



**CLEAN FUEL  
TECHNOLOGIES™**

## OPERATORS MANUAL – SERIES 500



# Cummins Clean Fuel Technologies

## 500 Series

### Operators Manual

## I. Legal Disclaimer

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## II. Preface

This manual is for Back Of Cab Fuel System Models: 500 with and without Fuel Management Modules. Service information is available by calling Cummins Clean Fuel Technologies at 1-844-CNG-TANK. DO NOT attempt to fill, defuel, vent, or perform basic maintenance on the system until you have read and fully understand the information presented in this manual.

If you have questions about any part of this manual, contact Cummins Clean Fuel Technologies 1-844-CNG-TANK.

This manual must always be kept in the vehicle so it is accessible to the operator at all times. This manual includes information that is important for the safety of the operator and First Responders (i.e. police, fire fighters) in the event of an emergency.

The following abbreviations are used throughout this manual:

1. CNG, which means Compressed Natural Gas.
2. FMM, which means Fuel Management Module

## III. Warning Statements

Warning statement definitions used in this manual.

 **DANGER**

*Indicates a hazardous situation which, if not avoided, will result in death or serious injury. The word "DANGER" applies to the most extreme situations.*

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** WARNING**

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

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** CAUTION**

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

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**NOTICE**

*Indicates practices not related to personal injury. The safety alert symbol shall not be used with this signal word.*

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### In Case of Emergency

Natural Gas Vehicles (NGVs) are subject to the requirements of the National Fire Protection Association (NFPA). NFPA 52, the Vehicular Gaseous Fuel Systems Code, details the safety requirements for NGVs and their fueling facilities.

### Fuel System Shut Down Procedure

In the event of an emergency or the vehicle requires service, shut down the CNG fuel system using the procedure below.

### Location of Manual Shut-Off Valves (Figure 1)

- One on the Fuel Management Module (FMM)
- One on each fuel cylinder

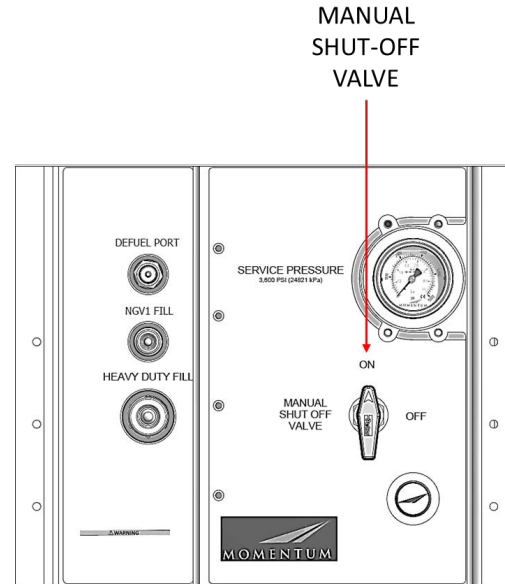


FIGURE 1 – MANUAL SHUT-OFF VALVE

### Step 1 – Turn OFF the Fuel Management Module (FMM) Manual Shut-Off Valve

The FMM Manual Shut-Off Valve isolates the fuel storage system from the engine. The FMM Manual Shut-Off Valve is RED and clearly labeled for easy identification.

(Figure 2)

To turn OFF the FMM Manual Shut-Off Valve:

1. Turn the ignition OFF and set the parking brake. Do not set the parking brake if the vehicle is being towed.
2. Open the fuel access door and locate the red Manual Shut-Off Valve.
3. Turn the valve clockwise 1/4 turn to the OFF position.

### Step 2 – Turn OFF the Fuel Cylinder Manual Shut-Off Valve(s)

The Fuel Cylinder Manual Shut-Off Valve on each tank isolates the fuel inside that tank.

**NOTE:** The Fuel Cylinder Manual Shut-Off Valve is designed so that it does not turn off pressure in the Pressure Relief Devices (PRDs) lines. This is a safety design so the CNG fuel system PRDs can still activate when the valves are shut off.

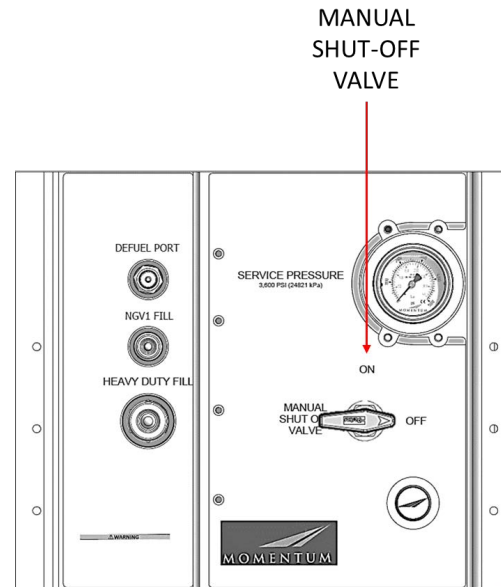


FIGURE 2 – MANUAL SHUT-OFF VALVE



# Section 1 – In Case of Emergency

To turn OFF the Fuel Cylinder Manual Shut-Off Valve:

- 1. Open the valve access cover to the fuel cylinder by opening the access door or turning the butterfly bolts counterclockwise. Locate the Fuel Cylinder Manual Shut-Off Valve. (Figures 5 through 10 on page 3A)
- 2. Turning off a Stem Valve style valve, one should turn the valve handle clockwise until handle stops turning. (Figure 3)
- 3. Turning off Ball Valve style valve, one should turn the valve handle clockwise until handle stops turning. (Figure 4)

**NOTE:** Use this method to turn OFF the valve on EACH tank. (Figures 3 and 4 Fuel System Cabinets figures 5 through 10 on page 3A)

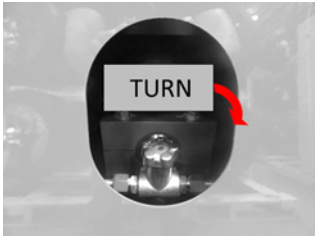


FIGURE 3 – CYLINDER MANUAL SHUT-OFF VALVE

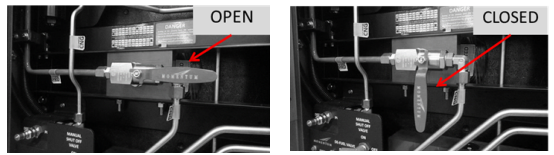


FIGURE 4 – CYLINDER MANUAL SHUT-OFF VALVE

## Section 1 – In Case of Emergency

Back of Cab MANUAL SHUT-OFF VALVES can be found on the driver side of the fuel system. Below are some of the fuel cylinder cabinets configurations with examples of valve locations and valve access manufactured by Cummins Clean Fuel Technologies. (Figures 4 - 5) **Note:** If vehicle is equipped with another manufactured fuel cylinder cabinet refer to their manual.

FIGURE 4 - CYLINDER MANUAL SHUT-OFF VALVE ACCESS DOOR

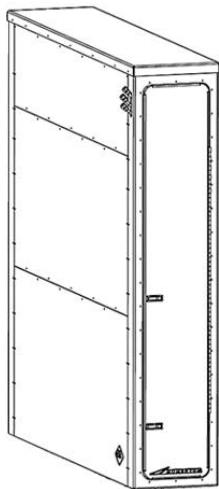
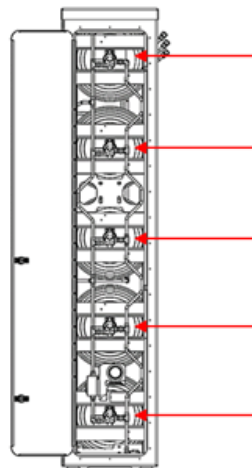


FIGURE 5 - CYLINDER MANUAL SHUT-OFF VALVE



### If You Suspect a Fuel Leak

#### **WARNING**

***Compressed natural gas is flammable and explosive. Serious personal injury can occur if leaking gas is ignited. If you suspect a leak, do not operate the vehicle. The vehicle must be inspected by a qualified technician before being returned to operation.***

---

### If You Smell a “Rotten Egg” Odor

An odorant which smells like rotten eggs is added to compressed natural gas to aid in detection of a leak. If you notice this kind of lingering odor coming from your vehicle, you may have a leak in the CNG fuel system.

**NOTE:** It is normal to detect this slight odor when the fueling nozzle is being connected or disconnected during the refueling process. The odor should quickly dissipate when fueling has been completed.

### Other Signs of a Fuel Leak

If you notice any of the following, you may have a leak in the CNG fuel system:

- Frosting at suspected leak point
- Bubbling in wet area
- Blowing or hissing sound
- Flames, if a leak has ignited

### If the Vehicle is Involved in an Accident

If the vehicle is involved in any accident or is leaking fuel, perform the following procedure.

#### **WARNING**

***If the vehicle is involved in any accident occurring in excess of 5 mph, the fuel system MUST be inspected by a CSA-qualified fuel system inspector before being returned to service.***

---

1. Turn the ignition switch OFF, turn the main battery OFF, and set the parking brake.

2. Eliminate all ignition sources such as fire, sparks, electronics, lights, or electrostatic charges. Never smoke near the disabled vehicle and do not light road flares. Inform First Responders the vehicle is a CNG vehicle and point out tank location.
3. If it is safe to do so, open the FMM access door and turn the FMM Manual Shut-Off Valve 1/4-turn clockwise to OFF position.
4. Open the service access panel. Turn all Fuel Cylinder Manual Shut-Off Valves clockwise 1/4-turn to the OFF position.
5. Conduct a visual check of the damaged area of the fuel system for signs of leaks.
6. Keep pedestrians and traffic away from the area.
7. If towing service is called, inform the operator of the presence of CNG and give guidance on proper safety procedures. Refer to the CNG Vehicle Safety Precautions procedure.
8. Have a qualified Cummins Service Technician inspect the fuel system and make any necessary repairs. Qualified service support can be found at [www.cumminscleanfueltech.com](http://www.cumminscleanfueltech.com)

## If the Vehicle is on Fire

1. Turn the ignition switch OFF.
2. Exit the vehicle in the safest manner possible.
3. Call 911.
4. If safe to do so, extinguish the fire using an appropriately-rated fire extinguisher.
5. Establish a safety zone of not less than 100 feet.
6. Report the following to the First Responder (i.e. police, fire fighters) when they arrive on site.
  - a. Vehicle is a CNG vehicle
  - b. Amount of fuel in the tank (psi reading if known)
  - c. Number of tanks
  - d. Location of the vent system

**Note:** Have the vehicle inspected by a qualified technician to ensure integrity of the CNG fuel system. Qualified service support can be found at [www.cumminscleanfueltech.com](http://www.cumminscleanfueltech.com)

### First Responder Alerts and Procedures

These procedures are intended for EMERGENCY PERSONNEL ONLY (i.e. police, fire fighters). Emergency First Responders are specially trained to handle emergencies involving alternative fuel vehicles. These instructions are not intended for untrained, unqualified individuals. DO NOT attempt to perform these procedures on your own. Call 911 and follow any preliminary emergency steps listed at the beginning of this section.

#### First Responder Emergency Procedure

1. Shut down the fuel system per the Fuel System Shut Down Procedure at the beginning of this section.
2. Turn the battery disconnect switch to OFF.
3. Notify additional emergency personnel, if needed.

### Fire Response Guidelines

#### **WARNING**

*Observe the following warnings when responding to a fire involving a CNG vehicle. Failure to do so can result in serious personal injury or death.*

---

#### **WARNING**

*If the fuel cylinders or fuel cylinder housing **ARE NOT** involved in the fire, use normal response tactics to extinguish the fire.*

---

#### **WARNING**

*If fire is impinging on the cylinder housing or the cylinders are on fire, move to a safe distance and let the vehicle burn to protect the public and yourself from the possibility of an explosion hazard.*

---

#### **WARNING**

***DO NOT** apply water to the cylinder housing or cylinder. Applying water can prevent the PRDs from activating, resulting in a catastrophic cylinder failure causing an explosion.*

---

Pressure Relief Devices (PRDs) on the CNG fuel system will activate at 230°F, releasing pressurized gas through the vent ports. This is to evacuate as much fuel as possible from the fuel cylinders.

### Location of Vent Ports and Vent Caps (Figure 6)

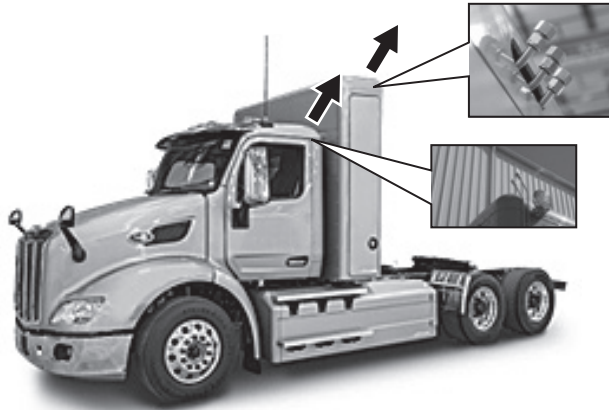


FIGURE 6 – VENT PORTS AND VENT CAPS

## **! DANGER**

*If fire exists and the PRDs do not activate, the cylinder pressure can increase to above the rated pressure (5,000 psi) causing a probable hazardous situation. Clear the area as far as possible and let the vehicle burn.*

## **! WARNING**

*When Pressure Relief Devices (PRDs) activate, the result could jet fire. Pressure within the system will determine the duration and distance of the jet fire. The fuel can re-ignite several times. Clear the area as far as possible and let the gas burn off.*

## **NOTICE**

*The amount of fuel will determine how long it takes for the fuel to be vented. On average, it takes 20 minutes to vent out all the gas through the vent system from PRD activation.*

**NOTICE**

*Once PRDs have activated and gas has stopped venting, it is safe to put water on the system.*

---

**NOTICE**

*After the fire is out, allow time for the system to cool before approaching the vehicle.*

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Safety

 **DANGER**

*The CNG fuel system has several significant differences from the typical diesel fuel systems used in heavy trucks. The fuel lines are under high pressure and leaking fuel can ignite. It is important to observe all safety statements in this manual to ensure safe operation of a CNG vehicle. Never disregard a safety directive.*

---

 **WARNING**

Maintenance, defuelling and depressurizing should be performed by a qualified technician only.

L'entretien, la vidange et la dépressurisation doivent être effectués uniquement par une personne qualifiée.

 **DANGER**

*It is the responsibility of the operator to read and understand all Warnings, Cautions, and guidelines in this manual BEFORE operating the vehicle or performing maintenance. Contact Cummins Clean Fuel Technologies if you do not clearly understand any part of the material presented here. Do not attempt to conduct any procedure you do not completely understand. Do not perform any procedure for which you do not have the specified Cummins Clean Fuel Technologies parts or required tools. Failure to do so can result in serious personal injury, or death.*

---

 **WARNING**

*Compressed natural gas is flammable and highly explosive. Serious personal injury can result if leaking natural gas ignites. If a leak is suspected, have the vehicle immediately inspected and repaired before returning it to operation.*

---



### **WARNING**

***One should never detect (smell) gas or hear gas escaping at any other time besides refueling. If the smell of natural gas or a hissing sound is detected at any time besides refueling, the CNG system should be shut down. Refer to the Fuel System Shut Down Procedure.***

### **WARNING**

***Only trained and qualified personnel should service this natural gas vehicle. Components in the fuel system are under extreme pressure. Severe injury or death can result from improper service or failure to follow safety precautions.***

### **Safety Tips**

1. A portable fire extinguisher having a UL rating not less than 20 B:C should be accessible and visible. Fire extinguishers must always be kept fully charged and up to date.
2. Always wear protective footwear and eyewear when conducting fueling operations.
3. Inspect for leaks using a methane detector or an approved liquid leak detector. Do not use any other method or products to find leaks.
4. Do not attempt to tighten or loosen fittings when the fuel system is under pressure.
5. Always use tools that are in proper working order and properly calibrated.
6. Appropriate work attire must always be worn when servicing or maintaining fuel system. Never wear loose clothes, rings or loose neck chains.
7. All maintenance and service procedures must be conducted in an environment that is free of dust.
8. Perform service only in CNG-approved facilities.
9. For any maintenance that may create a spark or flame, follow the Welding and Hot Work Procedures.

10. In accordance with federal law, any CNG fuel system vehicle must always be labeled to signify it as a CNG vehicle. The vehicle must be marked with a weather-resistant diamond-shaped label located on an exterior vertical or near-vertical surface on the lower right rear of the vehicle (on the trunk lid of a vehicle so equipped, but not on the bumper of any vehicle), inboard from any other markings. The label shall be approximately 4-3/4 inches by 3-1/4 inches. The marking shall consist of a border and the letters “CNG” (one inch minimum height centered in the diamond) of silver or white reflective luminous material on a blue background.

### CNG Vehicle Safety Precautions

#### **W A R N I N G**

*Following proper safety and handling practices is necessary when operating a compressed natural gas fuel system. Adhere to the following safety precautions when operating compressed natural gas fuel systems. Failure to do so can result in serious personal injury or death.*

---

1. Always have at least one fire extinguisher with a UL rating of 20 B:C or more installed on the vehicle in a place that is easily accessible. The extinguisher must be labeled or marked with that rating. Fire extinguishers must always be kept fully charged and in good mechanical condition. Fire extinguisher mounting brackets must allow visual determination of being fully charged.
2. If a gas leak is detected, do NOT try to start vehicle. Refer to the If You Suspect a Fuel Leak procedure.
3. Never perform service on the system when it is pressurized.
4. Do not allow the system pressure to exceed working pressure.
5. Do not smoke or produce open flame within 50 feet a CNG dispensing/filling station.

#### **W A R N I N G**

*If the vehicle requires service work that would generate flames, sparks, or excess heat, defuel the CNG system completely with an inert gas. Failure to do so can result in a fire or explosion.*

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### Codes and Compliances

For more information on CNG fuel system requirement in general, refer to following CNG codes and regulations:

- CGA C-6.4 CNG System Inspection Standard (also covers installation)
- FMVSS 304 (DOT) Cylinder Standards
- NFPA 52 Vehicular Gaseous Fuel Systems Code. 2013 Edition
- ANSI/NGV 2 CNG Vehicle Container requirements
- ANSI/IAS PRD 1 Pressure Relief Devices
- ANSI/IAS NGV 3.1 Valves, Fittings and Brackets
- Canada: CAN/CGA B109, CSA Group
- North America: ANSI/AGA NGV 3.1/CGA 12.3 and NGV 12.3-M95
- Compressed Natural Gas and Liquefied Natural Gas, Railroad Commission of Texas January, 2013

### Introduction

### System Overview

The engine in this vehicle is fueled by a compressed natural gas (CNG) system designed by Cummins Clean Fuel Technologies. The system uses the same type of gas used in household appliances such as ovens and dryers.

The main difference is that natural gas vehicle fuel is stored under high pressure (3,600 psi [24,800 kPa]).

### Compressed Natural Gas

CNG is a naturally occurring hydrocarbon gas mixture which consists primarily of methane.

It is:

- Colorless
- Odorless
- Non-corrosive
- Non-toxic

This gas is lighter than air, which means if gas were to leak, it would float upwards and quickly dissipate into the atmosphere. CNG will burn only when in an air-to-gas mixture of approximately 5-15% so its range of

flammability is limited compared to other fuels. The gas also has an ignition temperature of 1076°F which is significantly higher than diesel. As a fuel, CNG is less expensive and burns cleaner than diesel fuel, producing low emissions. These characteristics make CNG an efficient, safe choice for fueling vehicles.

### **WARNING**

***Compressed natural gas is flammable and highly explosive. Serious personal injury or death can result if leaking natural gas ignites. If a leak is suspected, have the vehicle immediately inspected and repaired before returning it to operation.***

***CNG is odorless and invisible in its natural state. To aid detection, a chemical odorant called mercaptan is added to it which gives it a distinctive, pungent smell, similar to “rotten eggs”. If you notice this kind of lingering odor coming from your vehicle, you may have a leak in the CNG fuel system.***

### **WARNING**

***One should never detect (smell) gas or hear gas escaping at any other time besides refueling. If the smell of natural gas or a hissing sound is detected at any time besides refueling, the CNG system should be shut down. Refer to the Fuel System Shut Down Procedure.***

---

### **WARNING**

***Only trained and qualified personnel should service this natural gas vehicle. Components in the fuel system are under extreme pressure. Severe injury or death can result from improper service or failure to follow safety precautions.***

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## Fuel Standards

This vehicle is designed to run on CNG that meets North American standards, NFPA-52 and SAE J1616 for fuel composition.

## Specifications

Cummins Clean Fuel Technologies CNG fuel systems are available in side mount, back-of-cab, roof mount, or refuse tail mount configurations. Systems may have one or more fuel storage cylinders in varying capacities. All systems use common components with slight variations, depending on the configuration.

## Components

The CNG fuel system consists of the following main components. (Figure 7 and 8)

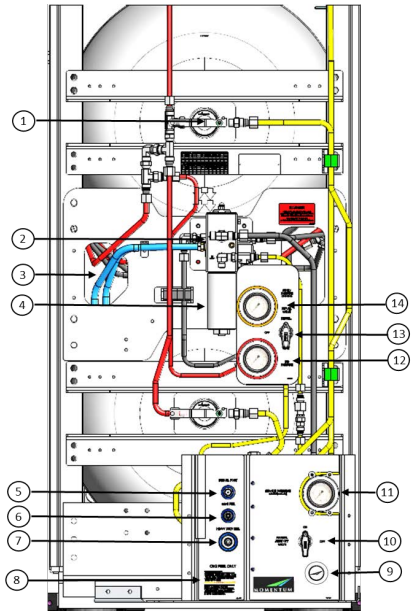


FIGURE 7 – CNG COMPONENTS  
DRIVER SIDE

1. Manual Shut-Off Valve
2. Regulator
3. Coolant Hose
4. High Pressure Filter
5. Defuel Nipple
6. Slow Fill/NGV 1
7. Fast Fill/HD Bus Receptacle
8. Warnings
9. Door Safety Interlock
10. FMM Manual Shut-Off Valve
11. High Pressure Gauge
12. Tank Pressure Gauge
13. Defuel Valve
14. Low Pressure Gauge

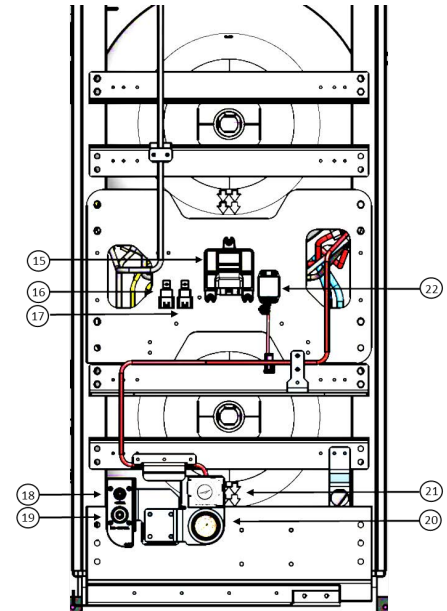


FIGURE 8 – CNG COMPONENTS  
PASSANGER SIDE

### **Fuel Management Module (FMM)**

The FMM houses the fuel filling receptacles, high and low pressure gauges, electronic controls, regulator, high pressure fuel filter, and fuel manifold.

#### **High Pressure Gauge**

The high pressure gauge indicates the fuel pressure in the fuel storage cylinders. The gauge has a range of 0 to 5000 psi. When cylinder(s) are full and the cylinder Manual Shut-Off Valve is open, the pressure reading should read approximately 3600 psi.

#### **Low Pressure Gauge**

The low pressure gauge indicates the fuel pressure sent to the engine. The gauge has a range 0 to 150 psi. When the regulator is working properly, the pressure reading should read approximately 125 psi.

#### **Cylinder Manual Shut-Off Valve**

The cylinder Manual Shut-Off Valve attached to each cylinder controls the flow of gas in and out of the cylinder. It is referred to as a “1/4-turn” valve because it only requires a 1/4-turn to open or close the valve. Turn the valve handle 1/4-turn clockwise to close the valve and counter-clockwise to open it.

### **FMM Manual Shut-Off Valve (Red Handle)**

The FMM Manual Shut-Off Valve controls the flow of gas to the engine. It is referred to as a “1/4-turn” valve because it only requires a 1/4 turn to open or close the valve. Turn the valve 1/4-turn clockwise to close the valve and counter-clockwise to open it.

#### **Fill Receptacles**

Fill receptacles are used to fill the CNG storage cylinders with fuel. There are two sizes: standard NGV1 (slow) or HD bus transit (fast) fill. The receptacles are equipped with built-in check valves to prevent fuel from escaping when the fuel fill nozzle is connected and disconnected.

#### **Fast Fill/HD Bus Fuel Receptacle**

The fast fill/HD bus fuel receptacle is the filling port for fueling the vehicle at public fueling stations.

#### **Slow Fill/NGV1 Fuel Receptacle**

The slow fill/NGV1 fuel receptacle is the filling port for fueling the vehicle at slow fueling facility, usually overnight.

#### **Door Sensor**

The door sensor that is located on the FMM functions as a safety interlock to prevent the vehicle from starting if the FMM access door is open.

### **Fuel Cylinder(s)**

The fuel cylinder(s) stores CNG fuel at a service pressure of 3,600 psi. The fuel cylinders used on this vehicle are type-4 composite containers, manufactured to meet FMVSS 304, NAI/IAS, or the CSA B51 Part 2 specifications. In accordance with applicable regulations, the cylinders must display permanent labels which provide information necessary for inspection.

### **Check Valve**

The 1-way check valve, located in the manifold, is used to prevent fuel from backing up during the fuel filling process.

### **High Pressure Filter**

The high pressure coalescing filter is used to remove contaminants and oil from the fuel prior to it entering the low pressure portion of the fuel system.

### **Low Pressure Filter**

The low pressure filter is located on the frame near the engine. The low pressure filter is used to remove contaminants and oil from the fuel prior to it entering the engine. See to the engine manufacturer's recommended instructions for maintenance and replacement.

### **Pressure Regulator**

The pressure regulator reduces the pressure of fuel in the system from high pressure (3,600 psi) to low pressure (125 psi) for the engine to use. Coolant from the engine circulates through the regulator to keep it from freezing.

### **Solenoid Valve**

The solenoid valve allows pressure to flow from the regulator inlet port to the outlet port when the ignition is on.

### **Bleed Valve**

The bleed valve vents residual pressure in the FMM portion of the system to allow for maintenance procedures. The bleed valve is the only fitting that it is safe to open while under pressure.

### **Defuel Valve**

The defuel valve controls fuel flow when removing fuel from the cylinder during defueling operations. It is a 3-way type valve marked OFF-DEFUEL-VENT. The valve must be in the OFF position when operating the vehicle.



### Pressure Relief Devices

The Pressure Relief Devices (PRD) are thermally-activated valves that open at a temperature of approximately 230°F. In the event of a fire, they are designed to release the fuel stored in the cylinders a safe distance from the vehicle to prevent over-pressurizing the fuel cylinders. When activated, the PRD cannot be closed and will vent all gas. (Figure 9)

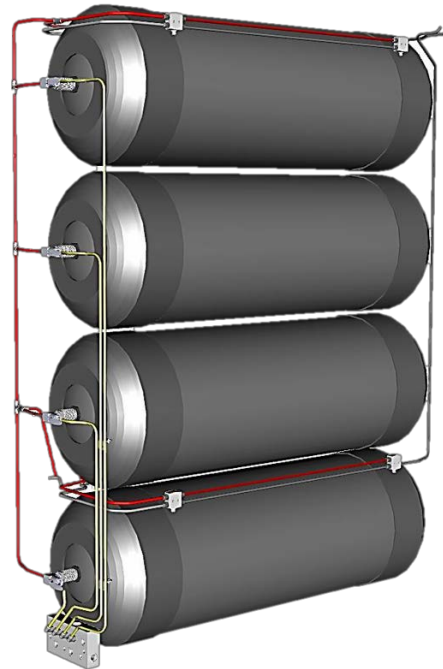


FIGURE 9 – PRESSURE RELIEF DEVICE (PRD)

## Section 4 — Inspection and Operation

### Inspection and Operation

#### Pre-Trip Inspection

Perform a Pre-Trip Inspection each day before driving the vehicle.

1. Verify the Manual Shut-Off Valve on the FMM is in the ON position.
2. Check the high-pressure gauge on the FMM to ensure it is operating and reading in a range consistent with the fuel gauge on the dash board. The fuel system maximum pressure is 3,600 psi.  
**NOTE:** Pressure of less than 250 psi could make the engine run rough.
3. Check the vent ports and vent caps for any signs the PRDs have been activated. Verify the vent ports and vent caps are clear of debris or damage.
4. Check the entire fuel system for any signs of damage or wear. Include checks for:
  - a. Gas leaks – Smell for gas, look for frost or ice, and listen for hissing noises at joints and components.
  - b. Look for external damage to housings and covers.

5. Drain the low pressure filters per the engine manufacturer's recommendation.
6. Turn the ignition key to ON and check that the low-pressure gauge reading is approximately 125 psi.
7. Verify the dashboard fuel gauge is functioning properly.
8. Have the fuel system and cylinders inspected by a certified CSA Cylinder and Fuel System Inspector if damage is found on any part of the components or structural parts of the fuel system. Qualified service support can be found at [www.cummins-cleanfueltech.com](http://www.cummins-cleanfueltech.com)

#### Weekly System Inspection

Perform the Weekly System Inspection to ensure the system is operating correctly, safely, and to maximize component performance.

1. Verify all of the cylinder Manual Shut-Off Valves move freely and are in the ON position.
2. Visually inspect the fuel system for any signs of damage or wear.
3. Check for damage on the cylinder shields and covers.

4. Check to ensure the cylinders are mounted securely. Inspect the mounts, brackets, rubber isolators, and all fasteners.
5. Check for leaks on all CNG fuel plumbing tubes, hoses, and fuel flow components. Check for the odor of rotten eggs. Look for frosting or the sound of hissing at valves and fittings.
6. If any system components or structural parts are damaged, the system and cylinders must be inspected by a CSA-certified fuel system inspector. Qualified service support can be found at [www.cummins-cleanfueltech.com](http://www.cummins-cleanfueltech.com)

### Starting the Vehicle

1. Follow the vehicle manufacturer's recommended instructions for vehicle start-up.
  - a. Open the Fuel Cylinder Manual Shut-Off Valve(s) by turning the valve 1/4-turn counter-clockwise.
  - b. Open the FMM Manual Shut-Off Valve by turning the valve 1/4-turn counter-clockwise.
2. Turn the ignition switch to ON and allow a few seconds delay for the vehicle to start up.

**NOTE:** This “delay” is the time it takes for the gas to flow from the storage cylinder through the solenoid valve to the engine.

3. For vehicles being started in the cold, allow the engine to idle for five minutes. This provides enough time for the engine coolant to warm up and help keep the regulator from “icing”. Let the vehicle idle for a longer period if it is extremely cold.

### Fueling

 **DANGER**

***Always follow the fuel system manufacturer's instructions on initial filling. Failure to do so may result in serious injury or death.***

---

## Section 4 — Inspection and Operation

### **WARNING**

*To reduce the risk of impact and/or fire, which if not controlled, could result in death or serious injury:*

- 1. Allow the fuel tank and all mounting hardware to acclimate to ambient temperature prior to initial fueling.*
- 2. Do NOT proceed to fill the cylinder(s) if a leak of CNG is detected or suspected. This includes, but is not limited to, the emission of a natural gas odor, unexpected loss of pressure in the fuel system, rattling, or other indications of loose connections, or unusual hissing or snapping.*

### **NOTICE**

*When fueling at public or private fueling areas, check for evidence of oil or other contaminants on the nozzle or on the ground below the nozzle. Oily or dusty conditions may be an indication of poor fuel quality, DO NOT USE. These conditions should be reported to the station maintenance personnel.*

### **NOTICE**

*If you smell gas (rotten eggs smell) when fueling, turn the station pump OFF. If the vehicle is on a cascade system or time fill system, disconnect the fuel nozzle. Report the presence of the rotten egg smell to the station maintenance personnel.*

## Fueling the CNG System

### **WARNING**

*Do not fill the CNG system fuel cylinder with any other type of fuel other than CNG (Compressed Natural Gas). No other type of fuel may be used in the cylinder.*

## Section 4 – Inspection and Operation

### **! WARNING**

Observe the following to reduce the risk of impact and fire. Failure to do so can result in death or serious injury and property damage:

1. Ensure that the fill nozzle at the CNG filling station is compatible with the fill fitting on the system before filling the fuel cylinder with CNG.
2. Verify the pressure rating is compatible with the fuel tank pressure rating.
3. Never fill the CNG system to a pressure that exceeds 4,500 psi at any temperature.

### **NOTICE**

The following are general fueling guidelines. Always check with your fuel station for specific pump operating instructions and procedures.

1. Open the fuel access door. Remove the cap from the appropriate fueling receptacle. (Figure 10)

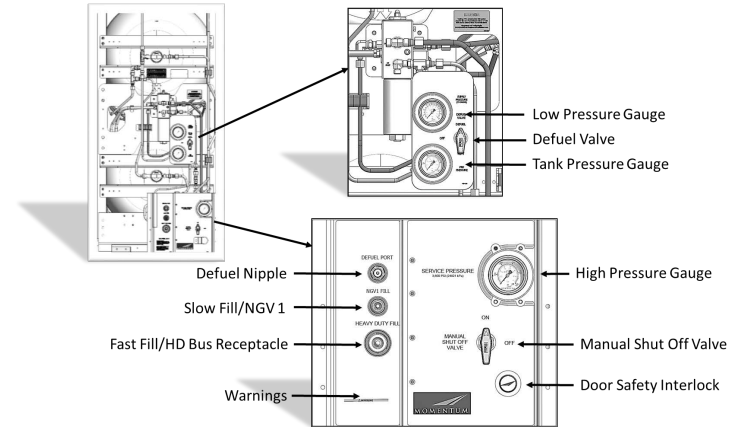


FIGURE 10 – FUEL MANAGEMENT MODULE

2. Wipe the receptacle with a dry, lint-free cloth.

## Section 4 — Inspection and Operation

3. Check that the fill nozzle is free from damage and the O-ring is present. If the nozzle is in acceptable condition, connect the nozzle to the fuel receptacle. NOTE: The NGV-1 and HD nozzles are different sizes. If the nozzle does not fit the receptacle, make sure you have selected the correct receptacle for your intended fueling.

### NOTICE

***If a fill receptacle is damaged, only qualified technicians are permitted to perform mechanical repairs to the receptacles.***

4. Turn the nozzle valve to the Fill position, if required. You will hear fuel start to flow.
5. Fueling will continue until the cylinder(s) have been filled. The fuel station pump will then shut off automatically.
6. Turn the nozzle valve to the Vent position to release it from the receptacle and remove the fueling nozzle.

### NOTICE

***The nozzles at fill stations are designed so they will not come off the receptacles when under pressure.***

7. Once the fueling process is complete, replace the cap on the receptacle and close the FMM door.

### NOTICE

***The fuel system is equipped with safety interlocks on the FMM door. The door MUST be closed in order for the engine to start.***

### Fast and Slow Fill and Pressure/Temperature Guidelines

#### NOTICE

*Compressed Natural Gas (CNG) can expand and contract significantly depending on temperature. The amount of CNG that can be stored in a vehicle's tank varies based on the following variables:*

1. Fueling rate: As the rate of fueling increases, the temperature of the fuel also increases dramatically. As the fuel warms up, it expands and becomes less dense, therefore containing less energy by volume when the fuel system reaches the rated pressure.
2. Ambient temperature: The outside temperature affects the temperature of the CNG. At higher temperatures, CNG is less dense, and therefore does not contain as much energy per unit volume as it would at a lower temperature.

3. Pressure rating: The fuel system service pressure rating is 3,600 psi. Fill pressures are based on a 70°F ambient temperature. The cylinders are designed for up to 125% of their operating service pressure. So, a 3,600 tank can be filled to 4,500 psi.

#### First Fill Procedure or Empty Fill Procedure

#### CAUTION

*Follow the initial fueling procedures any time there might be air or other oxidants present in the CNG fuel cylinder. Air can be present in the cylinder prior to an initial fuel fill, if the cylinder has under gone service, or the cylinder pressure has been reduced to less than 5 psi. If present, air will form an explosive mixture with CNG gas and cause an explosion hazard.*

#### DANGER

*Failure to follow the procedures below could in explosion, fire, causing death or serious injury.*

## Section 4 — Inspection and Operation

1. Remove all oxidants (including air) from a fuel tank before filling the fuel tank with CNG. Be aware that air may enter the fuel tank and form an explosive air/fuel mixture whenever the fuel tank has been vented to less than 5 psi or exposed to atmospheric pressure.
  2. The fuel tank must first be purged with an inert gas to ensure that no explosive mix is formed at any time.
  3. Never use ambient air as the purging gas. Ambient air has the potential to form an explosive air/gas mixture.
  4. When venting and flushing with inert gases (such as nitrogen) in a confined area, provide proper ventilation, and always use gas monitoring equipment to ensure safe and adequate oxygen concentration.
2. Vent with clean, dry, pure nitrogen gas, and equilibrate slowly (to avoid condensation on the fuel tank or tank valve) from the CNG fuel tank through the tank valve so that no less than 10-20 psi remains in the tank.
  3. Once the system has been vented to 10-20 psi, close the tank valve to prevent escape of the remaining nitrogen gas and to prevent entry of air into the fuel tank.
  4. When complete, the fuel tank, containing a small pressure of nitrogen, can be connected to the fuel system and charged with CNG.

### Defueling and Fuel Transfer Guidelines

#### **WARNING**

***Perform the following initial fill procedures for removing oxidants (including oxygen in the air) from the fuel tank prior to filling it with CNG:***

1. Fill the fuel tank with clean, dry, pure nitrogen gas, and equilibrate it to a minimum of 200 psi.

#### **DANGER**

***Always electrically ground the fuel tank, fuel system, and vehicle whenever a CNG fuel cylinder is being defueled. Failure to do so may result in explosion or fire.***



### **DANGER**

*Do NOT attempt to service or remove the fuel cylinder valve or any other fuel system hardware without following depressurization procedures. Failure to do so may result in death or serious injury and property damage.*

### **WARNING**

*To reduce the risk of explosion and fire, or asphyxiation from compressed natural gas (CNG), always vent in an area that allows for gas to dissipate quickly and observe the following guidelines. Failure to do so can result in death or serious injury.*

### **WARNING**

*Do not vent CNG in enclosed spaces. Breathing CNG can cause asphyxiation; a high pressure stream of CNG can penetrate skin, and a nearby source of ignition could spark an explosion.*

### **WARNING**

*Gas venting should only take place outdoors or following an alternative method which is in compliance with NFPA 52. This is to avoid the possibilities of asphyxiation or accumulation of an explosive gas mixture.*

### **CAUTION**

*Release the fuel slowly to reduce static electricity/ electrostatic discharge and to avoid freezing.*

### **NOTICE**

*Only a trained individual should conduct defueling operations*

## Section 4 — Inspection and Operation

### NOTICE

*Always keep a portable fire extinguisher with a UL rating not less than 20-B:C in the defueling area.*

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### NOTICE

*Use signage to mark the venting area stating “NO SMOKING” and “FLAMMABLE GAS.”*

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### Fuel System Defueling Procedure

1. Isolate any cylinder which you do not want to defuel by turning the Manual Shut-Off Valve 1/4-turn clockwise to the OFF position.
2. To relieve the pressure on the defuel nipple, turn the 3-way defuel valve to Vent position. This will relieve any pressure between the valves and defuel nipple through the muffler.
3. Connect the defueling hose to the defueling nipple.
4. Connect earth ground between the cylinders and the vent system.

5. Connect the defueling hose to the vent system using a conductive high-pressure defueling hose.
6. Ensure that the defueling hose end is located outside and away from buildings.
7. Mark the vent hose end so people know to stay clear of the area.
8. Open the 3-way valve slowly, keeping the flow rate steady to prevent icing.

### Scheduled Maintenance

Perform the maintenance tasks provided in this section as scheduled to prolong component life and ensure maximum performance of the CNG fuel system.

### Maintenance Schedule

<b>Maintenance Schedule</b>	<b>Frequency</b>
Check Vent Lines	Daily
Drain Low Pressure Filter	Daily
Replace Low Pressure Filter	Refer to the engine manufacturer for maintenance and replacement guidelines.
Drain High Pressure Filter	Weekly
Replace High Pressure Filter Element	At regular oil change intervals or every 1000 hours
Leak Test with Methane Detector	CFR Title 49 Subtitle B Chapter V Part 571
Component Inspection	CFR Title 49 Subtitle B Chapter V Part 571
Cylinders	CFR Title 49 Subtitle B Chapter V Part 571

**Maintenance Part Numbers**

Maintenance Part	Part Number
High-Pressure Coalescing Filter Element Kit	AR15-1000
Low-Pressure Fuel Filter Element	Refer to Engine OEM
Fast-Fill Fuel Receptacle O-Ring	MF38-1002
#6 O-Ring Face Seal – O-Ring	MF38-1004
#8 O-Ring Face Seal – O-Ring	MF38-1005
#6 O-Ring Boss – O-Ring	MF38-1000
#8 O-Ring Boss – O-Ring	MF38-1001
#4 O-Ring Boss – O-Ring (Transducer O-Ring)	MF38-1008

**NOTICE**

*The high-capacity, high-pressure fuel filter interval is directly affected by the fuel quality and can be negatively impacted by problems with the fueling station. The filter is designed to be changed at the same interval as the engine oil filter (around 30,000 miles), but poor fuel quality could reduce this interval significantly. The best way to determine a proper*

*interval (when always fueling at the same station) is to drain the filter on a weekly basis. If the oil level is too high in the filter bowl, it could cause the filter to bypass and contaminate the secondary filters as well. Constantly having high amounts of oil/water drain from the secondary filter(s) could be a sign that the primary filter should be changed.*

### Depressurizing Procedure

Before you drain or change the high-pressure filter, use the following procedure to remove fuel pressure from the lines connected to the high-pressure filter assembly.

1. Make sure that the ignition is turned OFF.
2. Close ALL cylinder Manual Shut-Off Valves (one on each cylinder) by turning the 1/4-turn handle clockwise to the OFF position.
3. Verify that the FMM Manual Shut-Off Valve is in the ON position.
4. Start the vehicle and let the engine run until it stops.
5. Turn the vehicle ignition switch OFF. Follow the manufacturer's recommended vehicle lock-out procedures. Remove the ignition key.
6. Look at the gauge on the fill panel (see Figure 6) and verify that all the pressure has been relieved.
7. Remove the FMM access panel.
8. Slowly open the bleed valve to relieve the remaining pressure.

Once this process is complete, the system will be fully depressurized up to the primary solenoid lock-off valve. Pressure may still remain downstream of the solenoid

valve. Use care when loosening fittings for the first time. Be aware that it is normal for a small amount of gas to leak out of any fitting downstream of the solenoid lock-off valve.

### Re-pressurizing Procedure

Once the high-pressure filter drain or change procedure is complete, perform the following procedure to re-pressurize the lines.

1. Make sure that the vehicle is OFF. Take the keys out of the ignition.
2. Close the bleed valve and torque the fitting to 4-5 ft-lbs.
3. Check that the filter bowl and the drain plug are installed and tightened.
4. Check that the FMM Manual Shut-Off Valve is in the ON position.
5. On each cylinder, slowly turn the cylinder Manual Shut-Off Valve 1/4-turn counter-clockwise to the ON position.
6. Re-install the fill panel cover (if removed).
7. Insert the ignition key and start the engine.

## Section 5 — Scheduled Maintenance

### High Pressure Filter Drain Procedure

1. Remove the excess fuel in the filter per the depressurizing procedure.
2. Ensure the FMM Manual Shut-Off Valve is in the OFF position.
3. Locate and access the high pressure coalescing filter inside the service access door/panel. The filter location will vary, depending on the system configuration.
4. Locate the drain plug at the bottom of the filter. Hold a cloth under the port to catch any draining liquid. Remove the plug and allow the liquid inside the filter to drain.
5. Re-install the drain plug and torque to 27 ft-lbs.
6. Confirm the bleed valve is closed.
7. Slowly open the FMM Manual Shut-Off Valve.
8. Check the high pressure gauge to ensure the fuel pressure has been returned in the system.

### High Pressure Filter Change Procedure

1. Remove the excess fuel in the filter per the depressurization procedure.

2. Ensure the FMM Manual Shut-Off Valve is in the OFF position.
3. Locate and access the high pressure coalescing filter inside the service access door/panel. The filter location will vary, depending on the system configuration.
4. Unscrew and remove the filter bowl from the filter housing. Note the filter is equipped with wrench flats to assist removal.
5. Empty and clean the filter bowl.
6. Remove the filter element by grasping and pulling it downward out of the filter housing. Place the new filter element into position and press it into place.
7. Install a new O-ring (supplied with the filter element) into the groove on the filter housing.
8. Re-install the filter bowl in the filter housing and torque to 40 ft-lbs.
9. Verify that the bleed valve is closed.
10. Slowly open the FMM Manual Shut-Off Valve.
11. Check the high pressure gauge to ensure fuel pressure has returned in the system.

### Cylinder and Fuel System Inspections

The Department of Transportation requires this statement on the label of all CNG cylinders used on motor vehicles: “THIS CONTAINER SHOULD be visually inspected for damage and deterioration after a motor vehicle accident or fire, and either (a) at least every 12 months when installed on a vehicle with a GVWR greater than 4,536 kg (10,000 lbs.), or (b) at least every 36 months or 36,000 miles, whichever comes first, when installed on a vehicle with a GVWR less than or equal to 4,536 kg (10,000 lbs.).

Evidence that the cylinders have been inspected can be found in one of the following forms:

1. A readily visible inspection label on the cylinder.
2. An inspection form/report provided by inspector (perhaps kept in glove box with insurance and registration papers).
3. Other: sticker on windshield, doorpost, fueling receptacle area.

### Periodic In-Service Inspection Requirements

Cylinders must be reinspected if over pressured, dropped, impacted, reinstalled on a different vehicle, exposed to excessive heat or fire, harsh chemicals, or if vehicle was in an accident of 5 mph or more.

This includes any CNG cylinder on a vehicle that was either in an accident that happened at a speed of 5 miles an hour or greater, or a vehicle involved in any fire, whether it related in damage to the vehicle or not, must undergo a detailed inspection certified CSA cylinder and fuel system inspector.

### ANSI/NGV 2 Cylinder Standards

**NOTE:** If no label is found on the cylinder and you are unable to determine who the specific manufacturer is, you must condemn the cylinder and remove it from service.

If you need a replacement sticker, contact **Cummins Clean Fuel Technologies @ 1-844-CNG-TANK.**

## NOTICE

***States and local Authority Having Jurisdiction (AHJ) including the local Fire Marshal may have their own requirements. Check for local requirements; states and municipalities may have requirements that vary from these codes.***

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## Section 5 — Scheduled Maintenance

### Welding and Hot Work Procedures



***Never weld on any fuel system components. Welding can ignite the fuel, resulting in an explosion or fire causing serious personal injury or death.***

#### NOTICE

***If a CNG fuel system component is damaged, do not attempt to repair it. Contact Cummins Clean Fuel Technologies for a replacement part.***

If any welding or 'hot work' (i.e., any work that involves burning or use of tools that produce a spark, flame, or source of ignition) is required on a CNG fuel vehicle excluding the CNG Fuel System, you must perform the following procedures:

1. Conduct work in a well-ventilated area.
2. Shut off every cylinder in the fuel system by turning the 1/4-turn valve clockwise to OFF.

3. Ensure the FMM Manual Shut-Off Valve is in the ON position.
4. Start the vehicle and let it run until the engine stops.
5. Turn the ignition key OFF and remove the key.
6. Check the gauges on the FMM to ensure all pressure is at ZERO.
7. Slowly relieve excess pressure by turning the bleed valve cap counter-clockwise until a hissing sound is heard. Close the bleed valve when the hissing stops.
8. Use a welding blanket to protect the fuel system from slag and sparks produced from welding and hot work operations.

#### NOTICE

***If slag or a spark comes in contact with the fuel cylinder, you must take the vehicle out of service and have it inspected by a certified inspector.***



### CNG Decals

#### CNG Decals

All vehicles that use compressed natural gas are required to display a blue “CNG” diamond label made of reflective durable material with minimum size of 5.7” x 4.2” on a vertical surface on the lower right rear of the vehicle, but not on the bumper. In addition, labels at the fuel fill receptacle and in the engine compartment must provide information as to the system working pressure, tank expiration, and next inspection date. (Figure 11)

The presence of a CNG diamond is an important signal for First Responders (i.e. police, fire fighters) to alert them of a high-pressure gas fuel system. If any of the CNG labels become damaged or lost, contact Cummins to obtain a replacement.



FIGURE 11 – CNG DIAMOND LABEL Part # MB34-1100-N

### Towing and Lifting

#### Lifting the Vehicle

Always raise the vehicle using the lifting points recommended by the vehicle manufacturer. Refer to the vehicle manufacturer's instructions for correct lifting instructions.

#### **W A R N I N G**

*Never use any part of the fuel system as a lifting point to raise the vehicle. Do not allow fuel system components to come into contact with any part of the lifting device. The fuel system can become damaged, resulting in a leak. Serious personal injury can occur if the gas is ignited.*

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#### Towing the Vehicle

Before towing the vehicle, close the Manual Shut-Off Valves on the FMM and all fuel cylinders using the Fuel System Shut Down Procedure.

Once the fuel system is shut down, follow the vehicle manufacturer's instructions for towing the vehicle.

#### **W A R N I N G**

*Do not attach towing equipment to or allow towing equipment to come into contact with any part of the fuel system. The fuel system can become damaged, resulting in a leak. Serious personal injury can occur if the gas is ignited.*

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### Service and Support

#### Cummins Parts and Service Hotline

To obtain CCFT parts and service information, call Cummins Clean Fuel Technologies at 1-844-CNG-TANK.



*All replacement parts must adhere to the standards and ratings specified by Cummins Clean Fuel Technologies. The integrity and safety of the system could be compromised if unspecified, untested parts are used.*

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#### Dealer Locator

To locate CCFT dealers and qualified CCFT service technicians, visit our website at [www.cumminscleantech.com](http://www.cumminscleantech.com)

#### Correspondence

Send correspondence by mail to:  
Cummins Clean Fuel Technologies  
1051 Republic Drive, Suite 200  
Roanoke, TX 76262  
1-844-CNG-TANK

## **ERX Hyliion**

### **ERX Hyliion**

In the ERX truck application, the installed Cummins Clean Fuel Technologies (CCFT) CNG system, is very similar to the performance, installation and operation of a conventional production stock CNG truck application. The base system remains a 3600 psi CNG system as with any other standard CNG vehicle. The mounting method and location of the main enclosure unit have been modified to support the mounting of surrounding electrified power-train components. In the production truck the engine control module (ECM) and CCFT Electronic Control Unit (FECU) work in parallel when the truck ignition is powered on. The FECU opens the solenoid at the fuel system regulator interface and charges the low pressure fuel hose to the engine with fuel. The engine will open the fuel control valve when the engine turns-over and begins to operate. Similarly, when the ignition is turned off, the engine stops supplying fuel to the combustion chamber, and the CNG fuel system solenoid closes stopping fuel delivery to the engine.

## **Section 9 — ERX Hyliion Hybrid CNG/Battery Electric**

In the ERX Hybrid application the Hyliion Control Unit (HCU) interfaces with both the ECM and a Hybrid FECU commanding the engine to turn on and off as well as opening and closing the regulator solenoid valve which pressurizes the low pressure fuel hose to the engine. A specific (Hybrid version) FECU program is released in the CCFT System when the ERX system is installed. The remainder of the CCFT system hardware remains production stock, other than the mounting as mentioned above.

In the ERX application, the total available driving range in the truck is a combination of available CNG remaining in the tanks as well as the remaining state of charge (SOC) in the high voltage batteries.

## **ERX Hyliion**

The FECU will calculate the CNG fuel level and drive the chassis OEM fuel gauge for the fuel level only. The HCU will read the fuel level from the CNG fuel system, and then calculate total fuel level and distance to empty. The HCU broadcasts total fuel level and distance to empty to the Co-Pilot Tablet.

## **Section 9 — ERX Hyliion**

### **ERX Additional/Specific Details**

The CCFT system is nearly a complete carry-over from the production stock vehicle. The main differences are the mounting brackets and the replacement of the conventional FECU program with a Hybrid FECU to support communication with the Hyliion HCU.

The same maintenance schedule applies as the standard fuel system see page 28 Section 5 Scheduled Maintenance

## ERX Hyliion

In the ERX application the Hyliion Control Unit (HCU) interfaces with both the Engine Control Module (ECM) and a Hybrid Fuel Electronic Control Unit (FECU), commanding the engine to turn on and off, as well as commanding the FECU to open and close the fuel delivery system solenoid valve within the regulator and high pressure filter assembly. If the solenoid valve does not open, no fuel will be delivered to the engine. In the conventional production stock truck, turning the key ignition to the "On" position (i.e., starting the engine) automatically opens the solenoid via the Fuel ECU. In the ERX application, the HCU has taken over the authority to open and close the CNG primary fuel delivery solenoid, to deliver or shut-off fuel to the engine.

## Section 9 — ERX Hyliion

Some important use case modes to understand when troubleshooting shooting the CNH fuel delivery system:

"Accessory" versus "On" key position - when the vehicle ignition key is in the "Accessory" position, the Fuel system solenoid (within the regulator and high pressure filter assembly) will not open to pressurize the system downstream to the engine..

In the key "On" position and in EV mode, the Fuel system solenoid (within the regulator and high pressure filter assembly) will not open to pressurize the system downstream to the engine..

In the key "On" position and in manual (engine on) mode, the Fuel system solenoid (within the regulator and high pressure filter assembly) will open to pressurize the system downstream to the engine, providing fuel to the engine to operate.

If the internal combustion engine (ICE) does not start/operate because of fuel system delivery issues, the ERX vehicle additions/modifications which would likely be at fault, if ERX component related, would be the HCU module or wire harness and electrical connections between the HCU and FECU or HCU and ECM. If the HCU is functioning properly and the wire harness interfaces are clean and secure, and wiring harnesses themselves are not damaged, then fuel system functional defects are likely associated with the production stock system hardware.

The Co-Pilot Tablet displays the CNG fuel level, fuel pressure and expected CNG driving range. The tablet is a passive device meaning that it only displays the results calculated by the Hyliion Drive Processor (HDP). If the Co-Pilot display is showing erroneous data, then the HCU and/or HDP are likely corrupt or damaged.

**Warranty**

**Warranty Procedures**

To file a warranty claim for fuel system, call Cummins Clean Fuel Technologies at 1-888-686-7278.

**Warranty Statement**

Any alteration of CCFT CNG fuel system or components will void the warranty. Contact CCFT before performing any modifications to the vehicle’s fuel system which may affect coverage.

Revision	Description	Author	Approved By	Published Date
Revision 1B	U-0181-CCFT Series 500	David O'Brien	Chris Culberson	January 1, 2023

1051 Republic Drive, Suite 200 | Roanoke, TX 76262 | 817-767-6000 direct | 844-CNG-TANK toll free

CUMMINSCLEANTECH.COM