CLEAN FUEL TECHNOLOGIES™

FUEL SYSTEM INSPECTION MANUAL

All Fuel Systems

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Preface

This manual covers CNG Fuel System Inspection Guidelines for all Cummins Clean Fuel Technologies fuel systems. This manual contains inspection information for Cummins Clean Fuel Technologies fuel systems and the installation of fuel system to chassis. If not a Cummins Clean Fuel Technologies fuel system. Refer to the original equipment manufacturer (OEM) fuel system manual. Component's location may vary slightly, however the operating and function of the components are the same.

Cummins Clean Fuel Technologies Service Procedures are in Cummins Engine Service Manuals, Section 42 Fuel Deliver System covers all CCFT Fuel Systems on Cummins QuickServe Online. Below are the engine platform manuals.

Cummins Clean Fuel Technologies Installation Procedures can be found on Cummins Clean Fuel Technologies website. https://www.cumminscleantech.com/customer-support/technical-support/installation-documents

Cummins Clean Fuel Technologies Troubleshooting Procedures can be found on Cummins Clean Fuel Technologies website https://www.cumminscleantech.com/customer-support/technical-support/service/troubleshooting

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Safety Warnings

Single Word	Color	Potential Injury or Damage	Likelihood of Occurrence
DANGER	Red Background White Letters	Severe	**WILL** occur if warning is ignored
WARNING	Orange Background Black Letters	Severe	**COULD** occur if warning is ignored
CAUTION	Yellow Background Black Letters	Minor	**MAY** occur if warning is ignored but result will be minor
NOTICE	Blue Background White Letters	None	N/A label is for important instructions **Unrelated** to hazards

DANGER DO NOT attempt to service or remove components attached to the (RED) tubes without following defueling procedures. Failure to do so will result in death, or severe injury and property damage.

DANGER DO NOT attempt to service or remove components attached to the (YELLOW) tubes and (ORANGE) tubes without following depressurizing procedures. Failure to do so will result in death, or severe injury and property damage.

WARNING Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

WARNING Follow company's Lockout Tagout (LOTO) policy to control all hazardous energy sources. Failure to do so could result in death, or severe injury and property damage.

WARNING Failure to follow company's Hot Work policy or NFPA 51B Standard for Fire Prevention During Welding, Cutting, and Other Hot Work. Could result in death, or severe injury and property damage.

WARNING Failure to follow company's Fall Protection policy or OSHA 1926.501 Duty to have fall protection. 1926.502 Fall protection systems criteria and practices. 1926.503 Training requirements. Could result in death, or severe injury and property damage.

WARNING Failure to follow company's PPE policy or OSHA 1910.132 Personal Protective Equipment. Failure to do so could cause injury.

WARNING Always check the temperature of the coolant before working on coolant hoses. Failure to do so could result in injury.

WARNING Never tighten or loosen fitting when under pressure. Could cause injury or damage to the fitting.

WARNING Natural gas is explosive and flammable. Always be sure to maintain adequate ventilation in the work area. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas with shared ventilation to reduce the possibility of severe personal injury or death when working on a natural gas system.

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CCFT Characteristic Notifications Symbols

Symbols are defined as components or procedure that has direct effects on safety of personnel, equipment, and regulatory compliance.

Safety Characteristic

Regulatory Characteristic

Safety and Regulatory Characteristic

Vehicle Codes, Regulations, and Standards

All components must meet requirements for the year the fuel system was built and installed found in:

- CGA C-6.4 CNG System Inspection Standard (also
- covers installation)
- FMVSS 304 (DOT) Cylinder Standards
- NFPA 52 Vehicular Gaseous Fuel Systems Code.
- 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
- CSA/ANSI NGV 6.1:21
- 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

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Qualified Person

Cummins Clean Fuel Technologies fuel systems MUST be installed, maintained and inspected exclusively by qualified person. All personnel engaged in activities in discharging CNG fuel containers or the inspection, maintenance, repair replacement, removal, or testing of CNG fuel system or its components shall be a qualified person. NFPA 52 2019, Defines **Qualified Person:** A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who by virtue of education, training, experience, or other special attributes, possesses expertise regarding particular subject matter, work, or project.

Cummins Clean Fuel Technologies Fuel System Procedures

Cummins Clean Fuel Technologies Service Procedures are in Cummins Engine Service Manuals, Section 42 Fuel Deliver System covers all CCFT Fuel Systems on Cummins QuickServe Online. Below are the engine platform manuals.

B6.7N

ISB6.7 G

ISL G

ISX12 G

ISX12N

L9N

L9N

X15N

Warranty Procedures

To file a warranty, claim email warranty@cumminscleanfueltech.com
Warranty information:
https://www.cumminscleantech.com/customer-support/technical-support/warranty-information

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.

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CNG Fuel System Inspections

CNG Inspectors: Certified vs Qualified

Inspector must be trained and certified Cummins Clean Fuel Technologies Fuel System Service Professional (CNG-CFSS) TC01-0001 and a certification by third-party organizations such as the CSA Group or Alternative Fuel Vehicle Institute (AFVi).

CNG Inspection Requirements

NHTSA has modified the required label for visual inspection of CNG fuel containers to specify that the 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.).

Leak Testing

Leak test using approved solution resulting in bubbling or foaming at the leak point. Give the solution 3 minutes under working pressure (3600 psi). Small leaks may appear as foam and no bubbles. Frost or ice around tube connection is an indication of leaking fitting. Note: when conducting leak test, fuel system must be at a pressure equivalent to 3600 psi at 70ºF figure1

Temperature Compensation

CCFT Fuel Systems has a standard fill pressure of 3,600 psi. Fill pressures are based on a 70ºF ambient temperature. The cylinders are designed to hold up to 125% of their operating pressure. So, a 3,600 cylinder can be filled to 4,500 psi. This makes it possible to fill a cylinder to a higher pressure on hot days when the gas is expanding, as well as compensate for the heat of compression. A good rule of thumb is that for every 1ºF plus or minus 70ºF, the pressure will change by 16 psi.

Temperature Compensated Cylinder Pressure	
3,600 psi service pressure calculated from the standard gas composition used to create the gasoline gallon equivalent	
Gas Temperature, Degrees F	Pressure in Full 3,600 psi CNG Container, psig
123.6	4,500
120.0	4,455
110.0	4,272
100.0	4,105
90.0	3,936
80.0	3,768
70.0	3,600
60.0	3,432
50.0	3,263
40.0	3,094
30.0	2,926
20.0	2,757
10.0	2,589
0.0	2,421
-10.0	2,253
-20.0	2,086
-30.0	1,919
-40.0	1,753

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Inspection Safety Precautions

DANGER If any damage is found on the cylinder, remove pressure by defueling the fuel system before performing detailed inspection of cylinder. Refer to Defuel Service Procedure 042-039.

DANGER If any leaks are found on components or tubing remove the pressure by depressurizing or defueling the fuel system before continuing the inspection. Refer to Service Depressurize Procedure 042-001 or Defuel 042-039.

DANGER Use hand tools or Intrinsically safe tools are designed to be used in potentially explosive environments without causing ignition until fuel system is verified leak free.

WARNING Inspectors should follow all internal and visiting company's safety policy and procedures.

WARNING Inspection should be conducted outside in a well ventilation area or in a facility that has been modified to handle the volume of natural gas storied on the vehicle that is being inspected in the event of gas release.

WARNING Cummins Clean Fuel Technologies fuel systems must maintain original design specifications, no modifications allowed to the fuel system. All replacement components must be approved by Cummins Clean Fuel Technologies.

NOTICE All replacement components must be inspected and clean before installation.

Service, Safety, and Training Contacts Information

For more information contact Cummins Clean Fuel Technologies

Service/Troubleshooting Support Contact
David O'Brien 817-767- 6012
Michael Brummer 817-767-6031
Kyle Quisenberry 817-767-6043
Chris Culberson 817-767-6039
Service@cumminscleantech.com

Parts Information

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1051 Republic Drive, Suite 200
Roanoke, TX 76262
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www.CumminsCleanTech.com
Orders@CumminsCleanTech.com
https://parts.cumminscleantech.com/

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CCFT Fuel System Inspection Table

Component	Description	Requirements	Paragraph #
CNG Dimond	CNG Dimond various location depending on vehicle configuration	▪ Must be placed in correct location ▪ Must be correct size ▪ Must be legible	1.1
Roof Mount	Any fuel system and supporting tubing and components located on the roof of vehicle or body.	▪ Fuel System housing and components below 13.5 ft ▪ Height label located in cab ▪ Guardrails in place and free from damage	1.2
Fuel System Covers	All fuel system covers, panels, access doors.	▪ Inspect for mission and damage i.e… bent cover, rubbing, abrasion or impact damage ▪ Covers should be secured with all fasteners secured ▪ Tighten loose fasteners or replace missing fasteners	1.3
Mounting Brackets, Isolators and Fasteners	Mounting brackets attach the fuel system with the use of fasteners. Some mounting brackets use isolators.	▪ Each fastener must be set to proper torque. Refer to CCFT Torque Specification ▪ Each fastener must be free from damage ▪ Inspected for excessive movement and missing fasteners	1.4
Heat Shielding	Near the exhaust system on the frame and engine compartment.	▪ Within 8 inches of the exhaust system tube or hose must be protected by heat sleeves ▪ Verify metal heat shields(covers) are in place between exhaust and fuel cylinder and components	1.5
Chassis Wiring Harness	On Chassis frame, Routed from fuel system to engine compartment and cab	▪ Harness free from damage ▪ Harness secure in a manner to prevent damage with no worn or loose clamps.	1.6
Regulated Fuel Hose	Fuel hose (black) connecting fuel system to engine	▪ Hose free from damage ▪ Hose secure in a manner to prevent damage with no worn or loose clamps.	2.1
Auxiliary Fuel Receptacle	Front bumper fill, rear bumper fill or side fill both street and curb side	▪ Check for proper operation by removing the cap and trying to engage the starter ▪ Check for signs of bypassing ▪ Inspect mounting hardware	2.2
Vent Tubes and Hose	Side mounts vent tubes and hose are located on the back of the cap. All other systems are located within the system housing	▪ Vent Tubes and Hose free from damage ▪ Vent Tubes and Hose secure in a manner to prevent damage with worn or loose clamps.	2.3

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Component	Description	Requirements	Paragraph #
Vent Cap	One on each vent tube by the decal stating "ATTENTION CNG Vent Location"	▪ Attached to each vent tube and free from damage. ▪ A label indicates the PRD(s) vent location(s) with the following language. ATTENTION CNG Vent Location must be present and legible **Note: If vent cap is missing the complete vent system must be inspected. Contact CCFT**	2.4
External High Pressure Tubing	Tubes within the fuel system, which includes Orange, Yellow, and Red tubes	▪ Leak test ever connection. Refer to Leak Testing ▪ Tubes free from damage ▪ Tubes secure in a manner to prevent damage with no worn or loose clamps.	2.5
Vehicle Fuel Receptacle	Behind the fuel access door	▪ Receptacles should be clean ▪ Receptacles should not have large gouges or wear. ▪ O-Ring should be free from damage	3.1
Fuel Check Valve	Inside the manifold behind the fueling receptacles	▪ Leak test the fueling connection check valve on the receptacles	3.2
Manual Shutoff Valve	Red handle, valve on the FMM near the fueling receptacles	▪ Verify Manual Shutoff Valve label is present and legible ▪ Verify proper valve operation by turning valve handle form ON to OFF ▪ Handle must turn easily by hand	3.3
Pressure Gauges	Regulated Pressure Gauge (Orange) Supply Pressure Gauge (Yellow) PRD Pressure Gauge (Red)	▪ Gauge must be free from damage, and full of oil. ▪ Gauge must be readable ▪ Yellow and Red gauge should read the same with cylinder valve OPEN. ▪ Stat engine Orange gauge should read 80-90 psi	3.4
Defuel Valve and Coupler	Defuel Valve is the Black handle, two way or three way valve behind the access panel. Coupler located by the fuel receptacles	▪ Verify proper valve operation by turning valve handle form OFF to defuel for two way valve and OFF to VENT then DEFUEL for three way valve ▪ Handle must turn easily by hand ▪ Coupler should be free from damage	3.5
Fuel Bleed Valve	Used for removing pressure during depressurizing	▪ Knurled cap should open and close easily using wrench ▪ Leak test bleed valve	3.6

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Component	Description	Requirements	Paragraph #
Fuel System Regulator	Located inside the fuel system housing	▪ Leak test all fittings and tubing connections ▪ Check Regulated Pressure Gauge (Orange) for pressure of 80-90 psi ▪ Check coolant flow by running the engine, regulator should be warm to touch	3.7
PRD(s) and Attached Vent Tubes	Inside the housing of the fuel system. PRD(s) are connected to the RED tubes	▪ Leak test all PRD(s) and tubing connections ▪ Verify PRD(s) free from corrosion or damage ▪ Verify eutectic devices do not show signs of eutectic creeping. ▪ Verify correct PDR(s) are installed Refer to 3.8 ▪ Verify vent tubs are connected to the vent port on the PRD(s) Refer to 3.8 ▪ Vent Tubes and Hose free from damage ▪ Vent Tubes and Hose secure in a manner to prevent damage with no worn or loose clamps.	3.8
Digital Fuel Gauge	Cab Dash	▪ Verify gauge is reading correctly Refer to Temperature Compensation and 3.9	3.9
Fuel System Wiring Harness	Inside fuel system housing. FMM harness is located in box bolted to FFM housing	▪ Harness free from damage ▪ Harness secure in a manner to prevent damage with no worn or loose clamps. ▪	3.10
Proximity Switch	Inside fuel access door	▪ Check for proper operation by opening the door and trying to engage the starter	3.11
Internal High Pressure Tubing	Tubes outside the fuel system, which includes Regulated (Orange), Supply (Yellow), and PRD (Red) tubes	▪ Leak test ever connection. Refer to Leak Testing ▪ Tubes free from damage ▪ Tubes secure in a manner to prevent damage with no worn or loose clamps.	3.12
Coolant System	Engine coolant routed to bulkhead to regulator	▪ Inspect for leaks, remove form service if leaking ▪ Secured in a manner to prevent damage with no worn or loose clamps or kinked hose.	3.13

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1 Inspection Requirement for Labels, Covers, and External Mounting

1.1 CNG Dimond

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. In addition to placement of the 'CNG" diamond label on the right rear of the vehicle, the "CNG" diamond label shall also be affixed to both sides of the *power unit figure1.

If a DOT number is required to be displayed in the accordance with 49CFR 390.21, then the labels shall be affixed near the DOT numbers on each side of the *power unit figure1.

The CNG Diamond Decal for vehicles with a GVWR of 19,500 lb. (8869 kg) or greater shall be a minimum of 5.7 in. long x 4.2 in. high (145 mm long x 107 mm high) figure 1.

The marking in the label shall consist of a border and the letters "CNG" 1 in. (25 mm) minimum height centered in the diamond] of silver or white reflective luminous material on a blue background figure 1.

Auxiliary fueling connection receptacle shall include the following:

- Identification as a CNG fueled vehicle
- Service pressure

***Power Unit** - A power unit can be a single-unit truck, also called a straight truck, or a "bob-tail" tractor. In a combination vehicle such as a tractor-trailer, the power is the tractor.

figure 1

1.2 Roof Mount

Where the fuel supply container is roof mounted or installed above the operator or passenger compartment of a vehicle; the following requirements shall apply:

1. The fuel supply container and its piping, fittings and valves shall be protected from damage by the following:
   - A guard rail or similar device that is designed to absorb the impact of a collision with a stationary object when the vehicle is moving either forward or backward at 5 mph/hr (8km/hr)
   - A shield designed to absorb impacts that can occur during loading, unloading, or use of the vehicle.
2. The top of the fuel supply container and any related piping, fitting, valve, housing, guardrail, or shield shall not be more than 13.5 ft (13 ft 6 in) or (4.1m) above the road surface.
3. The cylinder shall be protected from accidental contact with overhead electrical wiring by metallic or nonmetallic covers.

The vehicle shall include a permanent label in the driver's compartment, clearly visible to a seated operator, which includes the maximum total height of the unladen vehicle figure 2.

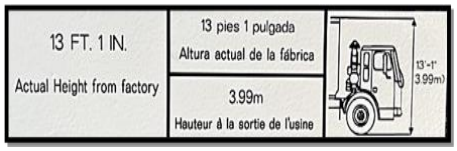

figure 2

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1.3 Fuel System Covers

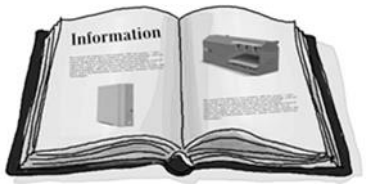
All covers, panels, and access doors must be present and free from damage, with all connecting fasteners installed.

All fuel system covers, panels and access doors must be on the fuel system, attached correctly and free from damage.

DANGER All cylinder shutoff valve access doors, panels or covers must be on and attached correctly for the PRD system to operate as designed. Any missing or damage covers, panels, or access doors could prevent the PRD(s) activating.

DANGER Remove fuel system from service if any covers, panels, or access doors are missing, bent or has holes.

DANGER Defuel fuel system to remove the pressure until repairs are completed.



R ***CFR 49 Subtitle B Chapter V 571.304 Standard No. 304; Compressed Natural Gas Fuel Container Integrity 4.7.2025.**

S8.3.4 Shielding. (a) Use shielding to prevent the flame from directly contacting the CNG fuel container valves, fittings, or pressure relief devices.

R ***NFPA 52 2019 Annex C Pressure Relief Devices (PRDs)**

(2) Manifolds for vent lines of multiple PRDs can be designed with a flow capacity less than the sum of the flow capacities of all of the PRDs. The following are some of the conditions in such a design:
(a) Containers can have PRDs at each end for protection against partial fire exposures. Either PRD will generally have sufficient flow capacity to vent the containers safely.
(b) Containers protected with high flow PRDs can be expected to vent to a safe pressure level before the fire spreads to containers located elsewhere in the vehicle.
(c) The individual PRD might have greater capacity than is required to perform safely in the container fire test. The container manufacturer will have data from the required container fire test that can support a manifold design with flow capacity less than the total PRD flow capacities.

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1.4.1 Mounting Brackets, Isolators and Fasteners (Back Of Cab)

Back of Cab mounting brackets should be inspected for loose fasteners or excessive movement and wear. If damaged fastener is found, replace with new bolt and nut and torque to specifications figure 1.

5/8-in Grade 8 bolt:

- Black Oxide 200-135 ft-lbs (271.2-311.8)
- Aluminum Zinc: 120–135 ft-lbs (162.7–183 Nm)
- Yellow Zinc: 159–185 ft-lbs (215.6–250.8 Nm)

With a length long enough to have 2 full threads past the nut after torquing.

R

Number of bolts required for Back of Cab brackets.

- **175 DGE** 8 bolts per bracket
- **135 DGE** 8 bolts per 2 brackets and 7 per 2 brackets
- **90 DGE** 6 bolts per bracket

Any cracked or broken bracket must to be replaced.

Inspect isolators rubber degradation due to environmental exposure, temperature extremes, and chemical reactions. Exposure to sunlight, especially UV rays, causes degradation, leading to hardening, cracking, and a loss of elasticity. Hot temperatures can cause softening and loss of shape, while low temperatures can make rubber brittle and prone to cracking. **Contact CCFT if isolators rubber shows signs of degradation.**

For service information Refer to Remove and Install Fuel Delivery System Service Procedure 042-003

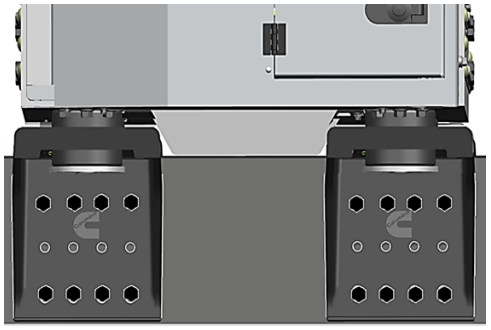

figure 1

1.4.2 Mounting Brackets, Isolators, and Fasteners (Side Mount)

Side Mount mounting brackets should be inspected for loose fasteners or excessive movement and wear. If damaged fastener is found, replace with new bolt and nut and torque to specifications figure 2.

5/8-in Grade 8 bolt:

- Black Oxide 200-135 ft-lbs (271.2-311.8)
- Aluminum Zinc: 120–135 ft-lbs (162.7–183 Nm)
- Yellow Zinc: 159–185 ft-lbs (215.6–250.8 Nm)

With a length long enough to have 2 full threads past the nut after torquing.

R

Number of bolts required for Side Mount brackets.

- **All side Mounts** 4 bolts per bracket

Any cracked or broken bracket must to be replaced.

Inspect isolators rubber degradation due to environmental exposure, temperature extremes, and chemical reactions. Exposure to sunlight, especially

figure 2

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UV rays, causes degradation, leading to hardening, cracking, and a loss of elasticity. Hot temperatures can cause softening and loss of shape, while low temperatures can make rubber brittle and prone to cracking. **Contact CCFT if isolators rubber shows signs of degradation.**

For service information Refer to Remove and Install Fuel Delivery System Service Procedure 042-003

1.4.3 Mounting Brackets, and Fasteners Fuel Management Module (FMM)

Side Mount mounting brackets should be inspected for loose fasteners or excessive movement and wear. If damaged fastener is found, replace with new bolt and nut and torque to specifications figure 1.

5/8-in Grade 8 bolt:

- Black Oxide 200-135 ft-lbs (271.2-311.8)
- Aluminum Zinc: 120–135 ft-lbs (162.7–183 Nm)
- Yellow Zinc: 159–185 ft-lbs (215.6–250.8 Nm)

With a length long enough to have 2 full threads past the nut after torquing.

Number of bolts required for FMM brackets.

- **All FMMs** 4 bolts per bracket

Any cracked or broken bracket must to be replaced.

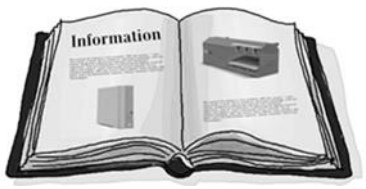
For service information Refer to Remove and Install Fuel Delivery System Service Procedure 042-003

Figure 1

1.4.4 Mounting Brackets and Fasteners (Body Mounted)

Refer to Cummins Clean Fuel Technologies Installation Specification

1.4 Heat Shielding



Fuel supply containers located less than 8 in, (200mm) from the exhaust system shall be shielded against direct heat.

Inspect heat shielding for worn or damage, replaces if damage is found.

In some CNG fuel system installation the fuel system covers will be used as heat shields. All covers must be installed and free from damage.

All covers, panels, and access doors must be present and free from damage, with all connecting fasteners installed.

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1.5 Chassis Wiring Harness

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Wiring shall be secured and protected from abrasion and corrosion to the same standard as the original wiring on the vehicle. All wiring shall be sized according to the Society of Automotive Engineers (SAE) and fuse protected with a 10-amp fuse.

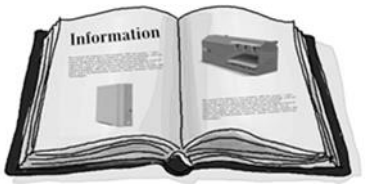
Route wiring harness in a manner to prevent moisture running down harness and collecting in wiring harness connectors or entering cab. Route and secure chassis wiring harness in a manner to prevent strain on the harness wires and connectors.

Chassis wiring harness passing through a panel should be protected by grommets or similar devices that shall snugly fit the piping or tubing and the hole in the panel or structural member.

Do not route chassis wiring harness on or near sharp edges or near moving parts. Use edge protector when necessary. Keep chassis wiring harness away from heat sources. Where necessary use heat protective covering.

Do not attach chassis wiring harness to Main Battery Cable, Regulated Fuel Hose, or CNG tubes, or Coolant hoses.

Wiring shall be secured and protected from abrasion and corrosion to the same standard as the original wiring on the vehicle.



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2. Inspection Requirements Hose, Auxiliary Fuel Receptacle, Vent System, and External Tubing

2.1 Hose (Regulated)

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Hose and metallic hose shall be constructed of or lined with materials that are resistant to corrosion and exposure to natural gas.

Hose, metallic hose, flexible metal hose, tubing and their connections shall be designed or selected for the most severe pressure and temperatures under normal operating conditions, with a burst pressure of at least 4 times the service pressure.

Prior to use, hose assemblies shall be tested by the OEM or its designated representative at a pressure a least TWICE the service pressure.

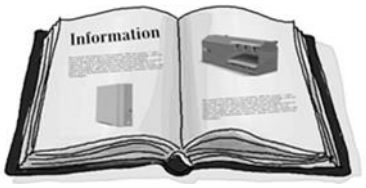
Vent Hose shall have a burst pressure of at least 1.5 times the pressure in the vent that will result from activation of the PRD.

Hose and metallic hose shall be distinctly marked by the OEM or component manufacturer, either by the manufacturers permanently attached tag or by distinct markings indicating the manufacturers name and trademark, applicable service identifier, and design pressure.

Vent Hose shall be electrically conductive.

Hose shall be secured at intervals in such a manner as to minimize the possibility of damage the possibility of damage, corrosion, breakage, or dislocation due to gas flow forces during venting, expansion, contraction, vibration, strain, or wear and to preclude and loosening wile in operation.

For service information Refer to High Pressure Fuel Hose Service Procedure 042-011 or Service Procedure Regulated Pressure Hose 041-016



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2.2 Auxiliary Fuel Receptacle

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The fueling connection receptacle shall be mounted to withstand the breakaway force not greater than 150 lb. (68 kg) when applied in any direction that the vehicle would move. The receptacle should be installed in accordance with the manufacturer's instruction figure 1.

- Inspect the rubber dust cap for cracks, corrosion, and other damage.
- Inspect the spring-like internal wire in the dust cap for damage, corrosion, and debris.
- Verify the wire spring springs back when depressed.
- Replace the dust cap if damaged.
- Inspect and test rubber cap for correct operation.
- Inspect wring for any act of bypassing the rubber cap function. Remove from service if bypassing found.

The clearance around the fueling connection shall be free of interference that prevents the connection of the fueling nozzle.

Leak test Refer to Leak Test Page 5.

For service information Refer to Auxiliary Fuel Receptacle Service Procedure 042-034

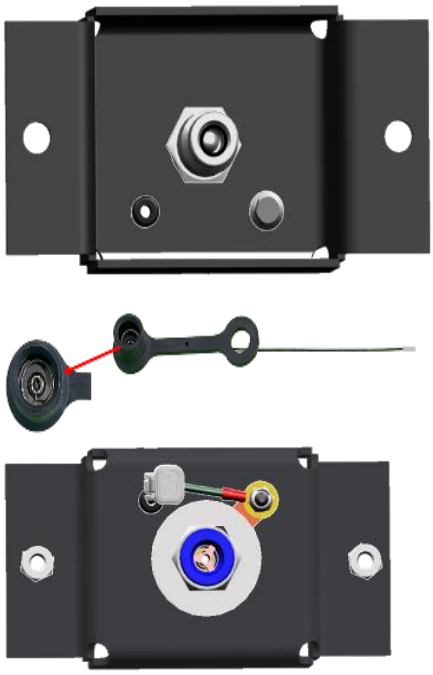

figure 1

2.3 Vent Tubes and Hose

R

The following components shall **NOT** be used for CNG service:

1. Specification for Ductile Iron Casting (Grade 60-40-18).
2. Plastic pie, tubing, and fitting for high-pressure service.
3. Galvanized pipe and fittings
4. Aluminum pipe, tubing and fittings.
5. Pipe nipples for the initial connection to a container.
6. Copper alloy with copper content exceeding 70 percent.

Piping and tubing passing through a panel or structural member shall be protected by grommets or similar devices that shall snugly fit the piping or tubing and the hole in the panel or structural member figure 2.

Fuel lines shall have clearance from the engine exhaust system to protect the fuel lines from excessive by durable and effective means.

Fuel lines shall be mounted, braced and supported to minimize vibration.
Fuel lines shall be protected against damage, corrosion, or breakage due to strain or wear.
A bend in piping or tubing shall be prohibited where such a bend weakens the piping or tubing.
Joints or connections on piping shall be located in an accessible location.

Refer to 2.1 Hose (Regulated and Vent) for Hose requirements.

For service information Refer to Vent Tube Service Procedure 042-012 and High-Pressure Fuel Hose Service Procedure 042-011

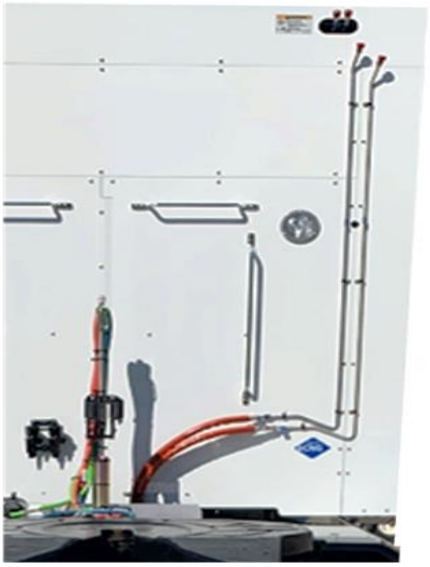

Figure 2

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2.4 Vent Cap

Vent Caps MUST be attached to the vent ports to prevent water, dirt, insects and any foreign objects from collecting in the vent lines of pressure relief device.

A label indicates the PRD(s) vent location(s) with the following language. ATTENTION CNG Vent Location.

Remove from service any with missing vent cap or label.

WARNING If vent cap(s) are missing, a qualified fuel system technician must inspect PRD(s) and attituded tubes for water/debris entry or corrosion and replace PRD vent cap.

WARNING If ATTENTION CNG Vent Location is missing or illegible remove vehicle from service until corrected.

For service information Refer to Vent Cap Service Procedure 042-012

figure 1

2.5 External High-Pressure Tubing

The following components shall NOT be used for CNG service:

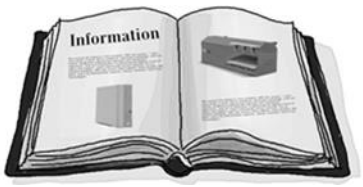
1. Fitting, street els and other piping components of cast irons other than those complying with ASTM A47, Standard and Specification for Malleable Iron Casting (Grade 35018), ASTM A395Standard Specification for ferritic Ductile Iron Pressure Retaining Casting for use at Elevated Temperatures, and ASTM A536 Standard Specification for Ductile Iron Casting (Grade 60-40-18).
2. Plastic pie, tubing, and fitting for high-pressure service.
3. Galvanized pipe and fittings
4. Aluminum pipe, tubing and fittings.
5. Pipe nipples for the initial connection to a container.
6. Copper alloy with copper content exceeding 70 percent.

Piping and tubing passing through a panel or structural member shall be protected by grommets or similar devices that shall snugly fit the piping or tubing and the hole in the panel or structural member.

Fuel lines shall have clearance from the engine exhaust system to protect the fuel lines from excessive by durable and effective means.

Leak test Refer to Leak Test Page 5.

For service information Refer to High Pressure Supply Tube Service Procedure 042-014



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3. Fuel Management Module (FMM), PRD(s), Neck Blocks, and Frame

3.1 Vehicle Fuel Receptacle

Vehicle Fuel Receptacle surfaces should be clear of dirt and debris.

Dust cap should be free from damage and snugly fit the receptacle. NOT present in picture figure 1

Inspect the O-ring on the fuel receptacle. Verify the O-ring is clean and free of cracks, tears, or other damage. If the O-ring is damaged, remove and discard the O-ring. DO NOT lubricate new O-ring.

Leak test fuel receptacle if leak is fund inside receptacle valve inspect Fuel Check Valve 3.2.

The use of adapters to defeat the pressure-specific nozzle and receptacle connections shall be prohibited.

Leak test Refer to Leak Test Page 5.

For service information Refer to Vehicle Fuel Receptacle Service Procedure 042-020

figure 1

3.2 **Fuel Check Valve** (Fuel Backflow Prevention)

Fuel Check Valve is a redundant valve to prevent gas escape during fueling in an event of fill receptacle failure figure 2.

Fuel Check Valve will close if the fueling receptacle fails to seal. Or if the fuel receptacle has damage causing it not to function properly.

Fuel Check Valve is located in the Fuel Manifold near the fueling receptacles.

Fuel Check Valve comes with two O-rings one on the front, and one on the back with a hard white plastic backing. O-rings are different sizes.

The fueling system shall be equipped with a backflow check valve that prevents the return flow of gas from the container(s) to the filling connection.

Leak test Refer to Leak Test Page 5.

For service information Refer to Fuel Check Valve Service Procedure 042-019

figure 2

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3.3 **Manual Shutoff Valve** (Fuel System Isolation)

Manual Shutoff Valve shall be installed that allows isolation of the container(s) from the remainder of the fuel system figure 1.

1. The fuel system isolation valve shall be mounted and shielded or installed in a protected location to minimize damage from vibration and unsecured objects.
2. Where a manual shutoff valve is used, it shall be in an accessible location.
3. The manual shutoff valve shall have not more than 90 degrees rotation (quarter turn fuel delivery valve) from the open to the closed positions. Verify proper valve operation by turning valve handle form ON to OFF. Handle must turn easily by hand.
4. Access to the manual shutoff valves shall not require the use of any key or tool.
5. Where a manual shutoff valve is used, the valve location shall be indicated by means of a decal or label containing the words **"MANUAL SHUTOFF VALVE."** Verify Manual Shutoff Valve label is present and legible.
6. A weather-resistant decal or label with red, blue, or black letters on a white or silver reflective background shall be used.

Leak test Refer to Leak Test Page 5.

For service information Refer to Manual Shutoff Valve Service Procedure 042-017

figure 1

3.4 Pressure Gauges

Pressure gauges installed outside a driver or passenger compartment shall be equipped with a limiting orifice, a shatterproof lens, and a body relief.

Pressure gauges shall be mounted, shielded, and installed in a protected location to prevent damage from vibration and unsecured objects.

Pressure gauge has no cracks, no oil leaking, and gauge face legible.

Supply Pressure Gauge has a range of 0 to 6000 psi. The Supply pressure gauge will read cylinder pressure if the cylinder valve(s) are open figure 1.

Regulated Pressure Gauge indicates the fuel pressure sent to the engine. The gauge has a range 0 to 200 psi. When the regulator is working properly and the key is on, the pressure reading should read approximately 80 - 90 psi figure 2.

Pressure Relief Device (PRD) Gauge will read the cylinder pressure regardless of the valve position figure 3.

Leak test Refer to Leak Test Page 5.

For service information Refer to Fuel Pressure Gauge Service Procedure 042-017

Yellow

Orange

Red

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3.5 Defuel Valve and Coupler

The Defuel Valve controls fuel flow when removing fuel from the cylinder during defueling operations figure 1.

- Verify proper valve operation by turning valve handle form OFF to defuel for two-way valve and OFF to VENT then DEFUEL for three-way valve.
- Handle must turn easily by hand.
- Coupler should be free from damage.

Leak test Refer to Leak Test Page 5.

For service information Refer to Defuel Valve Service Procedure 042-040 and Defuel Coupler 042-041

figure 1

3.6 Fuel Bleed Valve

Fuel Bleed Valve are manual bleed, vent, or drain valve for depressurizing the system figure 2.

The knurled cap is permanently assembled to the valve body for safety.
Open and close fuel bleed valve using a 5/8-inch wrench for prober operations.

Refer to Depressurize Service Procedures 042-001

Leak test Refer to Leak Test Page 5.

For service information Refer to Fuel Bleed Valve Service Procedure 042-021

figure 2

3.7 Fuel System Regulator

An automatic pressure-reducing regulator(s) shall be installed to reduce the fuel container pressure to a level consistent with the service pressure required by the gas-air mixer, throttle body, or fuel injectors figure 3.

Regulators shall be installed so that their weight is not placed on, or supported by, the attached lines.

Turn key to ON and check regulated pressure gauge for a pressure reading 80-90 psi.

All fuel connection on regulator must be leak tested.

figure 3

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Leak test Refer to Leak Test Page 5.

Run engine until operating temperature is reached the check coolant connections for leaks.

There should be no valves on the coolant hoses or tubes between the engine and regulator.

For service information Refer to Fuel System Regulator Service Procedure 042-022

3.8 PRD(s) and Attached Vent Tube

(PRDs) Inspections may require removing access panels or other items to view entire fuel cylinders and components.

- Leak test all PRD(s) and tubing connections.
- Verify PRD(s) free from corrosion or damage.
- Verify eutectic devices do not show signs of eutectic creeping.
- Verify correct PDR(s) are installed correctly Refer to 3.8.
- Verify vent tubs are connected to the vent port on the PRD(s) Refer to 3.8.
- Vent Tubes and Hose free from damage.
- Vent Tubes and Hose secure in a manner to prevent damage with no worn or loose clamps.

Note: OMB YORK Type 2 PRD. CNG only P36 (3600 psi) are the only approved PRD for Cummins Clean Fuel Technologies fuel systems figure 1.
Note: PRD's can only be replaced with the same PRD unless APPROVED by Cylinder Manufacture.

Leak test Refer to Leak Test Page 5.

For service information Refer to Pressure Relief Device (PRD)Service Procedure 042-010 and Pressure Relief Device Tube 042-009

figure 1

3.9 Digital Fuel Gauge

Pressure gauges located withing a driver or passenger compartment shall be installed in such a manner that no gas flows into the passenger compartment in case of failure figure 2.

Verify the digital gauge is working correctly, by turning the key ON and reference the digital gauge to the supply pressure gauge.

Leak test Refer to Leak Test Page 5.

For service information Refer to Digital Fuel Gauge Service Procedure 042-021

figure 2

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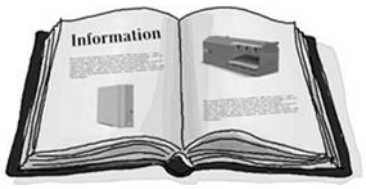
3.10 Fuel Delivery System Wiring Harness

Inspect for damage to wiring harness replace if damaged is found.

Wiring shall be secured and protected from abrasion and corrosion. Check all zip ties are free form damage.

For service information Refer to Fuel Delivery System Wiring Harness Service Procedure 042-036



3.11 Proximity Switch

Proximity Sensors (door sensor) is located on the fill panel of the FMM, functions as a safety interlock to prevent the vehicle from starting if the access door is open figure 1.

Inspect the gap between the proximity switch and metal target. Gap should be 3/16 inch.

Inspect proximity switch operation by closing the fuel door and trying to engage the starter. Starter should not engage when fuel door is closed.

For service information Refer to Proximity Switch Service Procedure 042-035

figure 1

3.12 Internal High-Pressure Tubing

The following components shall NOT be used for CNG service:

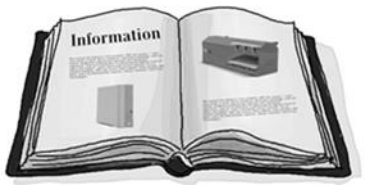
1. Plastic pie, tubing, and fitting for high-pressure service.
2. Galvanized pipe and fittings
3. Aluminum pipe, tubing and fittings.
4. Pipe nipples for the initial connection to a container.
5. Copper alloy with copper content exceeding 70 percent.

Piping and fitting shall be clear and free from cutting or threading burrs and scales. The ends of all piping shall be reamed and deburred.

Piping and tubing passing through a panel or structural member shall be protected by grommets or similar devices that shall snugly fit the piping or tubing and the hole in the panel or structural member.

Fuel lines shall have clearance from the engine exhaust system to protect the fuel lines from excessive by durable and effective means.

Leak test Refer to Leak Test Page 5.



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For service information Refer to High Pressure Supply Tube Service Procedure 042-014	

3.13 Coolant Plumbing

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Means shall be provided to prevent regulator malfunctioned due to refrigeration effects.

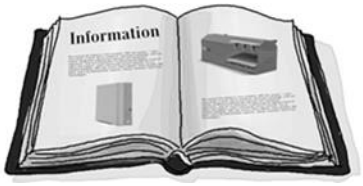
Inspect coolant hoses, tubing, and connections for leaks, remove form service if leaking.

Hoses and tubing must be secured in a manner to prevent damage with no worn or loose clamps or kinked hose or tube.

Run engine until operating temperature is reached the check coolant connections for leaks.

There should be no valves on the coolant hoses or tubes between the engine and regulator.

For service information Refer to Proximity Switch Service Procedure 042-035



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FUEL SYSTEM INSPECTION FORM

Customer	Truck #	Date Of Inspection

Vehicle Make	Model	VIN#	Year	Milage	

Fuel System VIN#(s)			

Type Fuel System Check Chassis System(s)		Back of Cab		Side Mount *(1 and/or 2)*		Roof Mount		Tailgate		Front of Body

Refer to the fuel system manufacture inspection guidelines, NFPA 52 and CSA 6.4 the year the fuel system built.

Vehicle History Reviewed	Yes		No		Comments	

Fuel System MUST be leak tested at 3600 psi at 70 °F or temperature equivalent too, with CNG or inert gas. P = Pass F = Fail NA = Not

Labels, Covers, and External Mounting Brackets	FS1	FS2	FS3	Comments
CNG Diamond on both sides of power unit and right rear of vehicle				
Roof Mount in cab vehicle height label present				
Covers and/or panels undamaged				
Door(s), Door Hinges and Latches functional and undamaged				
Door(s) safety interlock switch undamaged and operational				
Fuel System mounting fasteners undamaged and set to proper torque				
Mounting brackets have no movement or damage				
Fuel System Isolator(s) are undamaged				
Tubes secured to chassis per Fuel System requirements				
Heat Sleeves or shields present and undamaged				
Chassis Wiring Harness secured with no damage				
Regulated Hose, Remote Fill, Vent System, and Cross Over Tubes	**FS1**	**FS2**	**FS3**	**Comments**
Regulated Hose correctly installed with no damage				
Regulated Hose not secured to battery cables				
Remote Fill undamaged, leak test, CNG Diamond with pressure decal				
Remote Fill safety interlock switch undamaged and operational				
Vent tubes undamaged and secured to Chassis/Fuel System				
High Pressure Vent Hose undamaged and secured				
Vent Cap undamaged and secured, and ATTENTION CNG Vent Location decal				
External tubing undamaged, leak all connections				
Fuel Management Module (FMM), PRD(s), Neck Blocks, and Frame	**FS1**	**FS2**	**FS3**	**Comments**
Fuel Receptacle(s) dust cap serviceable, O-ring installed and undamaged				
FMM check valves is operational and leak test				
¼ turn MANUAL SHUTOFF VALVE labeled correctly				
¼ turn MANUAL SHUTOFF VALVE turns freely by hand and handle secured				
Pressure Gauge(s) undamaged and reads correctly, no oil is leaking, leak test				
Defuel Valve turns freely, undamaged, and in OFF position, leak test				
Defuel Coupler is free of damage, dust cap present and undamaged				
Bleed Valve is undamaged, and operational, leak test				
Regulator secured to fuel system, leak test				
Coolant system is leak free				
Pressure Relief Valve operational and connected to vent tube				
Fuel System Regulator Solenoid Coil clicks when key is turned on				
Regulated Pressure Gauge reads between 80-100 psi with key on				
PRD(s) install correctly, undamaged with no Eutectic creeping				
PRD(s) vent tube(s) connected to the vent port on PRD(s)				
Digital Gauge displaying Pressure, Fuel Level, and Miles to Empty				
Proximity Switch check for proper operation				
Wiring Harness secured and undamaged				
Coolant Plumbing leak free, coolant hoes secure and protected from damage				
Leak test all tubes and connections				

☐ Return Fuel System to service.

☐ Repair Fuel System as follows: _____

Inspector Signature _____

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