or death.

CAUTION!

Indicates a hazardous situation which, if not avoided, could result in ***minor or moderate injury.***

What is CNG?

CNG stands for *Compressed Natural Gas* compared to LNG, which stands for *Liquefied Natural Gas*.

Natural gas is a fossil fuel substitute for gasoline, diesel or propane. It is a safer and more environmentally clean alternative to those fuels.

Natural gas is a gaseous mixture of hydrocarbons naturally present in certain porous rocks. Drilling is required to properly extract it.

CNG is made by cleaning and compressing natural gas to less than 1% of the volume it occupies at standard atmospheric pressure. It is usually stored and distributed in cylindrical or spherical containers (or tanks) at a pressure of 3600 psi (248 bar) at 70° F (21° C).

Natural gas is a flammable gas. It is colorless, tasteless, and non-toxic. It is a light gas, weighing about two-thirds as much as air. It tends to rise and diffuses rapidly in air when it escapes from the system. CNG is odorized to facilitate detection of possible leakage. It is non-toxic but can cause asphyxiation when it displaces in a confined area without adequate ventilation.

Natural gas is a mixture of hydrocarbons, mainly methane (CH_4), and is produced either from gas wells or in conjunction with crude oil production. Natural gas is used in the residential, commercial, industrial, and utility markets.

The interest for natural gas as an alternative fuel stems mainly from its clean burning qualities, its domestic resource base, and its commercial availability to end-users. Because of the gaseous nature of this fuel, it must be stored onboard a vehicle in either a compressed gaseous state (CNG) or in a liquefied state (LNG).

If CNG Safe?

Vehicles that run on clean burning natural gas are as safe as vehicles operating on traditional fuels such as gasoline. In fact, many school transportation managers choose natural gas to power their school buses because compressed natural gas, unlike gasoline, dissipates into the atmosphere in the event of an accident.

The fuel storage cylinders used in natural gas vehicles (NGVs) are much stronger than gasoline fuel tanks. The design of NGV cylinders are subject to a number of federally required "severe abuse" tests, such as heat and pressure extremes, gunfire, collisions and fires.

While fuel storage cylinders are stronger than gasoline fuel tanks, the composite material used to encase the tanks are fundamentally more susceptible to physical damage than metals under abusive conditions. For this reason, composite materials on NGV cylinders must always be properly handled and protected. Incidents involving natural gas cylinder ruptures revealed that some form of chemical attack or physical damage to the composite overwrap on the cylinder was involved.

NGV fuel systems are "sealed," which prevents any spills or evaporative losses. Even if a leak was to occur in an NGV fuel system, the natural gas would dissipate into the atmosphere because it is lighter than air.

Natural gas is not toxic or corrosive and will not contaminate ground water. Natural gas combustion produces no significant aldehydes or other air toxins, which are a concern in gasoline and some other alternative fuels (source: AFDC).

Figure 1-1 CNG sticker affixed to body left side

CNG Fuel System Installation

Types of Installation Setup

Labrie Enviroquip Group offers four types of installation setup:

Figure 1-2 Behind the cab (left), rooftop (right)

Figure 1-3 Inside tailgate (left), along the chassis frame (right)

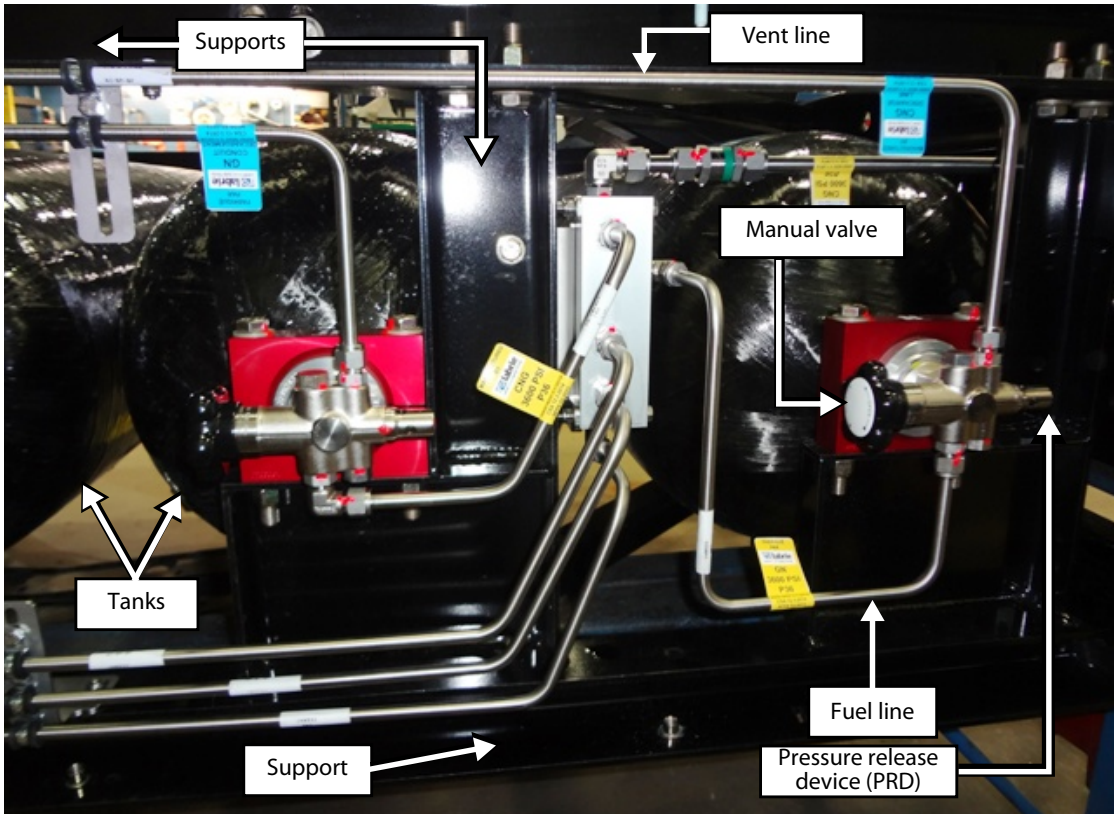
NOTE: Currently, the storage capacity can vary from 194 gallons (736 liters) to 338 gallons (1280 liters).

NOTE: Two types of installation setup can be found on the same vehicle (e.g. four tanks can be installed on the body rooftop and two others on one of the chassis frames).

Typical Installation of a CNG Fuel System

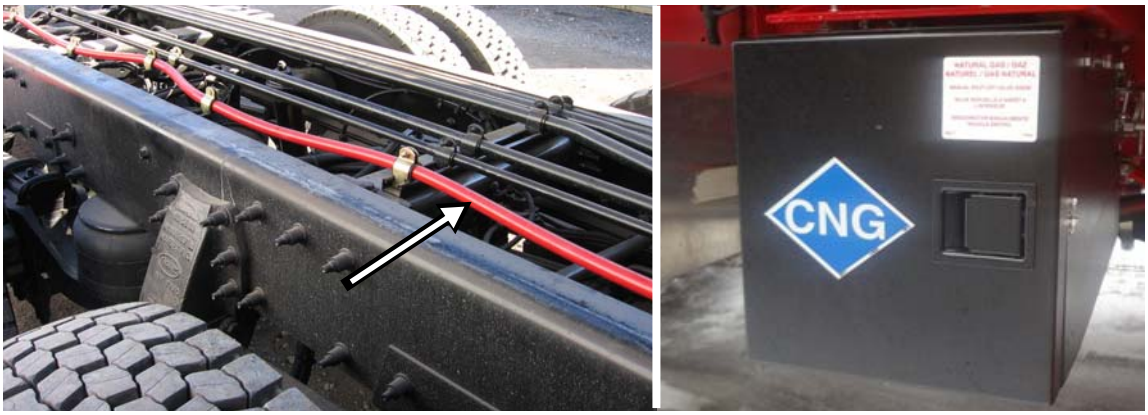
Here is a brief description of a typical installation of a CNG fuel system and its main components:

- The tanks are securely fastened to supports. Each tank is equipped with a manual valve. Pressure inside the tank must not exceed 3600 psi @ 70°F (21°C).

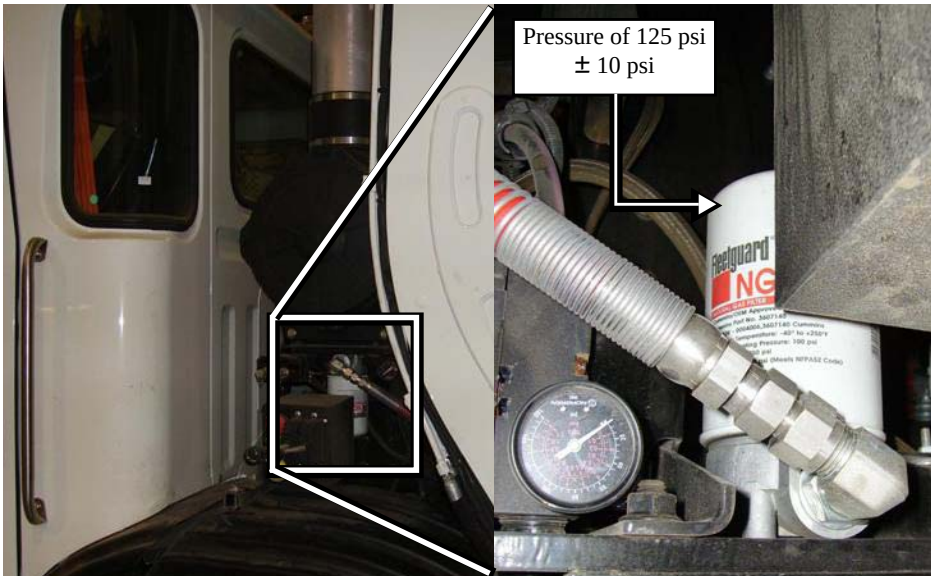


- A high-pressure fuel line is connected to the tanks.

- A red flexible high-pressure hose (left) and a fuel management module or control panel are installed on the chassis (right).



- A CNG low pressure filter is installed (the installation by Labrie of the CNG fuel system ends here; beyond the filter, the installation is done by the chassis manufacturer).



NOTE: Installation images presented in this document are for illustrative purposes only and may differ from the actual CNG system installation.

Main Components of the CNG Fuel System

The CNG fuel system that is installed on a natural gas-powered vehicle is comprised of the following components:

- Pressurized tanks (or cylinders, reservoirs) storing CNG fuel (pressure inside these tanks vary according to the needs and the type of installation setup)

Tanks may be placed either on the body rooftop or stacked behind the cab. They may also be placed either alongside the chassis frame or inside the tailgate. Their dimensions vary according to the volume of gas that can be stored inside.

- Integrated gas control system

  This control system is used for supplying gas to the engine.

- Pipes

  Pipes are used to connect the gas supply to the engine.

- Control panel (or fuel management module)

  The control panel is used for regulating the flow of gas to the engine.

- Fueling receptacle/nozzle (see Figure 1-7)

  This component is used for pressurized refueling of the truck.

- De-fueling system

  This system is used to partially or fully de-fuel the CNG system aboard the truck.

System Basic Principles

The control panel will supply CNG fuel to the engine when the solenoid valve, located inside the control panel, is activated and the storage tank valves and the manual shut-off valve are in their open position.

When the solenoid valve is activated, high pressure CNG fuel flows from the tanks to the pressure regulator, which reduces the pressure to about 125 psi, via the manual shut-off valve, manifold and coalescing filter.

The CNG Fuel System

This section deals with the CNG fuel systems that are mounted on Labrie vehicles. The emphasis will be put on the CNG tanks and the pressure relief devices as well as on the control panel, the nerve center of the CNG system.

NOTE: To determine if the vehicle operates effectively on natural gas, try to locate a blue sticker which has the letters CNG on it (see Figure 1-8). The sticker should be found on the tailgate and it may also be found on either side of the vehicle.

Labrie uses two types of CNG tanks:

- those composed of an aluminum lining with a continuous carbon fibre envelope (type 3)
- those composed of a plastic lining with a continuous carbon fibre envelope (type 4)

CNG fuel tanks are housed in steel or aluminum structures attached to the vehicle body or chassis. (see Figure 1-4). These structures are designed to protect the tanks in the event of a collision.

These structures also serve to protect the tanks from UV exposure and to improve the appearance and aerodynamics of the vehicle.

Each tank of a CNG fuel system is equiped with a manual valve on one end that can be used to isolate the contained fuel from the rest of the system (see upper picture on page 5). In the normal course of operations, all valves must be open.

Figure 1-4 Example of a tank-protecting structure

Pressure Relief Devices (PRDs)

WARNING!

- Pressure relief devices vent compressed natural gas into the atmosphere; the discharge pressure is the same as that in the tank.
- Damage to the vehicle and its position can change the direction of venting gas.
- The escaping gas may ignite, create a jet fire and reignite several times.

CNG fuel systems installed by Labrie include one or more pressure relief valves. Here are some points concerning these safety devices:

- Pressure relief valves are used, in particular, to protect CNG tanks. They allow the gas to escape to prevent the tanks from exploding. Pressure relief valves are activated by heat.
- Pressure relief valves activate (i.e. let gas escape) between 212° F and 220° F (100° C and 104° C).
- Location of pressure relief valves and directions of venting gas:
  - for systems installed on one of the chassis frames, gas is evacuated to the side of the body through a vent stack.
  - for systems installed on the body roof, rear vents form an upwardly curved exhaust stack.
  - for systems mounted behind the cab, the upwardly and backwardly curved exhaust stack allows the gases to escape in the opposite direction from the cab.
  - Some system models allow gases to escape to the ground or to the sides.

NOTE: Unlike a building or utility facility, where huge amounts of fuel can be found, a natural gas vehicle has a limited amount of fuel on board. It is therefore preferable, in the event of fire, to let the gases escape and to monitor the risks related to secondary exposure.

Figure 1-5 Direction of venting gas - tanks on the body rooftop and behind the cab

Figure 1-6 Direction of venting gas - tanks inside the tailgate and on the chassis

NOTE: Installation images presented in this document are for illustrative purposes only and may not represent the actual CNG system installation.

Control Panel

The control panel is equipped with a ¼ turn shut-off valve that isolates the fuel storage system from the engine for maintenance or emergency situations. Although the location and layout of the valves and gauges may vary, all control panels operate in the same manner.

Controls and Gauges

The control panel has the following elements:

NOTE: Refer to Figure 1-7 to help you locate these elements on the control panel.

- high-pressure gauge

  It indicates the nominal pressure of the fuel tank, that is 3600 psi.

- low-pressure gauge

  It indicates the nominal pressure at the regulator output, that is 125 psi.
- ¼ turn main shut-off valve

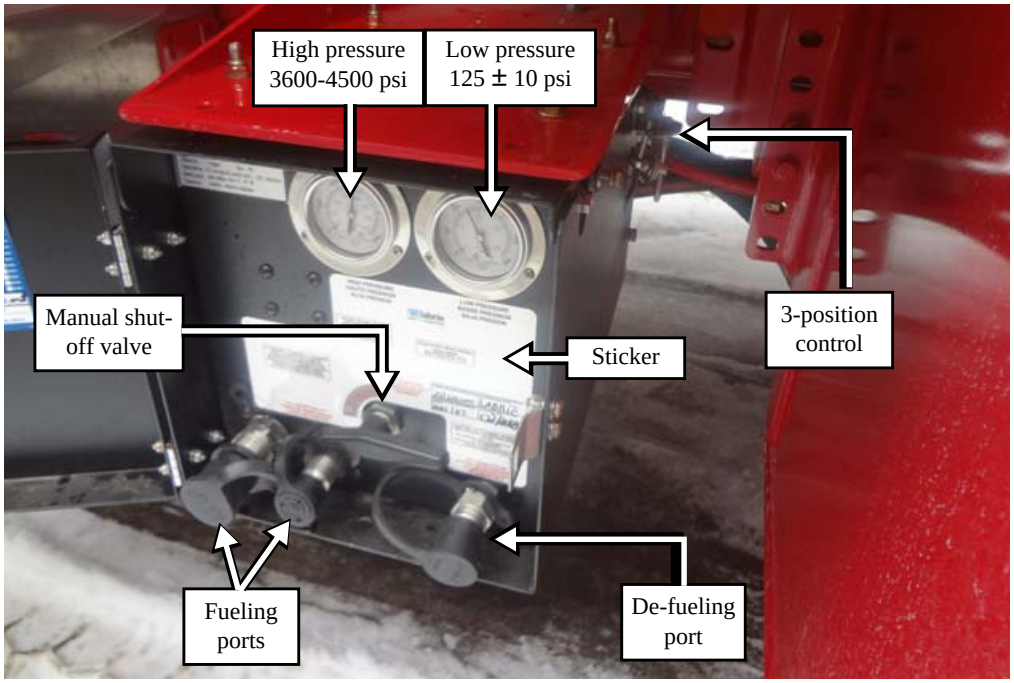
  This device stops the fuel flow to the engine. It is normally open. Turn it to the "CLOSED" position and depressurize the system before servicing.
- De-fueling port

  This port is used to empty the tank of its contents.
- Information sticker

  This sticker contains the following information: volume of water, number of gallons (liters), location and date of installation and tank expiry date.
- Fueling ports

  These ports allow for fast and slow fueling.

Figure 1-7 Control panel interface



Emergency Response

This section deals with the measures to be applied in the event of an emergency. The information herein is intended for first responders facing an emergency situation caused by an accident or fire involving a natural gas vehicle.

NOTE: To determine if the vehicle operates effectively on natural gas, try to locate a blue sticker which has the letters CNG on it (see Figure 1-8). The sticker is usually affixed to the right of the tailgate. To know the total volume of CNG contained in the truck's tanks, locate the sticker shown in Figure 1-1 on the body left side.

Figure 1-8 CNG sticker

WARNING! The pressure in the truck's CNG system is 3600 psi or more when the system is full. It is therefore important not to cut the CNG fuel lines.

Emergency measures

A. **If the vehicle has been damaged or if a leak has been detected**, apply the following measures:

- Eliminate all ignition sources such as fire, sparks, electronic devices, lights and electrostatic charges. Do not smoke near the vehicle or light flares.
- Turn OFF the ignition switch (this will close the solenoid valve), apply the parking brake and disconnect the main power supply (usually located near the battery compartment).
- If it is safe to do so, close the manual shut-off valve (Figure 1-7), close the tank valves (see top photo on page 5) and check for leaks in the CNG fuel system near the damaged area using the senses of sight, hearing and smell. CNG is odorized and can be detected by smell.
- Prevent pedestrians and drivers from getting too close to the area affected by the accident or fire.
- Open the cab doors to let fresh air in.

- If the vehicle is inside, open windows and doors to allow ventilation and avoid turning on lights or electronic devices that could create a spark. Pay particular attention to ignition sources, especially those near the ceiling, as natural gas will rise to the ceiling.
- Be aware that residual gas may still escape from the storage system, even if the ignition switch has been turned off and the manual shut-off valve has been closed.
- Inform towing operators that the damaged vehicle is an NGV (natural gas vehicle).
- Have any necessary repairs performed by a service technician qualified in servicing natural gas powered vehicles.

B. **If the vehicle is on fire**, apply the following measures:

DANGER!

- Do NOT apply water to tanks as this will prevent the pressure relief valves from activating, which could result in catastrophic tank failure (high pressure gas rupture).
- After 5 to 10 minutes in a fire without pressure relief valve activation, the pressure inside the tanks can increase to 5000 psi or more.
- The burst pressure of an intact CNG tank is 8000 to 9000 psi.

- Establish an 80 to 100 foot (24 to 30 metre) safety zone.
- If the flames do not touch the CNG tanks, they can be fought using normal response tactics.
- If, on the other hand, the flames touch the tanks even slightly or if the tanks are on fire, it is best to let the vehicle burn and monitor secondary hazards (e.g., the risk of damage to other surrounding structures or vehicles).
- When a pressure relief valve is activated, a jet fire often appears, which can go out and re-ignite several times.
  - Normally, a pressure relief valve installed on a CNG tank will take 2 to 5 minutes to activate. Then, it will take about 5 minutes for the complete evacuation of the gas, but this may vary depending on the amount of fuel in the system.
  - The tank can withstand flames for a total of 20 to 30 minutes.
- Inform towing operators that the burnt-out vehicle is an NGV (natural gas vehicle).

To Contact Labrie Plus

In the U.S.

Address:	1198 Shattuck Industrial Blvd. LaFayette, GA 30728
Toll Free:	1-800-231-2771
Telephone:	1-920-233-2770
General Fax:	1-920-232-2496
Sales Fax:	1-920-232-2498
Parts and warranty:	During business hours, 8:00 AM to 6:00 PM Eastern Standard Time
Technical Support Service:	Available 24 hours

In Canada

Address:	175A Route Marie-Victorin Levis, QC G7A 2T3
Toll Free:	1-877-831-8250
Telephone:	1-418-831-8250
Service Fax:	1-418-831-1673
Parts Fax:	1-418-831-7561
Parts and warranty:	During business hours, 8:00 AM to 5:00 PM Eastern Standard Time
Technical Support Service:	Available 24 hours
Website:	www.labriegroup.com
E-mail:	sales@labriegroup.com

IMPORTANT: For technical support and parts ordering, the serial number of your vehicle is required. Therefore, Labrie Enviroquip Group recommends to keep record of the information found on the VIN plate, which is located in the cab.