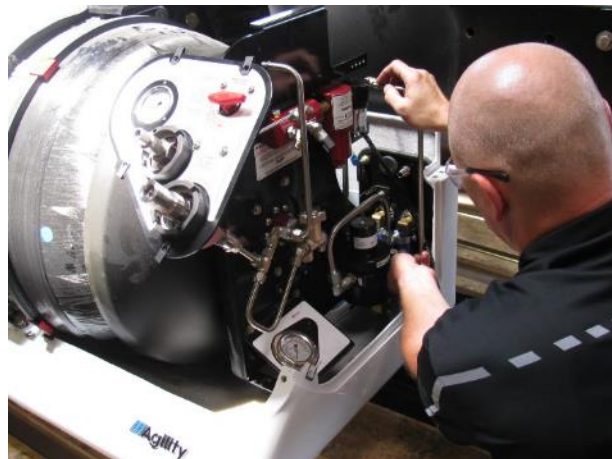


Agility[®]

fuel systems



Truck and Tractor CNG Fuel System Operation, Maintenance & Inspection Manual

**ENP-516
July 2016**



Table of Contents

I.	Proprietary Statement	5
II.	Preface	5
III.	Warning Statements Used in this Manual	5
IV.	Obtaining Product Support, Service or Parts	6
1.	Safety	6
1.1.	Qualified Personnel.....	6
1.2.	Safety Equipment.....	7
1.3.	General Safety Precautions.....	7
1.4.	CNG Vehicle Safety Precautions	7
1.5.	Welding & Hot Work Precautions.....	8
1.6.	Codes and Compliances	8
1.7.	First Responder Guide	8
2.	Fuel Flow and System Components.....	10
2.1.	Fuel Specifications	11
2.2.	System Configurations	11
2.3.	Fuel Flow	12
2.4.	Fuel Management Module Function and Components.....	13
2.5.	CNG Fuel Storage Cylinders	15
3.	Tubing and Fittings.....	16
3.1.	Fittings.....	16
3.2.	Tube and Fitting Installations.....	16
3.3.	Fitting Safety	16
4.	Fueling the CNG System.....	16
4.1.	Fueling Vehicles with CNG	16
4.2.	Fast Fill/Slow Fill and Pressure/Temperature.....	17



5.	CNG Fuel System Operation.....	17
6.	CNG Fuel System Inspections.....	17
6.1.	What is Inspected?.....	17
6.2.	CNG Inspectors: Certified vs Qualified.....	18
6.3.	Inspection Interval Confusion.....	18
6.4.	Recommendations.....	18
6.5.	Cursory Visual Inspection (Daily Pre- and Post-Drive Checks).....	20
6.6.	General Visual Inspection.....	21
6.7.	Detailed Visual Inspection.....	22
6.8.	Tools and Materials for Inspections.....	23
6.9.	Inspection Points for All Systems.....	24
6.10.	Behind the Cab (BTC) Flat Isolators.....	38
6.11.	Fuel Cylinder Clearances.....	42
6.12.	Side Mount Systems.....	43
6.13.	Roof Mount and Front of Body Systems.....	47
7.	Fuel System Maintenance Intervals.....	48
7.1.	Severe Duty.....	49
7.2.	Normal Duty.....	50
8.	CNG Fuel System Maintenance.....	51
8.1.	Depressurizing CNG Systems.....	51
8.2.	Repressurizing the System.....	52
8.3.	Pressure Relief Devices (PRDs).....	52
8.4.	Draining Vent Lines.....	52
8.5.	High Pressure Filter Maintenance.....	54
8.6.	Testing and Finding Leaks.....	55
8.7.	Tube Fitting Assembly and Adjustment.....	56
8.8.	Solenoid Valve Maintenance.....	57



8.9.	Removal Procedure for Regulator, High Pressure (HP) Filter and Solenoid Subassembly	59
9.	Defueling Preparation and Procedures.....	62
10.	Troubleshooting.....	64
11.	References and Service Bulletins	68



I. Proprietary Statement

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Agility Fuel Systems gives express consent to authorized dealers to utilize portions of this manual, or the manual in its entirety for the purposes of providing customers and clients of Agility with information pertaining to the Agility Fuel Systems compressed natural gas (CNG) fuel storage system with appropriate acknowledgement of copyright.

II. Preface

This manual dated July 20, 2016 replaces several individual manuals: "Truck and Tractor CNG System Operation Manual, ENP-007; "CNG Fuel System Inspection Guidelines," ENP-468 and "CNG Maintenance Interval Guidelines," ENP-493. The "CNG System Users' Manual," ENP-314, is available for download from the Agility Fuel Solutions website.

This manual contains general operation, maintenance and inspection information for Agility Fuel Solutions CNG vehicle fuel systems. If an OEM fuel system manual exists, it shall take precedence over this manual. Your system or specific components may vary slightly from this text, but the operating principles and functions of the components are the same.

No attempt shall be made to fill, install, or maintain the natural gas fuel system until this manual and all referenced supporting documentation have been read and fully understood.

Go to the Agility Fuel Solutions Product Support web page for the latest documents.

III. Warning Statements Used in this Manual



Personal injury or death will occur if procedures are not followed.



Personal injury or death may occur if procedures are not followed.



Damage to equipment, fuel system or vehicle is possible if instructions are not followed.



Best practices or hints to help an operation or procedure go smoothly.

CAUTION

1. All replacement parts must adhere to the accepted standards and ratings as specified by Agility Fuel Systems. The usage of any part that is not approved by Agility Fuel Systems is not recommended and may compromise the integrity and safety of the system.
2. Do not remove components from original packaging until absolutely necessary. Any components that are to be reinstalled must be thoroughly cleaned, inspected, and stored in a satisfactory manner until reinstallation.

IV. Obtaining Product Support, Service or Parts

Fuel system in- or out- of warranty product support can be obtained by calling the Product Support Group (PSG) Hotline at 949-267-7745, and follow the prompts.

The PSG can be contacted via e-mail: support@agilityfs.com

For aftermarket and non-warranty parts: parts@agilityfs.com

Visit our website for more information, including CNG and LNG fuel system videos, posted on the Product Support Group web page. Go to www.agilityfs.com

Table 1 Revision History

Revision	Description	Author	Approved By	Date
--	Initial Release	W. Yoshida	C. Forsberg	7/20/16

Agility Fuel Systems Product Support Group
 1815 Carnegie Ave | Santa Ana, CA 92705 USA
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 www.agilityfs.com

1. Safety

WARNING

If the vehicle has been in an accident or fire, cylinders and system must be examined by a qualified inspector.

This section outlines general safety guidelines that must be followed when operating and servicing natural gas equipment provided by Agility Fuel Systems.

1.1. Qualified Personnel

CNG systems should be maintained and inspected exclusively by trained personnel. As with all pressure vessels, CNG storage and fuel delivery systems are dangerous.

1.2. Safety Equipment

1. CNG safety signage should be visible at all applicable locations as stipulated by federal, state and municipal law.
2. Natural gas rated fire extinguishers should be accessible and visible throughout all servicing and fueling areas. Be sure all fire extinguishers are charged and up to date.
3. Areas designated for CNG fueling systems must have adequate lighting that complies with NFPA and other applicable codes.
4. Search for leaks using only certified leak detecting solutions and equipment such as Swagelok Snoop®. Any other product or solutions are unacceptable.
5. Use tools that are in good working order with proper calibration.
6. Wear appropriate attire and personal protective equipment (PPE) while servicing or maintaining any CNG system.

1.3. General Safety Precautions

1. Follow all maintenance procedures in order; do not skip steps unless so noted.
2. Never use an open flame as a source of illumination near a CNG system.
3. CNG fuel systems are to be serviced in designated areas that comply with all federal, state and municipal laws and regulations.
4. CNG servicing and fueling areas must be well ventilated.
5. Perform all maintenance and service procedures in a dust free environment.
6. Never attempt to depressurize or vent a system by loosening a fitting.

1.4. CNG Vehicle Safety Precautions

WARNING

Strict compliance to proper safety and handling practices is essential when operating compressed natural gas fuel systems.

The following safety precautions should be considered at all times when operating natural gas fuel systems and equipment:

1. A portable fire extinguisher must be installed on the vehicle in an easily accessible location.
2. Do not start the engine if a natural gas leak is detected.
3. Never attempt to open system components that are under pressure.
4. System pressure must not exceed 3000 psi for public vehicles in Canada.
5. For all other vehicles the system pressure must not exceed 3600 psi.
6. Do not smoke or produce an open flame within 30 feet of a CNG vehicle or a CNG dispensing/filling station.
7. Always ground a vehicle prior to defueling.

8. If a CNG vehicle must be out of service for an extended period of time, turn cylinder valves to the “OFF/CLOSED” position and run the engine until it stalls. This will consume the residual fuel in the closed off lines.

1.5. Welding & Hot Work Precautions

⚠ WARNING ⚠ CAUTION

- A. Before performing any hot work procedure, make sure the fuel system is leak-free by performing a leak test with a suitable leak detection solution.
- B. Before performing any welding on the vehicle chassis or body, ensure the main battery disconnect switch is turned off. Follow OEM or body builders’ manual for welding procedures.
- C. Disconnect the CNG fuel system electrical connector at the rear of the FMM box or at the Agility ECU to prevent damage.

For any welding in or near a CNG storage system, follow these safety recommendations:

1. Ensure the vehicle is parked in a well-ventilated area. Do not park the vehicle in an area where natural gas may accumulate.
2. If welding or hot work is performed more than six feet/two meters away from the CNG vehicle, it is not necessary to defuel the system. **However**, the fuel system should be depressurized as described in Section 8.
3. If performing hot work closer than six feet/two meters from the CNG cylinders, they must be **de-fueled**, see Section 9
 - a. Cover all CNG components, including the cylinders and fuel lines, with fireproof blankets or a metal shield. Isolation must prevent sparks and slag from hitting the cylinders.
 - b. A single spark or weld slag could compromise CNG components.
 - c. If the cylinder is hit by a spark or slag, the vehicle must be taken out of service and inspected.

1.6. Codes and Compliances

USA: NFPA 52

Canada: CAN/CGA B109

North America: ANSI/AGA NGV 3.1/CGA 12.3 and NGV 12.3-M95

1.7. First Responder Guide

NOTICE

Refer to the *Agility Fuel Systems First Responder Guide, ENP-084* for CNG and LNG firefighter first responder information.

A vehicle equipped with a natural gas fuel system will have a blue reflective decal on the rear of the vehicle identifying compressed natural gas (CNG).



Figure 1 CNG vehicle blue diamond identification decal.

Natural gas possesses unique hazards that are not present in gasoline or diesel fuel. CNG is in a gaseous state at room temperature and pressure. For storage purposes, natural gas must be compressed to 3600 psi. Agility Fuel Systems minimizes these potential hazards with state of the art design and testing practices.

1.7.1 Storage Cylinders and Fuel Management Module

The storage cylinders for CNG fuel are housed in metal frames that are bolted to the truck body or chassis. These structures are designed to protect the cylinders in a collision. Each individual cylinder has a valve at one end which allows the fuel in that cylinder to be isolated from the rest of the system. During normal operation, all cylinder valves should be open.

The fuel management module (FMM) is equipped with a 1/4-turn shutoff (red-handle) valve which isolates the fuel storage system from the engine for emergency situations. This valve is OPEN for normal operation.

Note, this valve should not be used when depressurizing or defueling the system. The best practice is to close each cylinder valve.

⚠ DANGER

- 1. CNG storage cylinder pressure can reach 4500 psi. DO NOT cut fuel supply plumbing.**
- 2. All pressure relief device (PRD) lines contain full cylinder pressure at all times and cannot be isolated by cylinder valves. Make sure you know where the PRDs and PRD lines are on your vehicle.**

1.7.2 Emergency Response for Gas Leaks

If the vehicle has sustained damage or a gas leak is detected:

1. Do not approach the vehicle if any sources of ignition may exist such as fire, sparks, electrostatic charges, lights or electronic devices.
 - a. If ignition sources may be present, vehicle fuel cabinet doors should remain closed.
 - b. If no ignition sources are present, keep the vehicle and fuel cabinet doors open to prevent gas accumulation.



2. If the vehicle is indoors, move the vehicle outside and away from any ignition sources.
3. Do not use road flares.
4. Do not smoke or allow anyone else to smoke near the vehicle.
5. Turn the ignition switch off, set the parking brake and turn off the battery at the main disconnect.
6. If it is safe to do so, close the main shutoff valve and the cylinder valves. Check the fuel system near the damaged area for leaks by smell, sight, and sound. CNG is odorized.
7. Keep traffic and pedestrians away.
8. Beware that gas may continue to leak once ignition is turned off and the manual shutoff valves are closed.
9. Verify leak locations with suitable methane detection fluid.

NOTICE

The leaks should be repaired by a qualified technician.

1.7.3 Vehicle Fire Procedures

In the event of a CNG fire, it is imperative that the vehicle operator acts quickly:

1. Call 9-1-1.
2. Get passengers out of the vehicle as quickly as possible.
3. Evacuate the area.

⚠ WARNING

Thermally activated pressure relief devices (PRDs) protect the cylinders from rupturing in a fire. The PRDs MUST NOT be allowed to cool in order to activate and relieve excess pressure. PRDs typically activate between 212°F and 220°F and will cause high pressure CNG to vent. The CNG may ignite and add to the fire.

1.7.4 Emergency Shut Down Procedure

To shut down a CNG storage system:

1. Turn the ignition switch to "OFF" and set the parking brake.
2. Turn off the battery disconnect switch.
3. Shut off fuel at 1/4-turn valve on the FMM.
4. Inform emergency personnel.

2. Fuel Flow and System Components

All figures and illustrations are intended for reference only and do not necessarily reflect the exact configuration for any given system. All plumbing and fuel management module layouts are consistent across platforms; however there may be some differences depending on vehicle-specific options. Please contact Agility Fuel Systems Product Support Group (PSG) if you have any questions about your system that are not covered in this manual.

2.1. Fuel Specifications

⚠ CAUTION

Failure to meet fuel requirements may result in poor engine performance and damage that is not covered under warranty.

Fuel quality is crucial for maximum engine performance, life expectancy and emission standards. CNG fuel must meet or exceed the minimum requirements. Table 2 references the minimum fuel quality standards as determined by the Cummins Engine Company®, SAE J1616 “Natural Gas Recommended Practice.”

Table 2 Fuel Specifications

Property	Limit	Test Method
Hydrocarbon		
Methane	90% min.	ASTM 1945-81
Ethane	4% max.	ASTM 1945-81
Propane	1.7% max.	ASTM 1945-81
Other		
C4 and Higher	0.7% max.	ASTM 1945-81
C6 and Higher	0.2% max.	ASTM 1945-81
Other Gaseous Species		
Hydrogen	0.1% max.	ASTM 2650-88
Carbon Dioxide + Nitrogen	3% max.	ASTM 1945-81
Carbon Monoxide	0.1% max.	ASTM 2650-88
Oxygen	0.5% max.	ASTM 1945-81
Other Species		
Sulfur	10 ppm max.	Title 17 CCR Sect. 94112 Meth. 16
Performance Related Properties		
Wobbe Index	1300-1377	Calculated

2.2. System Configurations

The fuel system structures and components are designed to meet or exceed all safety and vehicle standards. The figures below represent the typical systems available.

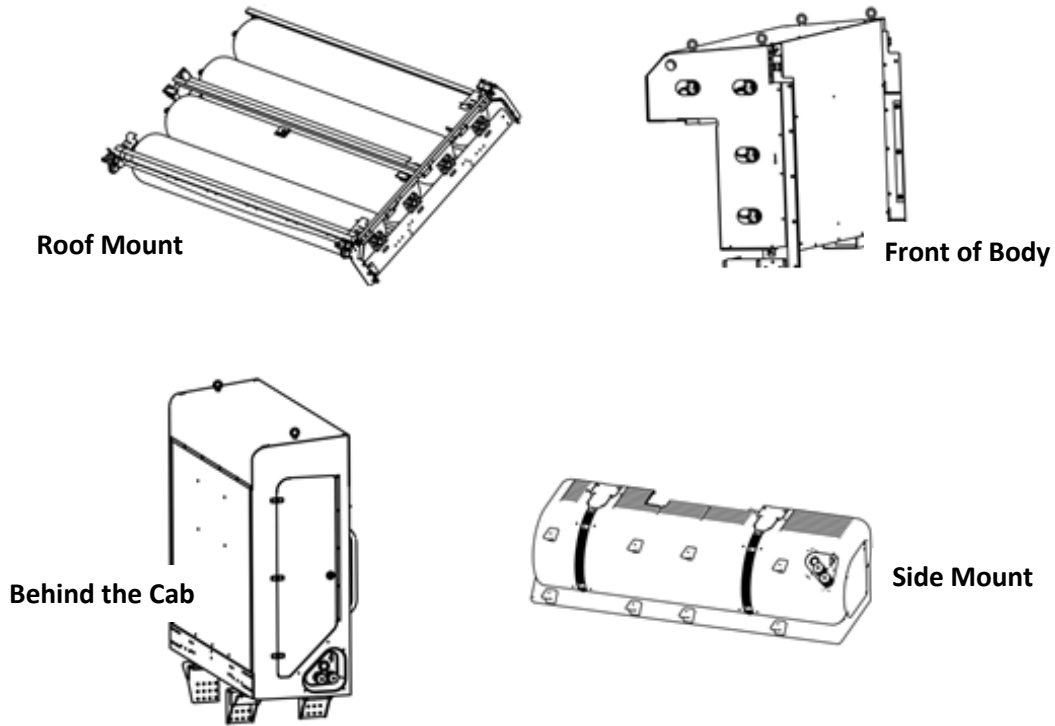
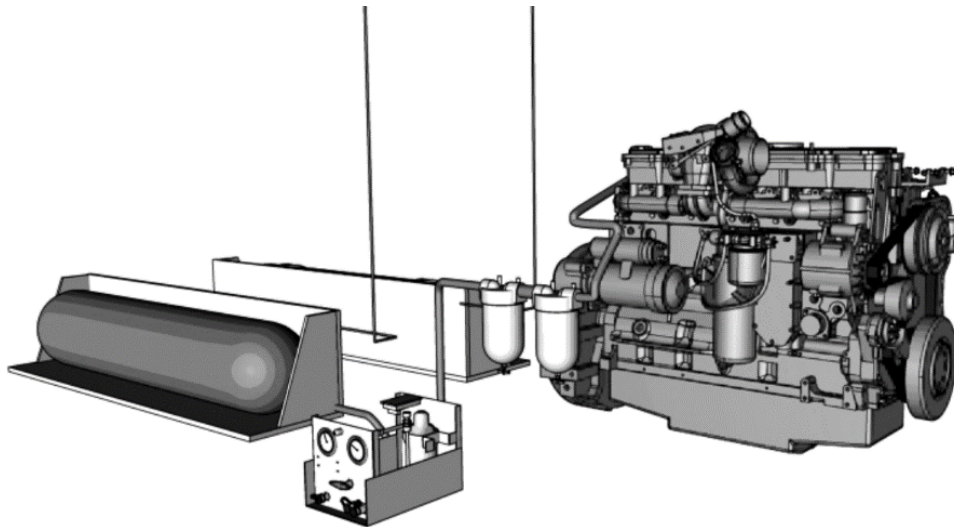


Figure 2 Typical CNG system configurations.

2.3. Fuel Flow

Refer to Figure 3. Fuel is stored in one or more CNG cylinders. Gas is stored in these cylinders at a nominal pressure of 3,600 pounds per square inch (psi). Every Agility system is housed in a protective structure, and can be found on the roof, at the sides or behind the cab.

Each cylinder is protected by one or more pressure relief devices, or PRDs.



Starting from the fuel cylinder(s), high-pressure gas flows through the cylinder shut-off valves to the fuel management module (FMM). The FMM houses control valves, a filter and a pressure regulator to condition the fuel for use by the engine.

The high-pressure regulator reduces gas pressure from 3,600 psi to approximately 125 psi. Gas at 125 psi leaves the regulator and flows through the low-pressure filter, and finally to the engine. An internal regulator in the engine further reduces the gas pressure for consumption.

Note: The CNG fuel system ends at the input side of the low pressure fuel filter, usually located in the engine bay.

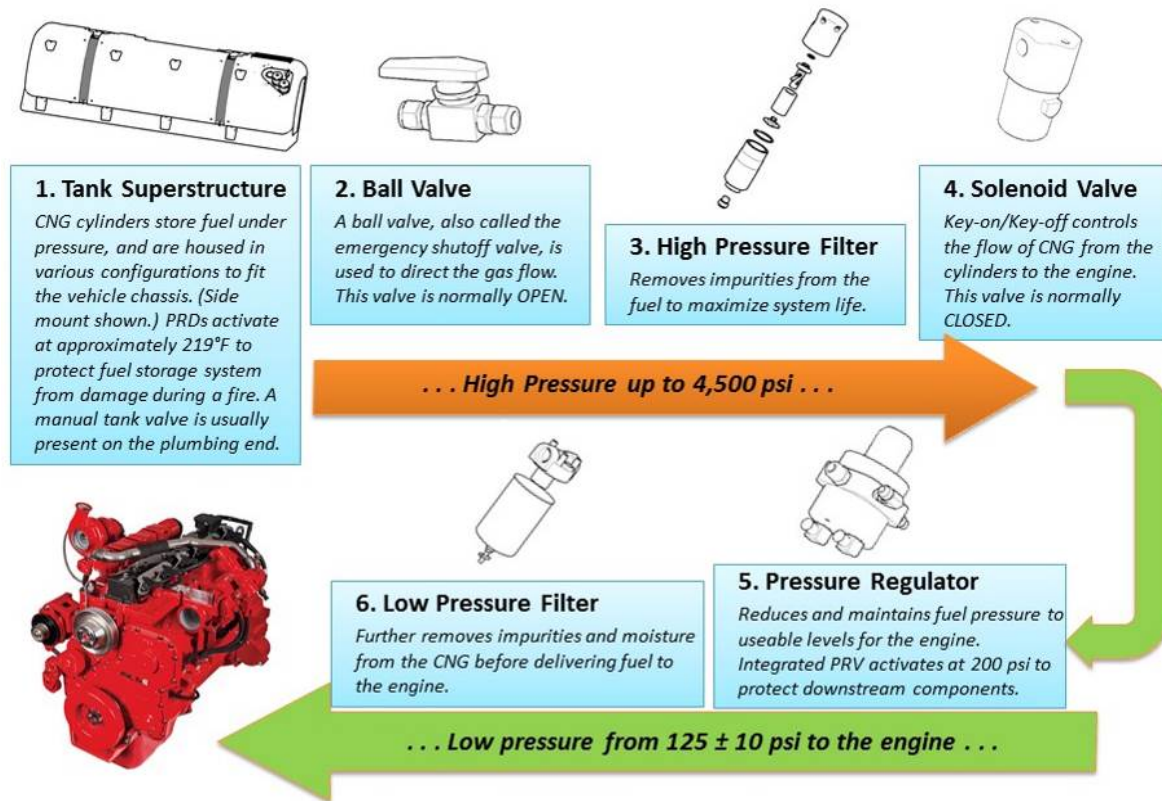


Figure 4 CNG fuel flow and nominal pressures.

2.4. Fuel Management Module Function and Components

The FMM is the interface between the vehicle fuel storage and delivery system and the vehicle engine and operator. There are several FMM configurations, depending on the fuel storage system and vehicle. The FMM can be mounted on either the driver or passenger side of the vehicle.

1. A 1/4-turn manual valve controls fuel flow from the FMM to the engine. It is “on” or open for normal operation.
2. The standard NGV1 fuel receptacle is found across North America. Some systems also have a “fast” or “transit fill” high-volume flow receptacle.
3. The defuel receptacle permits the fuel in the cylinders to be removed when necessary.

4. The high pressure gauge indicates pressure in the cylinders and plumbing components flowing to the regulator. Minimum pressure should be 500 psi, maximum pressure is 4,000 psi and nominal pressure is 3,600 psi when full.
5. The low pressure gauge shows the gas pressure coming out of the regulator and going to the engine. Minimum pressure is 115 psi, maximum pressure is 135 psi and nominal pressure should be 125 psi.
6. The manifold is a “plumbing hub” where the gas is distributed to various places in the system.
7. A bleed valve is used to relieve any remaining pressure after the depressurizing process. It is normally closed.
8. The defuel valve is opened when defueling. It is closed for normal operation.
9. The solenoid valve is activated by the vehicle ignition key.
10. If equipped with DriveAway™ Protection, the engine cannot be started unless all fuel caps (including fuel system doors and auxiliary fill caps) are securely in place. These caps include a sensor trigger (magnet) which closes a reed switch on the FMM panel to send an “OK to crank” signal to the engine control unit (ECU). If the caps are not securely attached, the engine will not crank.

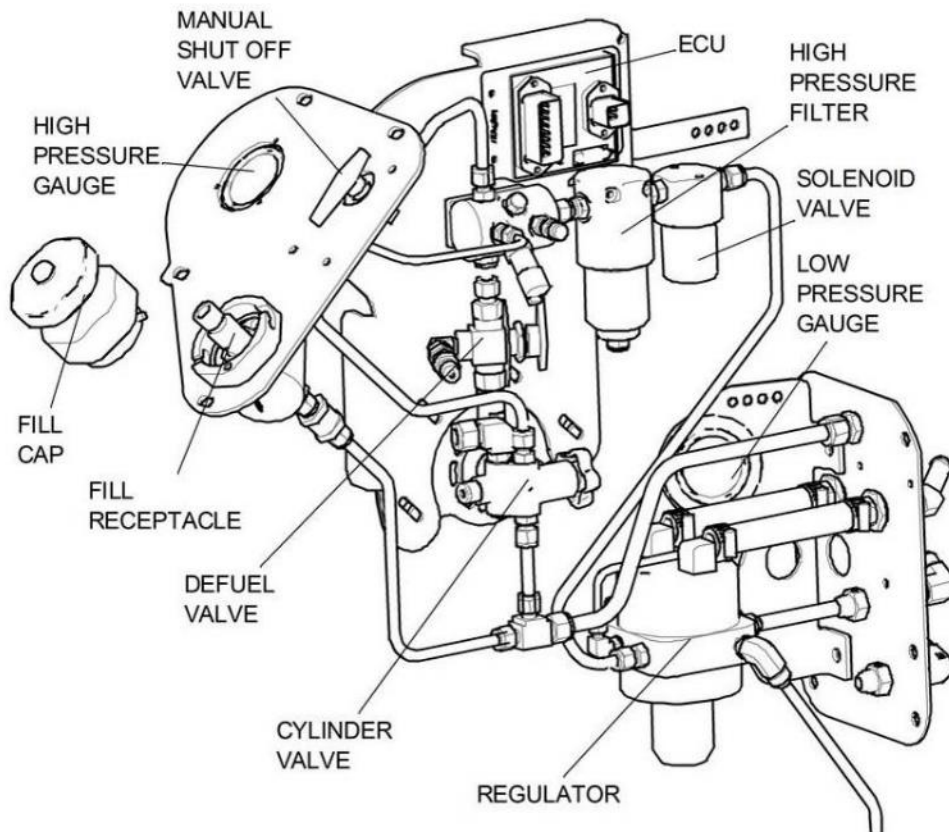


Figure 5 Typical integrated FMM used in side mount systems. Note, some parts are hidden from this view.

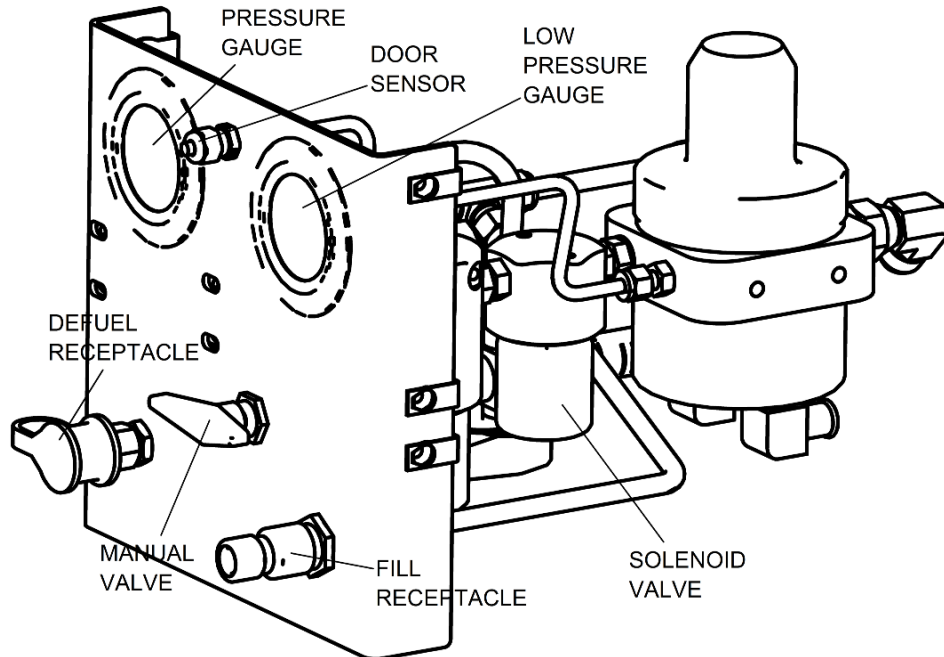


Figure 6 Typical cabinet style FMM front panel with cover removed.

2.5. CNG Fuel Storage Cylinders

CAUTION

Cylinders that have been in an incident should be depressurized prior to inspection.

The fuel cylinders on the vehicle are manufactured to comply with FMVSS 304, NAI/IAS, or the CSA B51 Part 2 specifications. Cylinders must have permanent labels in accordance with applicable regulations. If labels are missing or illegible, contact the manufacturer to obtain replacements. The manufacturer's labels provide valuable information to cylinder inspectors and service personnel.

Cylinders should be inspected immediately if:

1. The vehicle has been in an accident.
2. The fuel cylinder or vehicle has been subjected to fire, impact, excessive heat or any other means that may have caused external or internal damage.
3. Unusual behavior is observed. This may include but is not limited to, emission of natural gas odor, unexpected loss of gas pressure, snapping or hissing sounds, rattling and any other indications of loose parts.
4. The fuel cylinder has been transferred to another vehicle or the cylinder installation has been altered significantly.

WARNING

Failure to perform regular or emergency inspections may put the vehicle and its operator at risk of serious injury or death.

3. Tubing and Fittings

All tubing is stainless steel manufactured according to ASTM A-269 or ASTM A213. It is cold finished, bright annealed, seamless tube. Tubing can be 316 SS or 304 SS, maximum hardness HRB90.

3.1. Fittings

CAUTION

Do not mix tube fittings from other manufacturers; this may result in leaks, damage or serious injury.

CNG fuel systems are plumbed with Swagelok® stainless steel compression tube fittings. The stainless steel fittings are designed specifically for use in CNG applications.

3.2. Tube and Fitting Installations

Installing tube fittings correctly requires adequate training, correct parts and appropriate tools. Tubes must be bent accurately to minimize system stress. Fittings must be assembled according to manufacturer's specifications. Maintenance personnel must receive proper training from Swagelok or Agility Fuel Systems.

3.3. Fitting Safety

1. Do **not** bleed the CNG system by loosening or "cracking" a fitting connection.
2. Do **not** disassemble new fittings prior to use.
3. Do **not** attempt to torque fittings while system is pressurized.
4. When tightening a compression nut on a fitting, make sure the fitting body is held securely.

4. Fueling the CNG System

NOTICE

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

4.1. Fueling Vehicles with CNG

1. Open the FMM door (if applicable) and remove the dust cap from the fueling receptacle.
2. Wipe the receptacle and nozzle. Check the O-ring, and then connect the nozzle from the fueling station to the fuel panel receptacle.
3. Turn the nozzle valve to the "fill" position and fuel will start to flow.
4. Continue filling until the fuel station pump shuts off automatically.
5. Remove the fueling nozzle by turning the nozzle valve to the "vent" position and release it from the receptacle. The receptacles are designed so the nozzle will not come off under pressure.
6. Once fueling is complete, replace the cap and close the FMM door. When Agility fuel systems are equipped with optional safety interlocks (Drive Away Protection), the FMM doors and all receptacle caps must be in place in order for the engine to start.

NOTICE

Before adding fuel, swab the station fill nozzle. Look for any signs of oil or other contaminants. An oily or dusty condition may be an indication of poor fuel quality or a station that is not well maintained. Report this condition to the station operator.

Do you smell gas when filling the system? Turn off the station pump and check the O-ring inside the fill receptacle. If it is worn or damaged, clean the receptacle and replace the O-ring with a new one. If the O-ring is OK, contact the station provider.

4.2. Fast Fill/Slow Fill and Pressure/Temperature

Typically, stations fill to a service pressure of 3,600 psi. During fast filling, gas heats as it compresses inside the cylinders, which is normal. On a hot day, pressure from the filling station will indicate full system pressure, but the fuel cylinders may not be filled completely. This is normal.

For example, the ambient temperature at a filling station is 120°F (50°C) in the afternoon, and the CNG dispenser stops at 3,600 psi as expected.

Later that evening, ambient temperature drops to 70°F (20°C). As the gas cools, pressure in the cylinders decrease. So instead of having a complete fill of 3,600 psi at 120°F, you have about 3,000 psi at 70°F.

Fueling stations can partially compensate for the heat generated during fast filling, but generally cannot achieve more than 70% to 80% full. Slow filling results in a nearly 100% full system, because the gas is able to cool during the filling process.

5. CNG Fuel System Operation

Starting a natural gas vehicle requires a few seconds delay between battery power (ignition switch) turn-on and starter motor activation (engine crank). This allows time for the gas to flow from the storage cylinder, through the solenoid valve and regulator and to the engine.

1. Follow standard manufacturer recommended start-up procedures.
2. If the vehicle is starting from cold, let the engine idle for about five minutes. This will allow engine coolant to warm the fuel and ensure the low-pressure lines downstream of the primary pressure regulator do not freeze. On extremely cold days, allow the vehicle to idle for a longer period until the coolant temperature is high enough to warm the fuel.

6. CNG Fuel System Inspections

Compressed natural gas (CNG) fuel systems must be inspected regularly to ensure safety, optimum performance and compliance to legislation.

6.1. What is Inspected?

1. **Mandatory Decals and Labels**
2. **Mechanical and Hardware Items**
 - a) Fasteners
 - b) Clips and supports
 - c) Cylinder brackets and mounts

- d) System frame
- e) Housings, covers, shields
- f) Rubber isolators

3. Fuel Cylinders, Lines and Components

- a) Fuel cylinders
- b) Pressure relief devices (PRDs)
- c) Fill receptacles
- d) Tubes and hoses
- e) Valves
- f) Fittings
- g) High pressure filter
- h) Regulator
- i) Gauges

NOTE

It is not normally necessary to disassemble anything for inspection. Visual observation, measurements and other checks can be performed by looking through vents, doorways or access panels. Inspection mirrors or borescopes may help simplify the process.

6.2. CNG Inspectors: Certified vs Qualified

CNG fuel system inspectors are certified by CSA after passing a written examination on CSA standards. An acceptable alternative to the certified status is a CNG inspector who is qualified and trained as described by the Compressed Gas Association (CGA): A qualified inspector must have at least one of the following: (a) two years' experience conducting inspections; (b) working under supervision of someone with two years' experience inspecting systems; or (c) approved by a CNG cylinder manufacturer. Fleet owners should determine how they wish to implement and manage their inspectors and inspector training programs. Refer to "CNG Cylinder and System Inspection Regulations, Codes and Guidelines" for more information. See References section for more information.

6.3. Inspection Interval Confusion

Based on cylinder manufacturer recommendations and industry standard practices, visual CNG cylinder inspections should be performed at a frequency of 3 years or 36,000 miles, whichever occurs first. This is based on common passenger car or light-duty applications, where lower mileage per year is common. This inspection frequency is applied to all CNG vehicles regardless of final use application, which results in greatly varying actual frequency from a time-based perspective.

High mileage vehicles, such as over the road trucks, may accumulate 36,000 miles in several months; well in advance of the anticipated 3 year time-frame. However, because heavy-duty vehicles are often subject to more demanding duty cycles than passenger cars, performing cylinder inspections at 3 year intervals would not be appropriate.

In addition, there is no legislation for CNG *system* inspections. Fuel cylinders are only a small portion of a complete vehicular fuel system, and all the other components should be inspected to ensure optimum safety and performance.

6.4. Inspection Recommendations

Because of this confusion, Agility Fuel Systems recommends a practical alternative schedule for detailed fuel system inspections, which includes cylinders – at intervals selected by the fleet manager or vehicle owner.

These guidelines are intended to be consistent with the pending Recommended Practice (RP) from the American Trucking Association's Technology & Maintenance Council and the recommendations from the



NGVA Technology Committee Working Group on CNG Fuel System Inspections, of which Agility is a member and active participant. The working group is working closely with DOT, NHTSA and FMCSA to update FMVSS 304 to be consistent with the ATA-TMC (RP) and Agility guidelines.

Agility Fuel Systems Recommends the Following

- 1. The common recommendation of every 3 years or 36,000 miles, whichever occurs first, OR**
- 2. After every 1 year, regardless of mileage**

A practical approach to inspection and maintenance of the fuel system would be to match intervals and procedures with other vehicle maintenance tasks, such as engine oil and filter changes, or the yearly DOT inspection.

⚠ CAUTION

Regardless of which interval is selected, Agility recommends all inspection routines include a daily walk-around visual inspection, and the use of three inspection categories as outlined below.

6.5. Cursory Visual Inspection (Daily Pre- and Post-Drive Checks)

Visually check the following items in Table 2 before and after vehicle operation. If all is well, the vehicle is cleared for operation. If anything is wrong, a qualified CNG system technician should make the necessary repairs. This check should take about five minutes or less.

Number	Item	Description and Location	Observation / Action
1	System and vehicle decals	Various locations on vehicle body	Must be in place and legible. Replace if needed.
2	Gas or coolant leaks	All fittings and components	Notify repair personnel if any leaks are found.
3	Cylinder mounts	Brackets and straps for side mounted systems, neck blocks for BTC and roof systems	Side mount: Manual valve handle is at 12 o'clock position. Others: Check for loose or missing fasteners.
4	Cylinder valves	Mounted on each cylinder	Open fully.
5	Emergency/Manual Shutoff valve	Red handle, 1/4-turn ball valve on the FMM	On/open position for normal operation.
6	High pressure gauge	5000 psi gauge on or near the FMM	500 psi min., 4,000 psi max. nominal, 3,600 psi when full. Re-fuel as needed.
7	Low pressure filter	Under hood, at engine	Drain fluid.
8	Low pressure gauge	200 psi gauge, on or near the FMM	Turn ignition on or start engine. 115 psi min., 135 psi max., 125 psi nominal.
9	Dashboard fuel gauge	In cab dashboard	Should indicate fuel level.
10	Hoses and tubes	Various locations on vehicle and fuel system	Listen or smell for leaks, look for damaged or missing fasteners, excessive corrosion.
11	PRD components	Plastic or rubber vent tube caps	Caps must be in place. If missing, check PRD components and replace caps.
12	Drive-away prevention caps	Fuel receptacle dust caps on drive-away prevention equipped systems.	All caps must be in place. Remember to check remote fill receptacles, if equipped.

6.6. General Visual Inspection

A general visual inspection is performed by a service technician when performing routine maintenance on the vehicle, such as an oil and filter change. Although access panels may not have to be removed, all shields and components must be checked for damage. This inspection should take from 10 to 20 minutes.

Number	Item	Description and Location	Observation / Action
1	System and vehicle decals	Various locations on vehicle body	Must be in place and legible. Replace if needed.
2	Cylinder mounts	Brackets and straps for side mounted systems, neck blocks for BTC and roof systems	Side mount: Manual valve handle is at 12 o'clock position. Others: Check for loose or missing fasteners.
3	Cylinder valves	Mounted on each cylinder	Open fully.
4	Emergency/Manual Shutoff valve	Red handle, 1/4-turn ball valve on the FMM	On/open position for normal operation.
5	High pressure gauge	5000 psi gauge on or near the FMM	500 psi min., nominal 3,600 psi when full. Re-fuel as needed.
6	Low pressure filter	Under hood, at engine	Drain fluid.
7	Low pressure gauge	200 psi gauge, on or near the FMM	Turn ignition on or start engine. 115 psi min., 135 psi max., 125 psi nominal.
8	Dashboard fuel gauge	In cab dashboard	Should indicate fuel level.
9	Hoses and tubes	Various locations on vehicle and fuel system	Listen or smell for leaks, look for damaged or missing fasteners, excessive corrosion.
10	PRD components	Plastic or rubber vent tube caps	Caps must be in place. If missing, check PRD components and replace caps.
11	Drive-away prevention caps	Fuel receptacle dust caps on drive-away prevention equipped systems.	All caps must be in place. Remember to check remote fill receptacles.

6.7. Detailed Visual Inspection

Each year, a detailed visual check is to be performed on the vehicle by a certified or qualified CNG inspector. The checks are more detailed, and includes the inspection of safety components, such as pressure relief devices (PRDs). Inspections may require removing access panels or other items to view the entire fuel cylinder(s) and components. This inspection should take approximately 45 minutes to one hour.

Number	Item	Description and Location	Observation / Action
1	Cylinder	Depends on configuration	Inspect cylinder per manufacturer's instructions, or use CGA C-6.4
2	Check cylinder shields and covers for damage	All housings and cabinets	A) Covers should be intact and secure. Tighten loose fasteners or replace missing fasteners. B) Look for rubbing or abrasion especially around fuel cylinders
3	Cylinder bracket mounts	Neck blocks for back of cab and roof systems, brackets and straps on side mount systems	Check loose or missing fasteners and all mounting points for damage.
4	Cylinder isolator displacement	Side mount systems only	Visually check for missing or worn rubber isolators on side mount straps.
5	Cylinder valves and PRDs	Manual valve and PRD mounted on or near each cylinder	Perform leak check. Valve should open and close freely by hand. If range or mileage has reduced, valve may be stuck in the closed position.
6	BTC isolator mounts	Rubber isolators between the vehicle chassis and BTC cabinet	A) Check for displacement or metal-to-metal contact. B) Check height of each isolator – if isolators vary by 1/8-in. or more – the isolators should be replaced.
7	Leak check	All fittings, plumbing tubes, hoses and flow control components. Various locations	Visually inspect for chafing or loose clamps. Perform leak check.

Some states have specific requirements for CNG fuel cylinder inspections.

- a. **Arizona:** Inspection is required when the vehicle is placed into service and then annually. Inspection must be performed by an individual trained by the system manufacturer.
- b. **Kentucky:** Inspection is required every 36 months or 36,000 miles, whichever comes first, and after collision. Does not state who performs the inspection.
- c. **Oklahoma:** Inspection is required every 36 months or 36,000 miles, whichever comes first. Inspection is performed by a certified technician.
- d. **Texas:** The owner of the vehicle must prove that the container meets the inspection criteria of FMVSS 304. (Every 36 months or 36,000 miles, whichever occurs first.)
- e. **Utah:** Inspection is required every 36 months or 36,000 miles, whichever occurs first. Inspection must be performed by a CSA certified technician.
- f. **West Virginia:** Does not state the frequency of inspection, however, all CNG activity must be overseen by a CSA certified technician. Note, this legislation is not signed into law yet.
- g. **Ohio:** Coming soon

NOTE: Inspections must be performed by qualified inspectors using guidelines from the fuel cylinder manufacturer in addition to the guidelines listed in this bulletin.

⚠ WARNING

If a CNG-fueled vehicle has been involved in an accident or fire, the system and cylinders must be inspected by a certified or other qualified CNG fuel system inspector.

6.8. Tools and Materials for Inspections

Common hand tools are needed for CNG cylinder and system inspection. Here are some additional helpful items.

- a. Torque wrench
- b. Depth gauge/micrometer
- c. Leak detection fluid
- d. Inspection mirror
- e. Flashlight
- f. Borescope
- g. Creeper
- h. Ladder or scaffold
- i. Notepad or vehicle record
- j. Camera
- k. Personal protective equipment (PPE), including eye protection, hard hat, reflective vest and fall arrestment harness as needed

6.9. Inspection Points for All Systems

6.9.1. Cylinder Labels

Various vehicle and highway legislative agencies require warning and informational decals for CNG fueled vehicles. Cylinder manufacturer labels, indicating cylinder type and expiration date, must be in place and legible. If the cylinder label is damaged or missing, contact the cylinder manufacturer for a replacement.

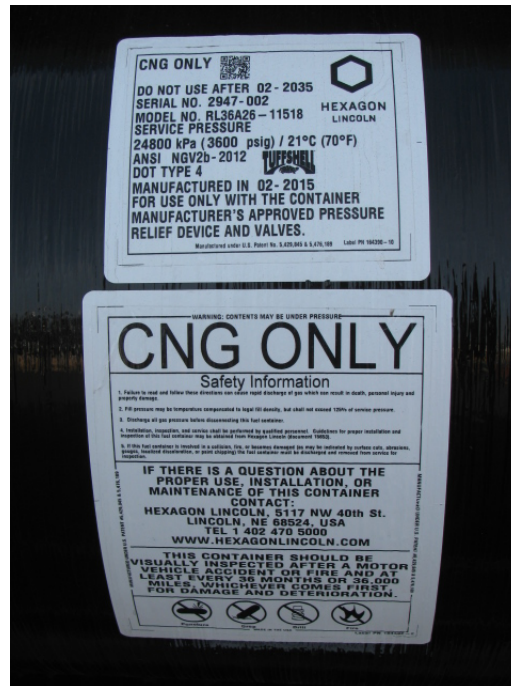


Figure 7 CNG cylinder manufacturer's label must be in place and legible.

CAUTION

If the cylinder label is not attached to the cylinder, and the manufacturer and serial number are not available or cannot be verified, the cylinder must be condemned.

6.9.2. Fuel System and Vehicle Decals

Vehicle decals must comply with size, shape, color, wording and font requirements. The decals must be present in specific locations, as indicated in the following pictures and captions. All Agility Fuel Systems decals comply with applicable regulations, and are available from the parts department.

Part numbers shown in this manual are examples only. Decals may be system- or customer-specific. Order decals using the part number and revision printed on the decal. If the part number is not legible, contact the Agility Fuel Systems Product Support Group (PSG) for assistance.

NOTE

Other informational or warning decals are present on Agility systems, however, not all of them may be required. This section addresses required decals. Local authorities or customers may have additional labeling requirements for CNG vehicles. If in doubt, contact the AHJ – authority having jurisdiction.

6.9.3. Blue Diamond CNG Decal



Figure 8 CNG-fueled vehicle blue diamond decal.

Agility Fuel Systems part number 10602105. This decal indicates the vehicle runs on CNG. It must be located on the right rear of the vehicle, but not the bumper. When no body panels exist (for example, in a roll-off chassis refuse tractor, the decal may be placed on a frame member on the right rear of the vehicle as shown). Other blue diamond CNG decals may be placed on the vehicle sides or front, but this is not a requirement. In any case, if the decal is missing, illegible or damaged, it must be replaced.



Figure 9 Left: CNG fueled vehicles are identified by a blue and white decal on the right rear of the vehicle. Right: A CNG decal may also be located on the front of the vehicle as shown.

6.9.4. Fill Receptacle / Fill Panel / FMM Decals

Fill receptacles and information on the fuel system are stated on the fuel management module (FMM) decal. Required information includes name of installer, installation date, cylinder storage capacity in



water volume and other information. Since there are several configurations – and more to be developed in future designs – system decals must match your vehicle fuel system. Here are typical examples for some current systems. Back of cab, roof mount and bus system decals have similar wording, each decal has its own Agility Fuel Systems part number.

200 Series Cabinet Style FMM Face Plate Decal, Part Number 10600030



Figure 10 Typical cabinet style FMM front panel decal.

267 Series One Piece Aluminum Side Mount FMM Face Plate Decal, Part Number 10602176



Figure 11 One piece aluminum cover side mount system with integrated FMM decal.

237 Series Composite Cover Side Mount FMM Face Plate Decal, Part Number 10602146



Figure 12 237 and other series composite cover side mount system FMM decal.

237 Series Side Mount Auxiliary Fill Panel Decal Part Number 10602114



Figure 13 When equipped with an auxiliary fill panel, this decal is required.

6.9.5. Danger Venting High Pressure, Part Number 10602108

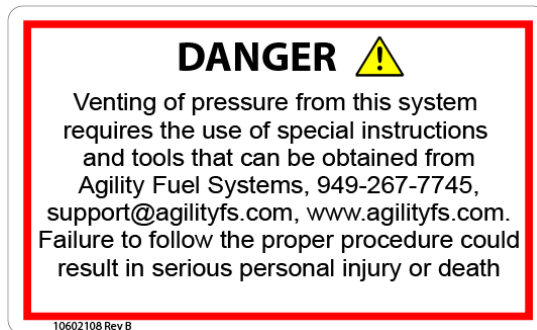


Figure 14 This decal is placed near the cylinder and/or the bleed valve.



Figure 15 The “Danger venting gas” decal is placed in several locations, usually near cylinder and bleed valves.

6.9.6. PRD Vent Line Decal, Part Number 10602234

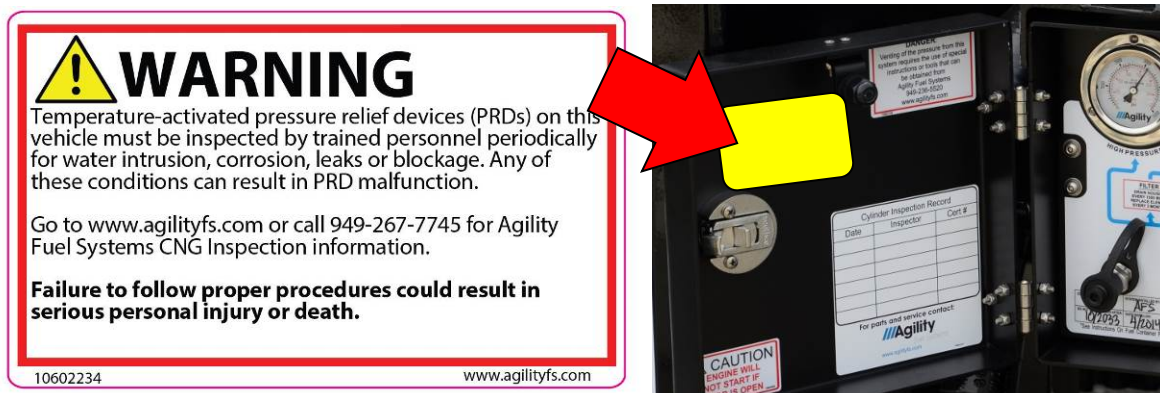


Figure 16 Left: PRD vent line warning decal. Right: The vent line warning decal should be placed near the FMM so the operator can see it. Position this decal near the “Danger venting gas” decal as indicated in yellow.

This decal is not required, but it is a warning reminder from Agility Fuel Systems to make sure there are no potential PRD problems caused by water entry. Pressure relief device vent lines must not allow moisture and debris to enter the system. This warning decal is to be placed in two locations:

1. Near the operator interface (FMM) or cylinder valve end.
2. Next to or near the “Danger venting of pressure” decal, part number 10602108

Examples of decal placement are shown below.

General Rule: The PRD vent line decal must be in a visible location and not cover any existing decals.



Figure 17 PRD vent line decal locations shown in yellow.



Figure 18 More PRD vent line decal locations, shown in yellow.

CAUTION **WARNING**

If a PRD vent cap is missing or damaged, the PRD vent lines and PRDs should be inspected for blockage, water intrusion, corrosion or damage. DO NOT simply replace the cap.

6.9.7. CNG Vent Line Cap Decal, Part Number 10602021



Figure 19 CNG vent line information decal.

UV-protected vent caps must be in place to prevent water and debris entry into the PRD system. This decal is not required by law, but it is a reminder to maintain the vent system to prevent damage to the PRD and to help ensure vehicle safety.

6.9.8. Natural Gas Filter, Part Number 10602085 (L) or (R)

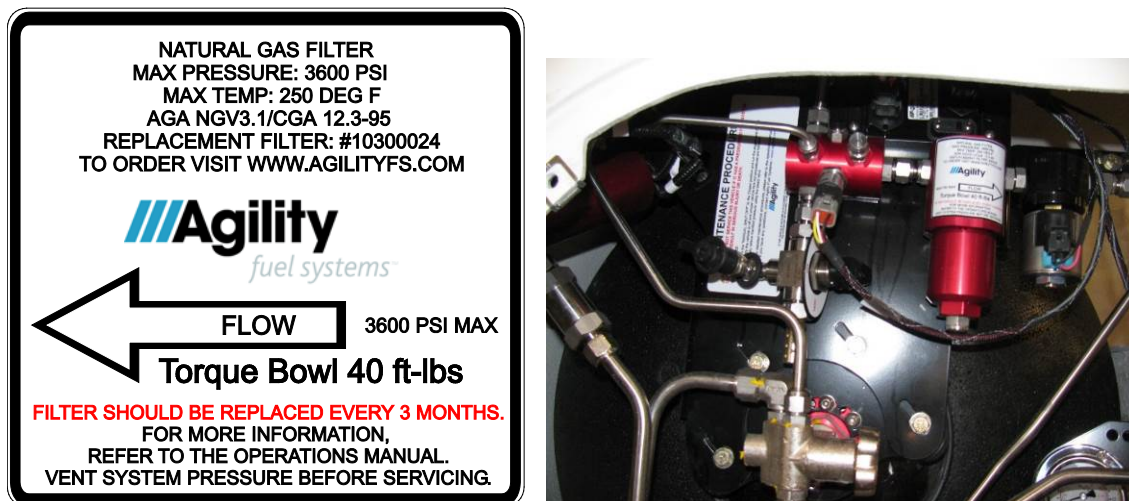


Figure 20 The natural gas filter decal is placed on the upper part of the high pressure filter.

6.9.9. Conspicuity Marker, Part Number 10602039

This white, reflective decal is not something for natural gas vehicles, but is a requirement any tractor-trailer. Conspicuity markers are mounted at the top of the BTC cabinet as shown. This decal is supplied as a single, straight strip. Each corner must have the L-shape as shown. Reference: FMCSA Federal Motor Carrier Safety Association, Section 393.11: “Lamps and reflective devices.” Other agencies mention conspicuity markers.

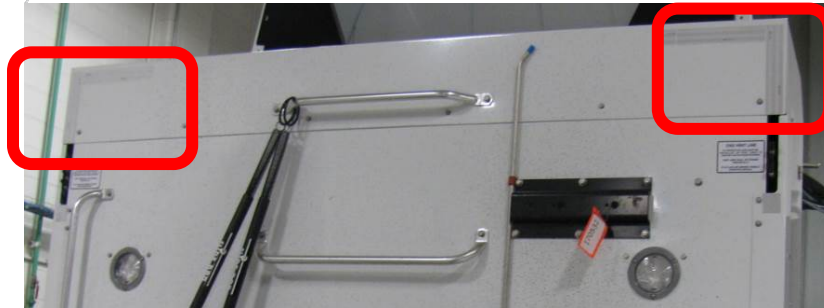


Figure 21 Conspicuity reflector decals at the top of a BTC system cabinet.

6.9.10. System Covers and Framework

Make sure all fasteners are tight. Check clearance between cylinders and support framework and covers. Spacing should be from approx. 1/2-in. to 3/8-in. (Remember to check system pressure when assessing clearance around cylinders since a full cylinder will be larger than an empty one.) Look for scratches or other abrasion damage to inside surfaces of cabinet doors and panels as well as fuel cylinders. Correct the clearances before this condition worsens. Make sure metal heat shields and coverings are in place between exhaust components and fuel lines or wiring. Check hinges and latches for proper operation.



Figure 22 Typical behind the cab system.

6.9.11. Pressure Relief Devices (PRDs)



If a PRD vent cap is missing or damaged, the PRD vent lines and PRDs should be inspected for blockage, water intrusion, corrosion or damage. **DO NOT** simply replace the cap.

Pressure relief devices cannot be repaired. However, they must be inspected for leaks and corrosion. PRDs are located on each cylinder and are near or part of the manual valve and along each cylinder. The PRD is considered to be a sub-system, since the PRD and its associated plumbing (such as vent lines) are needed for proper operation.

Two major PRD types are used in Agility Fuel Systems installations: The area PRD and the point PRD. Regardless of type, the weep hole at the lowest portion of the vent tube must be kept open to drain moisture from the vent tube. It must be kept clear of debris and insects to ensure proper drainage. The caps at the end of the vent tubes must be in place to prevent water and debris entry.

Area PRDs

Area PRDs protect an entire length of the cylinder and increase the protection area to an entire cylinder cabinet.

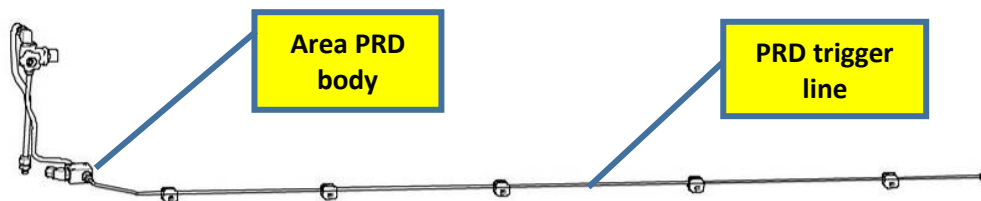


Figure 23 Side mount area PRD systems include a trigger line that monitors the entire length of the cylinder. A vent tube (not shown) routes the high pressure gas away from the vehicle if the PRD is activated.



Figure 24 Back of cab system showing area PRD trigger lines behind the side door. Similar trigger lines are routed on the opposite side.

Point PRDs

Point PRDs offer protection within a specific radius around the cylinder.

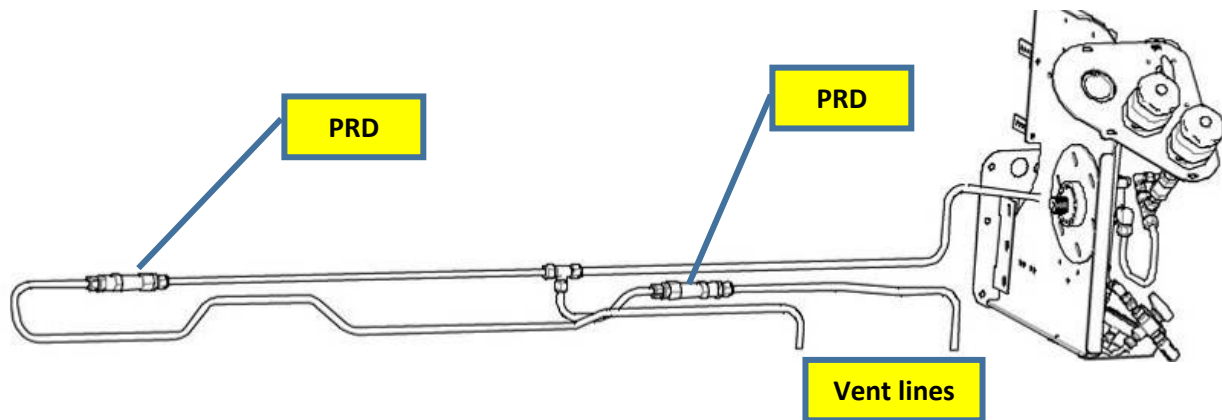


Figure 25 Side mount point PRD system.

PRD Vent Tubes and Caps

UV-protected vent tube caps must be in place to prevent water, debris and insects from entering the system. If caps are missing, the vent lines and PRDs must be inspected for moisture and corrosion and the caps replaced. The part number is 10702028 for 3/8- and 1/2-inch PRD caps. The caps are heat-shrinkable and must be installed using a hot air gun.



Figure 26 PRD vent caps must be in place at all times to prevent water and debris from entering the system.

⚠ CAUTION ⚠ WARNING

If a PRD vent cap is missing or damaged, the PRD vent lines and PRDs should be inspected for blockage, water intrusion, corrosion or damage. **DO NOT** simply replace the cap.

6.9.12. CNG Fuel Cylinder Inspection

Agility Fuel Systems uses Type 3 and Type 4 cylinders, therefore, other cylinder types are not covered in this manual. This section is for reference only. It includes examples of cylinder damage.

⚠ CAUTION

Cylinder inspections must be performed by a certified or other qualified CNG fuel system inspector.

Types and Levels of Damage

Damage type, level and measurement/assessment procedures are defined by the cylinder manufacturer as well as CGA C-6.4. Cylinder manufacturers provide repair procedures where applicable.

There are three damage levels:

- a. Level 1 is noted on the vehicle inspection records
- b. Level 2 can be repaired
- c. Level 3 must be condemned and replaced

The cylinder inspector will make various measurements to assess the damage and disposition of the cylinder or cylinders on the vehicle. Examples of cylinder damage are shown in Figures 26 through 30.

One type of damage is not shown: Chemical damage. Discoloration, stains or residue may come from chemical contamination. Depending on what the chemical is, it can be neutralized and washed off, or the chemical may have compromised the cylinder enough to condemn it. If possible, try to find out what the chemical is to help assess cylinder condition.

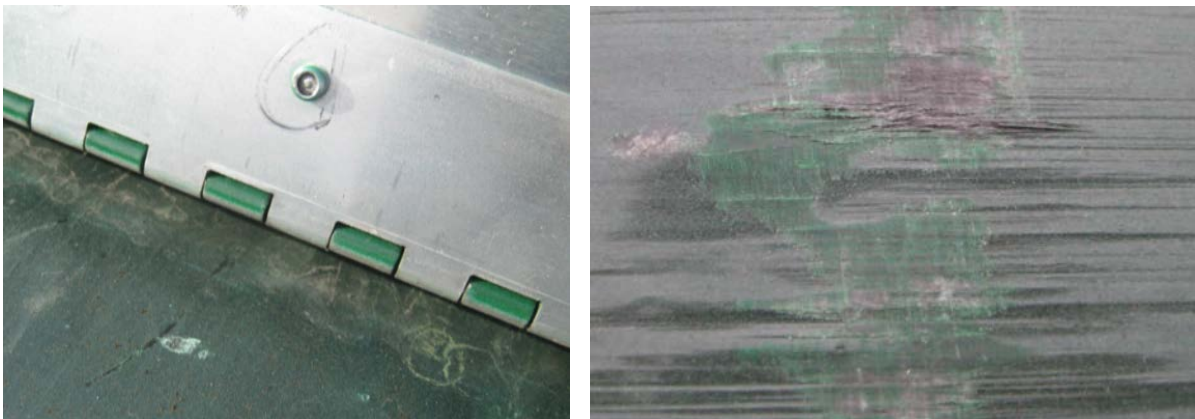


Figure 27 Abrasion damage is the result of contact with frame or other vehicle components. Left unchecked, this condition may go from “field repairable” to “condemn the cylinder.”

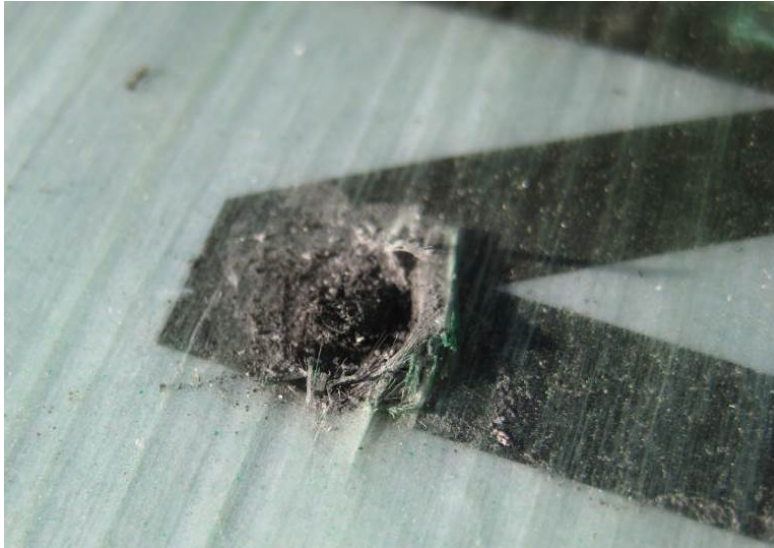


Figure 28 Cut and gouge damage.



Figure 29 Damage from impact can be seen as missing composite sections.



Figure 30 An example of de-bonding and delamination.



Figure 31 Fire damage. In this photo, the outer composite cover has burned away. The cylinder, although intact, must be immediately inspected by a CGA C6.4 certified or other qualified CNG inspector.

Side Mount, Back of Cab and Other Cylinder Mounts

Inspect for loose or damaged fasteners, impact damage and excessive corrosion.

6.9.13. Fuel Lines and Flow Control Components

Visually inspect all components for excessive corrosion, loose mounting and wear. If you can smell natural gas (Mercaptan), perform a leak test on all components, fittings, tubes and hoses. Leaks must be repaired by a qualified technician.

The manual valves on each cylinder must be fully open for normal operation. The valve handles must be easy to open or close by hand, without tools.

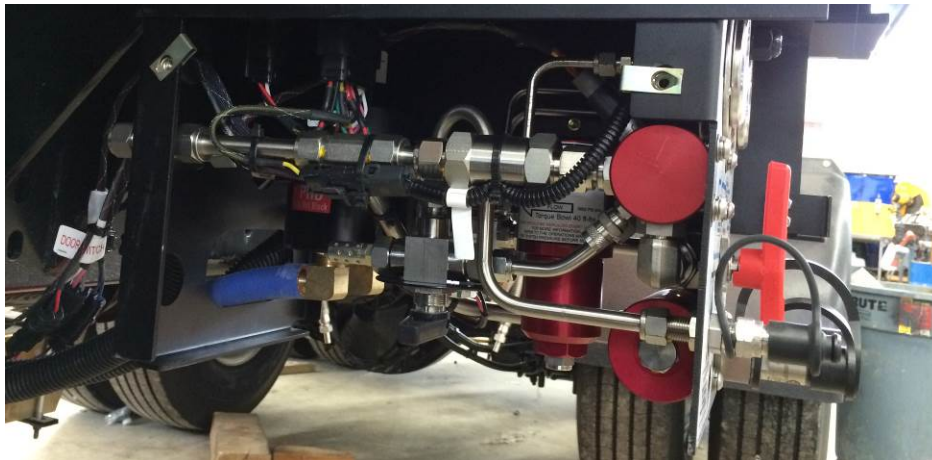


Figure 32 The FMM covers have been removed for this view. Most flow control components are located in or near the FMM.

6.9.14. Hoses – Special Notes

High pressure, flexible CNG fuel hoses can become compromised if exposed to corrosive chemicals, such as road de-icing products, or if hoses are altered or moved during or following a repair. Always make sure hoses remain routed and clipped properly for maximum performance and reliability.

Clean hose ends and fittings with mild soap and water using a soft bristled brush to expose the braid.

1. If the hose end is covered by fire sleeve, it may be temporarily moved to expose the hose end for inspection. The fire sleeve must also be inspected for damage.
2. Corrosion is indicated by red, brown or yellow discoloration.
3. Broken wire braid strands.



Figure 33 If the hose is covered with a sleeve, move it to enable inspection of the braid and ferrule. Remember to inspect the sleeve for damage, too.



Figure 34 Corrosion on CNG hose braid and fitting.



Figure 35 Broken wire strands in the braid are also evidence of compromised hoses.



Figure 36 The outer covering of this hose has been worn away due to abrasion. It should be replaced and secured properly away from any other surfaces or components.

6.9.15. Routing and Clipping – Plumbing Lines

Hoses installed within approximately 8 inches of a heat source, such as the engine exhaust, should be protected by a heat shield.

6.9.16. Routing and Clipping – Electrical Wiring Harnesses and Cables

Make sure wire harnesses and supporting clips are in place and do not show signs of abrasion and wear. Replace clipping hardware with identical or similar, UV resistant materials.

6.10. Behind the Cab (BTC) Flat Isolators

Rubber isolators are used between the vehicle chassis and BTC cabinet mounting brackets to dampen vibration. The isolator is a maintenance item, but vehicle duty cycle, use/application and road conditions vary significantly.

Isolator service lifetime varies widely and is independent of vehicle mileage, so isolator wear is best observed visually.

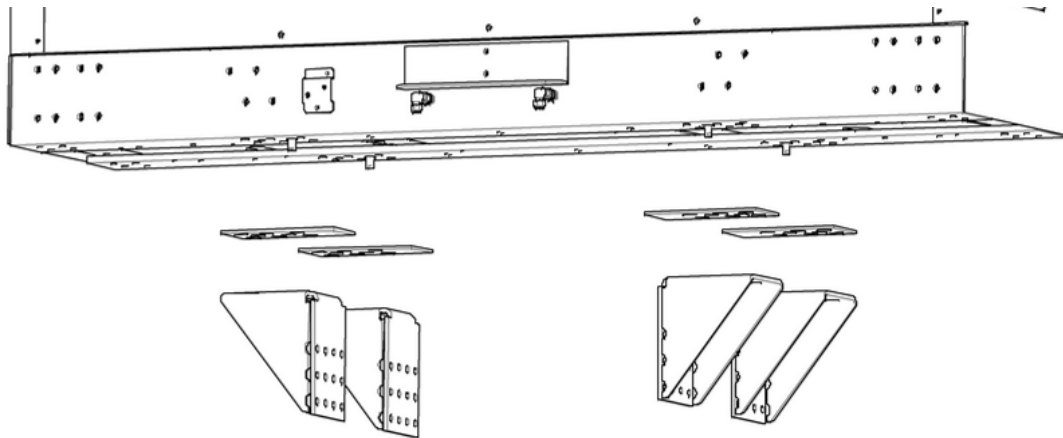


Figure 37 BTC rubber isolators are located under each mounting point as shown. "Flat" rubber isolator part number is 22400136.



Figure 38 Rubber isolator between the BTC cabinet and vehicle chassis on a four year old system with 316,000-plus miles. A quick look indicates the rubber pad is in good condition.

6.10.1. BTC Flat Isolators – Acceptable

Isolators that are in place and do not allow metal-to-metal contact are acceptable. Some isolator movement is considered normal as shown.



Figure 39 There should be no metal-to-metal contact between the vehicle chassis and fuel system cabinet. Some isolator movement is acceptable as shown on the right.

6.10.2. BTC Flat Isolators - Replacement Needed

Excessive push-out, metal-to-metal contact and cracks are indications that an isolator must be replaced.



Figure 40 Isolators with excessive "push out" should be replaced.

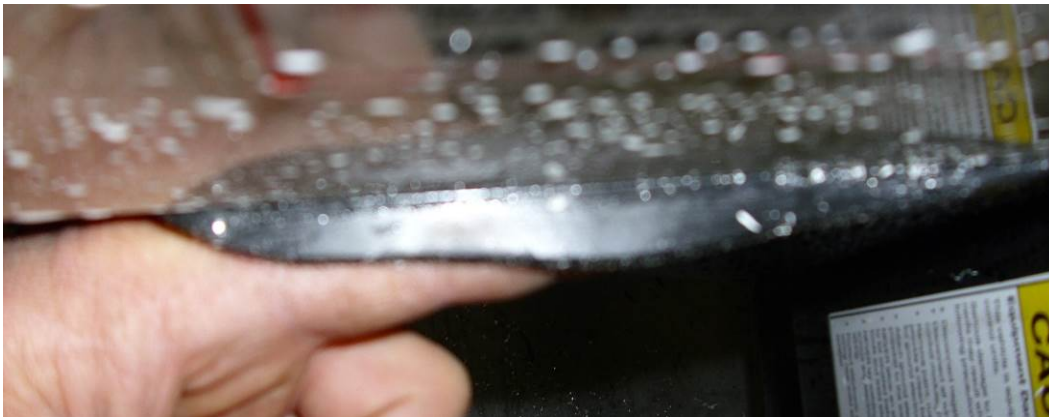


Figure 41 Push out of approx. one inch or more is considered excessive, and the isolator should be replaced.

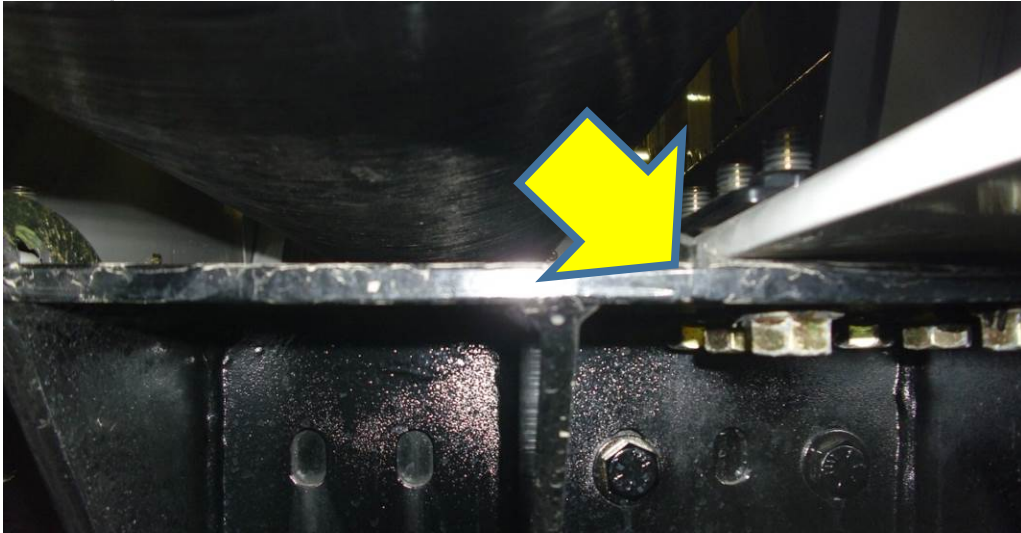


Figure 42 Metal-to-metal contact between the vehicle chassis rail and the fuel system cabinet can be seen in this picture. This isolator should be replaced.



Figure 43 Cracked isolators should be replaced.

6.10.3. BTC Ring and Bushing Type Isolators

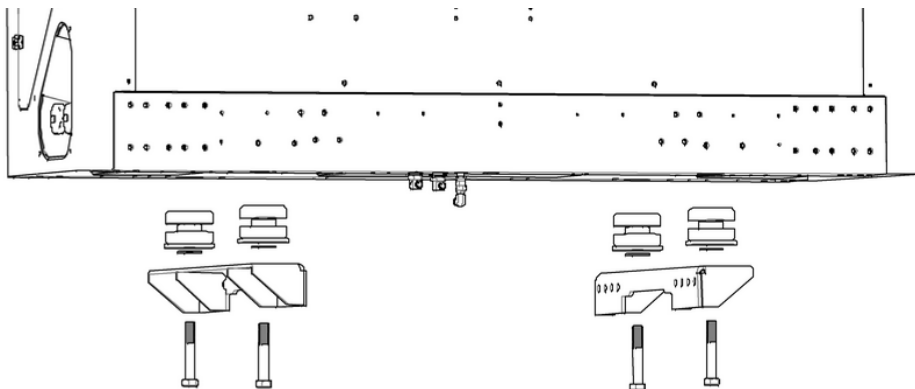


Figure 44 "Hockey puck" isolator part number is 10712233.



The gap between mounting bracket and lower frame should be within 1/8-inch of each other on back of cab systems with ring and bushing isolation mounts. If the gap difference between isolators is greater than 1/8-inch, the fuel system may have experienced loads exceeding normal operating conditions: inspect the entire fuel system for signs of damage. Measure the system and make sure it is square. If there are no signs of damage, remove and replace the isolators.



Figure 45 Measure gap between the system mounting bracket and the lower frame at each isolator and compare the differences. See text for more inspection details.

NOTE

Refer to Field Service Bulletin ENP-357, “Behind the Cab Cabinet Isolator Inspection and Replacement” for replacement procedures.

6.11. Fuel Cylinder Clearances

CNG fuel cylinders expand and contract in normal operation. When checking clearance around cylinders, check fuel system pressure, since cylinders will be “larger” when full and “smaller” when empty.

Look for scratches or other abrasion damage to cabinet doors and panels as well as fuel cylinders as evidence of rubbing and damage. Correct the clearances before this condition worsens.

For 246xxxxx and 256xxxxx Series BTC Systems

Cylinder to cylinder clearance: Minimum 0.36-in. at zero psi, 0.14-in. at 3600 psi

Near the fixed neck block: Minimum 0.12-in. clearance at any pressure

Near the expanding end of the fuel cylinder, along the axis (for longitudinal expansion): Minimum 0.5-in. at zero psi, minimum 0.12-in. at 3600 psi.

Around the diameter: Minimum 0.375-in. at any psi.

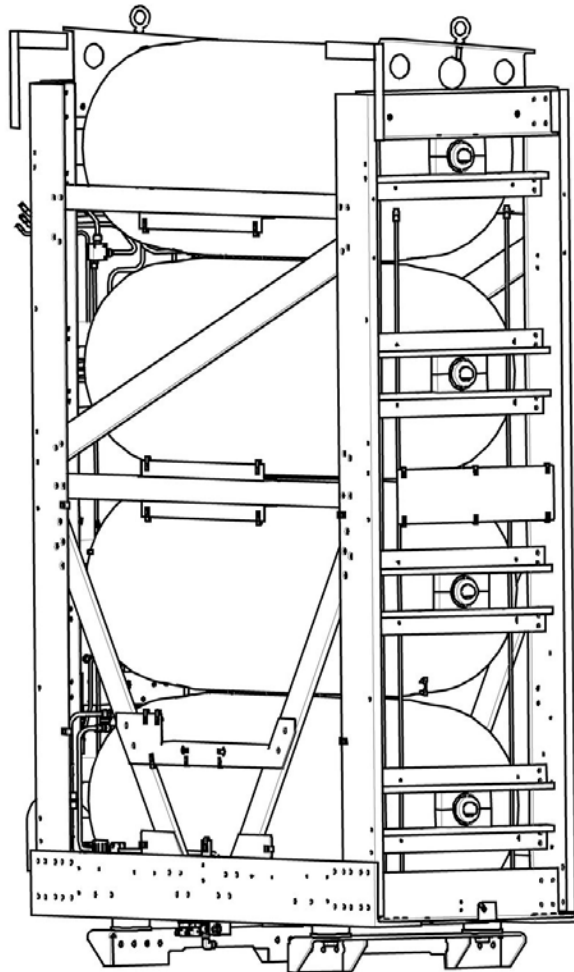


Figure 46 The “plug end” of the CNG fuel cylinder usually expands and contracts along the cylinder length as pressure changes.

6.12. Side Mount Systems

Because of normal cylinder expansion and contraction, side- or rail-mount system straps and brackets may loosen over time, and can lead to tank (cylinder) spin or other preventable damage. Although some cylinder movement is normal, excessive movement must be corrected as soon as it is observed. Loose cylinders and mounting symptoms can be observed visually and include:

- a) Changes in cylinder valve position.
- b) Changes in tube routing connected to the cylinder valve.
- c) Loose, damaged or missing rubber isolators around the fuel cylinder and mounting straps.

These conditions must be corrected immediately to prevent damage.

6.12.1. Side Mount Systems with Aluminum Covers, 210 Series

Aluminum cover side mount systems, produced prior to May 2013, system numbers 210xxxxx and similar units. In Figure 48, the cylinder has rotated 180 degrees from its original position, and is an extreme example. A simple visual check can be performed by looking at the valve through the access port as shown in Figure 49.

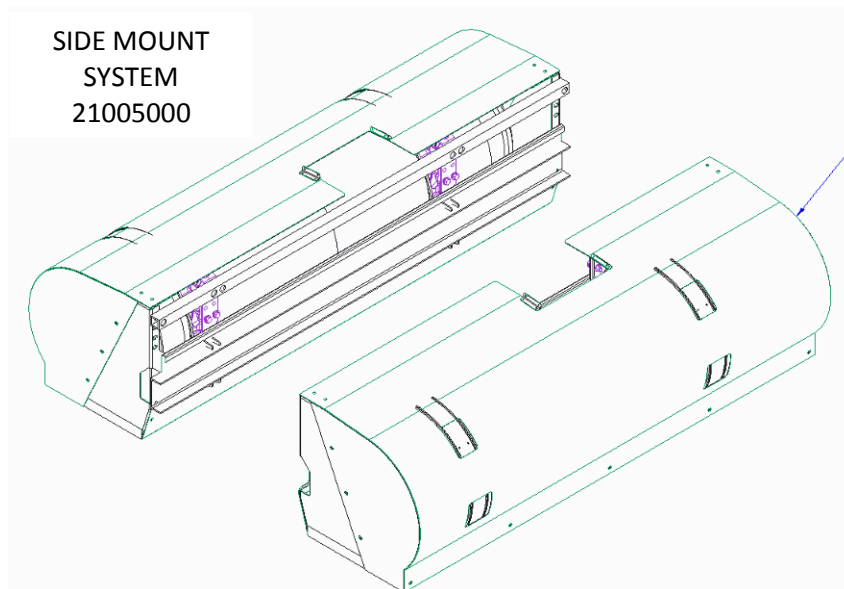


Figure 47 210 series aluminum cover side mount system.



Valve handle should be
located at 12 o'clock

Figure 48 An example of excessive tank spin – an avoidable situation.



Figure 49 The cylinder valve handle on side mount systems should be at the 12 o'clock position as shown above.

6.12.2. Side Mount Isolator Movement/Displacement

The isolator should be positioned exactly between the attachment strap and the cylinder with the isolator ears securely fastened to the attachment strap. If the bracket system is loose, the rubber isolator may become damaged or displaced. If isolators are missing or damaged, the isolator must be replaced.

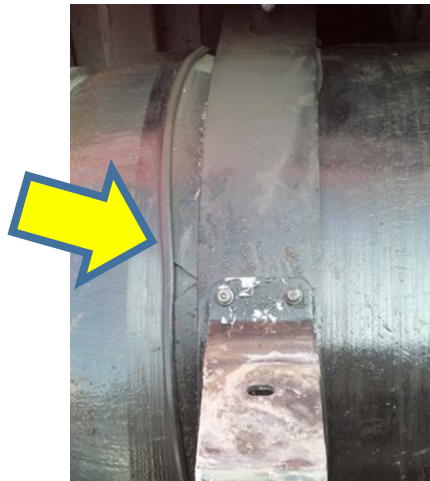


Figure 50 Displaced or damaged rubber isolators should be replaced.

6.12.3. Bracket, Strap and Isolator Torque Specs

⚠ CAUTION

Observe cylinder pressure when applying torque to cylinder strap mounting bolts.

Various mounting systems are used in side mount fuel systems. Belleville washer stacks, straps and isolators help maintain clamping pressure, yet allow for normal cylinder expansion and contraction.

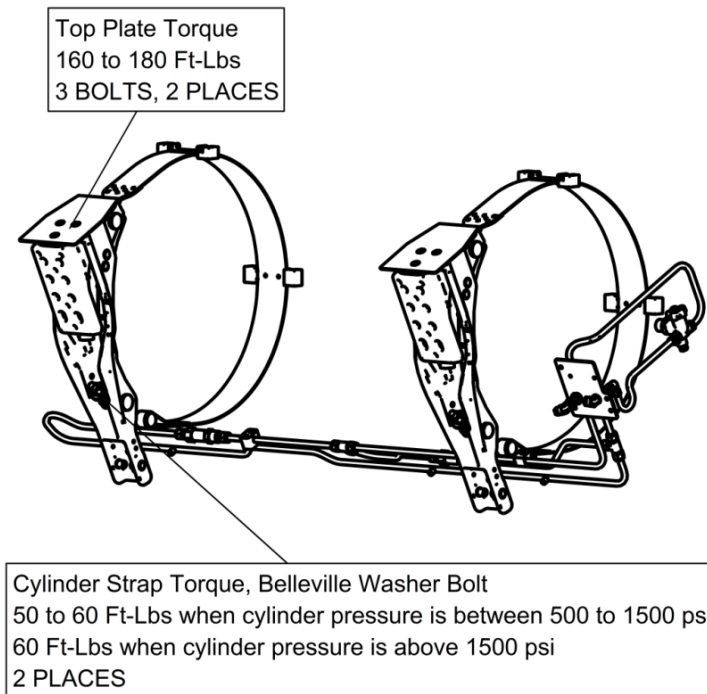


Figure 51 When applying torque to the Grade 9 bolt and Belleville washer stacks, make sure to observe cylinder pressure.

6.12.4. Manual Tank Valve Stuck in the Closed Position



Figure 52 This type of manual cylinder valve is prone to fail in the closed position.

The manual tank valve used in some side mount systems may stick in the closed position, preventing fuel flow. In some cases, the valve may remain in the closed position even though the handle can be turned to the open position. If this happens, fuel capacity is reduced and limits vehicle mileage. If this condition is observed, the valve should be replaced.

⚠ DANGER

Always assume a CNG system is pressurized. If the tank valve becomes stuck in the closed position while the handle is turned to the open position, the lack of gas flow may lead to the false assumption that the tank is depressurized when it is not.

6.12.5. Side Mount Systems with Neck-Mounted Cylinders, 22922xxx Only

Examine cylinder mounting bolts. Tighten loose bolts to 90 Ft-Lbs. Replace any missing bolts and include a Belleville washer stack. Refer to Service Bulletin ENP-435 for repair procedures.

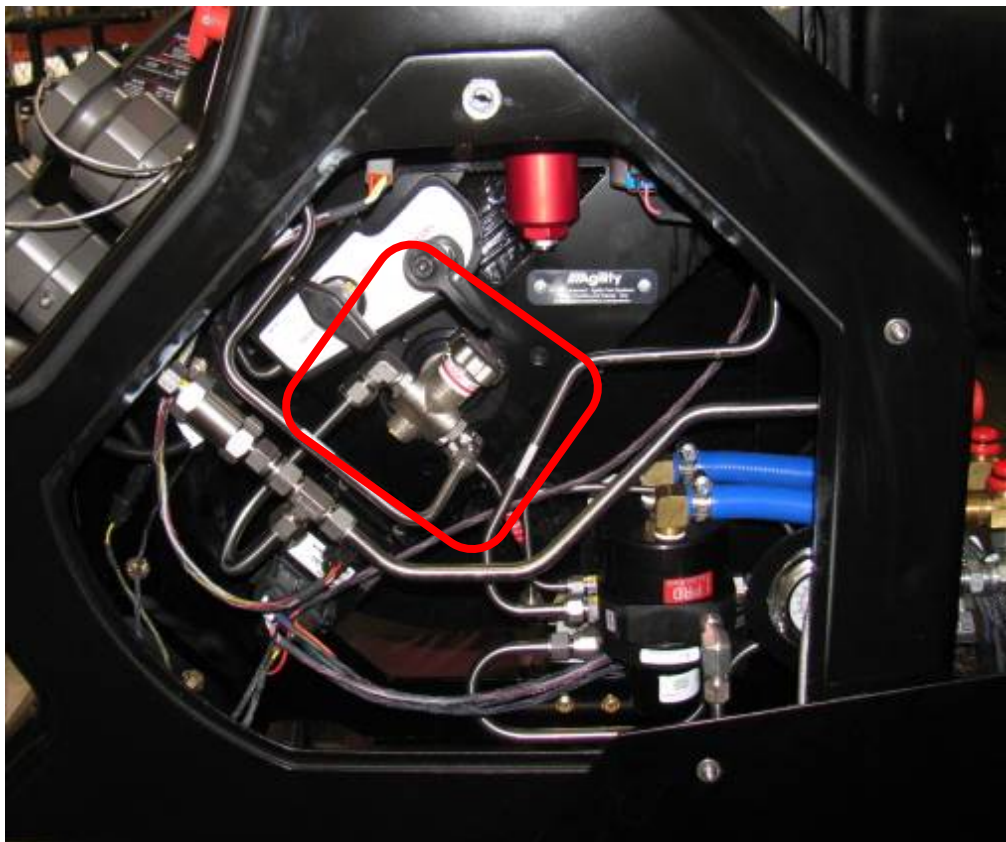


Figure 53 Check for loose, broken or missing bolts on neck-mounted cylinders in the area shown.

6.13. Roof Mount and Front of Body Systems

Roof mounted systems are subject to damage from overhead objects such as tree limbs. Examine all cabinet panels for collision damage and missing or loose fasteners. Open the door panels and check to make sure they are not rubbing against the cylinders.

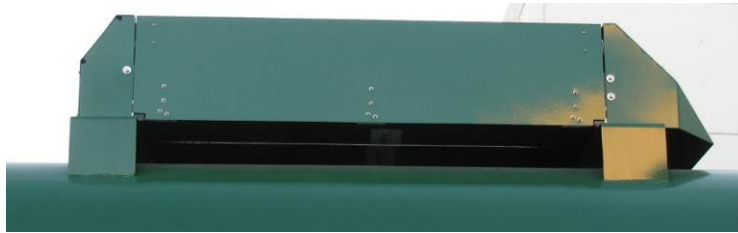


Figure 54 Roof mount systems are subject to damage from tree limbs and other overhead objects.



Figure 55 Roof mount system cover showing evidence of rubbing against cylinders. When repairing holes or cuts with weld beads, make sure to grind the surface smooth to reduce effects of rubbing on cylinders.

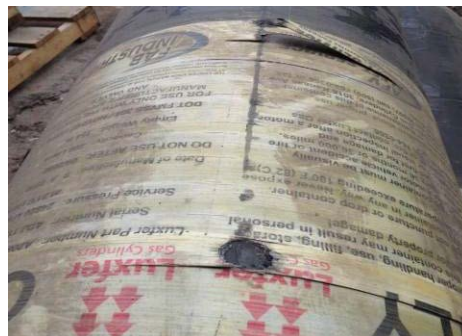


Figure 56 Abrasion damage to fuel cylinders from upper doors.

7. Fuel System Maintenance Intervals

Performing regular maintenance will help ensure your vehicle fuel system delivers safe and reliable performance and minimize down time.

To determine the correct maintenance intervals for your vehicle, you must first determine the type of service or conditions the vehicle will be operating. Always select the interval that occurs first.

Severe Duty

- Operation on extremely poor roads or off-roads/highways
- Frequent short-distance or stop and go travel, such as refuse or transit bus
- Construction site operation

Normal Duty

- Long haul, over the road with infrequent stops
- Perform the service tasks indicated



Agility Fuel Systems recommends an oil analysis be performed on the high pressure fuel filter residue to determine fuel quality from the station and to determine whether or not fuel filter maintenance intervals can deviate (be extended) from these guidelines.

7.1. Severe Duty

Items to Check	1st 1,000 Mi. 6 Mos.	Daily	5,000 Mi. 250 Hrs.	10,000 Mi. 500 Hrs.	15,000 Mi. 1500 Hrs.
Fuel and coolant leaks	x				x
Frame/system fastener torque check	x				x
Tank strap fastener torque check (side mount)	x				x
PRD vent caps check	x	x	x	x	x
Fuel gauge operation check	x				x
Manual tank valves operation	x				x
Shut-off valve operation	x				x
Fill receptacle inlet O-rings check	x				x
Rubber isolators condition/displacement check	x				x
System and vehicle decals		x	x	x	x
Fuel and coolant leaks		x	x	x	x
Cylinder mounts		x	x	x	x
Tank strap fastener torque check (side mount)		x	x	x	x
PRD vent caps check		x	x	x	x
Manual tank valves operation		x	x	x	x
Emergency/Manual Shutoff valve		x	x	x	x
Fill receptacle inlet O-rings check		x	x	x	x
Drain high pressure filter		x	x	x	x
Replace high pressure filter element*			x	x	x
Replace solenoid valve coil**					
High pressure gauge		x	x	x	x
Low pressure filter - drain		x	x	x	x
Low pressure gauge		x	x	x	x
Dashboard fuel gauge		x	x	x	x
PRD and components for corrosion		x	x	x	x
Drive-away prevention caps		x	x	x	x
Frame/system fastener torque check					x
Pressure test/coolant leak check					x
Rubber isolators condition/displacement check					x
Cylinder inspection***					x
All fuel and coolant hoses and tubes					x
Check cylinder shields and covers for damage					x
Cylinder bracket mounts					x
Cylinder isolator displacement					x
Cylinder valves and PRDs					x
BTC isolator mounts					x
Leak check					x

*High pressure fuel filter element replacement will vary depending on fuel quality and seasonal changes.

**Solenoid coil replacement depends on solenoid valve type, see Section 8.8.

***The fuel cylinder should be inspected every year or 100,000 miles (160,900 km), whichever occurs first.



7.2. Normal Duty

Items to Check	1st 8,000 Mi. 6 Mo.	Daily	25,000 Mi.	50,000 Mi.	75,000 Mi.
Fuel and coolant leaks	x				x
Frame/system fastener torque check	x				x
Tank strap fastener torque check (side mount)	x				x
PRD vent caps check	x	x	x	x	x
Fuel gauge operation check	x				x
Manual tank valves operation	x				x
Shut-off valve operation	x				x
Fill receptacle inlet O-rings check	x				x
Rubber isolators condition/displacement check	x				x
System and vehicle decals		x	x	x	x
Fuel and coolant leaks		x	x	x	x
Cylinder mounts		x	x	x	x
Tank strap fastener torque check (side mount)		x	x	x	x
PRD vent caps check		x	x	x	x
Manual tank valves operation		x	x	x	x
Emergency/Manual Shutoff valve		x	x	x	x
Fill receptacle inlet O-rings check		x	x	x	x
Drain high pressure filter		x	x	x	x
Replace high pressure filter element*			x	x	x
Replace solenoid valve coil**					
High pressure gauge		x	x	x	x
Low pressure filter - drain		x	x	x	x
Low pressure gauge		x	x	x	x
Dashboard fuel gauge		x	x	x	x
PRD and components for corrosion		x	x	x	x
Drive-away prevention caps		x	x	x	x
Frame/system fastener torque check					x
Pressure test/coolant leak check					x
Rubber isolators condition/displacement check					x
Cylinder inspection					x
All fuel and coolant hoses and tubes					x
Check cylinder shields and covers for damage					x
Cylinder bracket mounts					x
Cylinder isolator displacement					x
Cylinder valves and PRDs					x
BTC isolator mounts					x
Leak check					x

*High pressure fuel filter element replacement will vary depending on fuel quality and seasonal changes.

**Solenoid coil replacement depends on solenoid valve type, see Section 8.8.

***The fuel cylinder should be inspected every year or 100,000 miles (160,900 km), whichever occurs first.

8. CNG Fuel System Maintenance

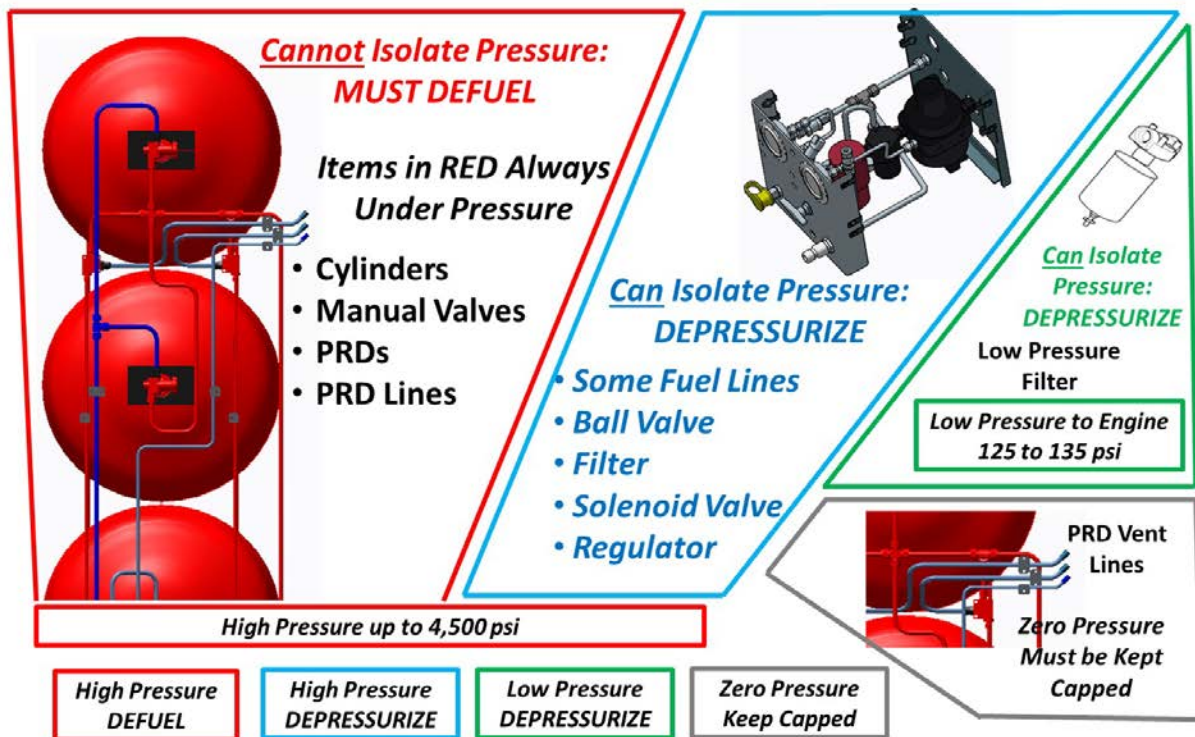


Figure 57 A general guide to determine whether to depressurize or to defuel.

Depending on where work must be performed, the fuel system must be either depressurized or defueled.

When working on system components downstream of manual cylinder valves, fuel pressure can be isolated by closing manual cylinder valves and **depressurizing** the system.

When working on fuel cylinders, cylinder valves, pressure relief devices (PRDs) and lines – the fuel system must be **defueled** because there is no way to isolate the high pressure contained in these components. See Section 9 for defueling instructions.

8.1. Depressurizing CNG Systems

1. Turn the vehicle off.
2. Close all cylinder valves.
3. Ensure the 1/4-turn manual shut off-valve on the FMM is in the “ON/OPEN” position.
4. Start the vehicle and run the engine until it stops.
5. Ensure the vehicle is off and the proper vehicle lock-out procedures are followed. Remove the ignition key.
6. Check the FMM gauges to ensure all pressure is relieved. (Gauges read zero.)
7. Remove the access cover on the rear of the fill panel (optional).

8. Relieve the remaining pressure by slowly opening the bleed valve as shown below.

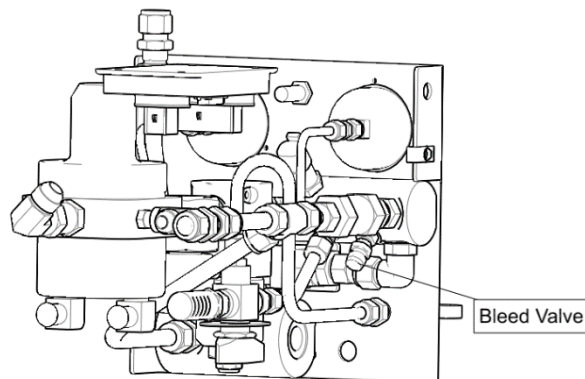


Figure 58 Bleed valve location.

9. The system is now depressurized up to the primary solenoid lock-off valve. There may be some residual pressure remaining downstream of the solenoid valve, so be careful when loosening fittings for the first time.

8.2. Repressurizing the System

1. Ensure the vehicle is off and remove the keys from the ignition.
2. Close the bleed valve and torque to 4-5 ft-lbs.
3. Ensure the filter bowl and the drain plug are installed and tightened.
4. Re-install the fill panel cover (if removed).
5. Ensure the 1/4-turn manual shutoff valve on the FMM is in the "ON/OPEN" position.
6. Slowly open all cylinder shutoff valves (one on each cylinder).
7. Start the engine.

8.3. Pressure Relief Devices (PRDs)

⚠ DANGER

PRDs and their plumbing lines are always under full cylinder pressure and cannot be isolated using fuel system valves.

PRDs do not have consumable parts and require no additional maintenance other than visual inspections and leak testing. PRDs that leak, are corroded or damaged must be replaced by a qualified CNG service technician.

8.4. Draining Vent Lines

⚠ DANGER

1. Make sure you loosen or remove the vent lines and NOT the PRD fuel lines. Loosening or removing PRD fuel lines will result in serious injury because they always contain high pressure gas.
2. Fuel cylinders must be depressurized and defueled before performing any service procedure on the PRD or PRD fuel lines.
3. Vent lines are plugged with a UV-protected plastic cap.

The vent lines have a drainage hole in the lowest point on the tube. The lines should be checked for blockage to prevent water build-up that can corrode the components. If your system is operating in a high humidity environment, the vent lines should be drained more often. If caps are missing, vent tubes should be drained immediately, the PRDs must be inspected and caps replaced. The vent tubes are not under pressure so it is safe to remove them. Ensure the vent lines on both sides of the PRDs are clear.

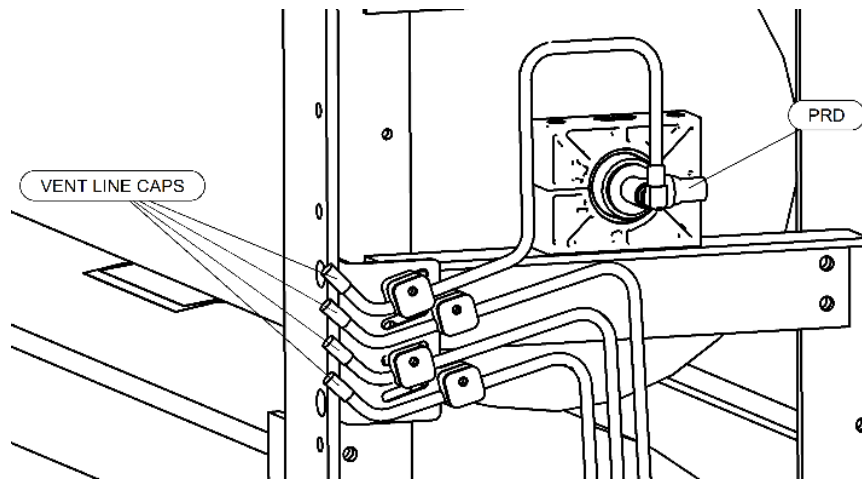


Figure 59 PRD vent caps must always be in place. If they are missing or loose, examine the vent lines and the PRD for damage or corrosion. (Cylinder plug end in a back of cab system shown.)

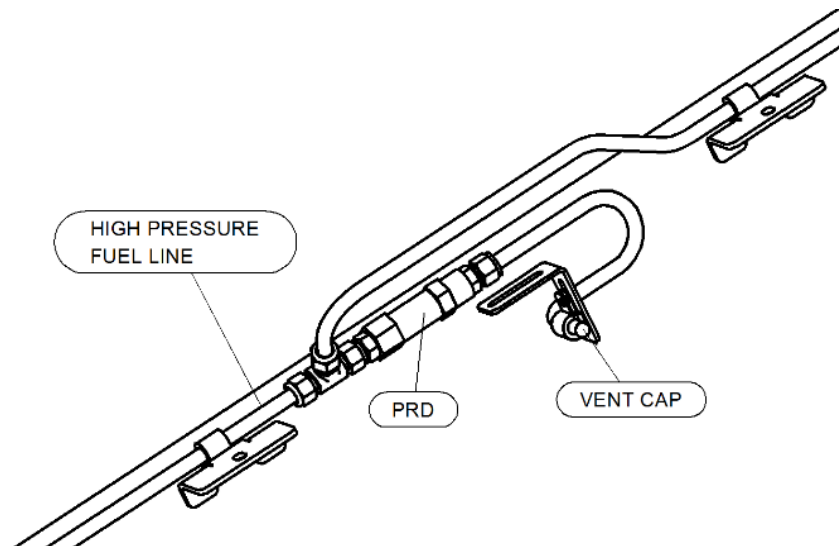


Figure 60 Typical example of roof mounted PRD and vent line cap.

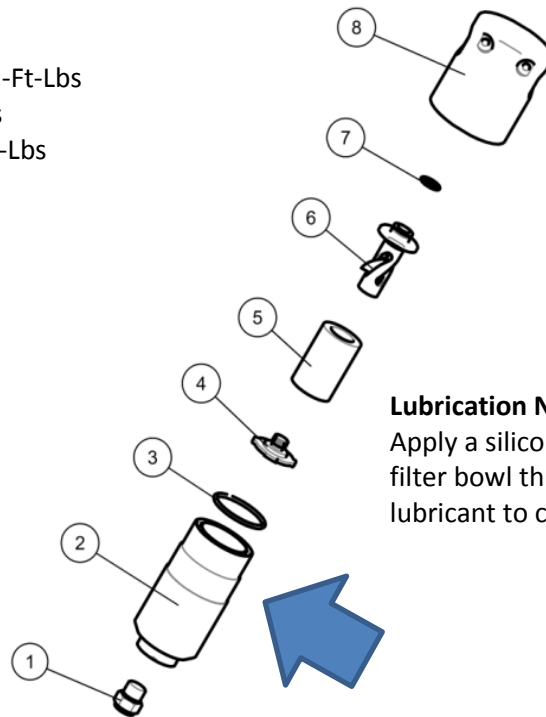
8.5. High Pressure Filter Maintenance

Torque Specifications

Filter Bowl: 40 Ft-Lbs, ± 1 -Ft-Lbs

Hex Plug: 25 to 30 Ft-Lbs

In/Out Ports: 25 to 30 Ft-Lbs



Lubrication Note

Apply a silicone-based spray lubricant to the filter bowl threads only. DO NOT allow lubricant to contaminate the filter or O-rings.

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10200266	9/16-IN. HEX PLUG
2	1	20100107	FILTER BOWL
3	1	10500022	FILTER BOWL O-RING
4	1	20100110	ELEMENT BASE
7	1	10500017	O-RING
5	1	20100109	FILTER ELEMENT KIT
6	1	20100108	ELEMENT HOUSING
8	1	20100106	FILTER HOUSING

Draining the High Pressure Filter

1. Depressurize the system.
2. Slowly remove the drain plug (hex cap) with an 11/16-in. wrench.
3. Drain until there is no residual liquid left.
4. Inspect the O-ring on the drain plug and replace if necessary. (Drain plug O-ring part number 10500014.)
5. Replace the drain plug and torque to 25-30 ft-lbs.

Replacing the Filter Element

1. Depressurize the system.
2. Drain the filter.

3. Unscrew the filter bowl by using a filter bowl removal tool or open-end wrench.
4. Remove and replace the old filter element.
5. Inspect the O-ring on the filter element holder for damage and replace if necessary.
6. Lubricate the filter bowl threads with a silicone lubricant. DO NOT allow lube to contaminate the bowl or filter element.
7. Reinstall the bowl and tighten to 40 ±1 ft-lbs.

8.6. Testing and Finding Leaks



Figure 61 If you smell gas, locate leaks using leak detection solution.

Fittings and connections should be checked periodically for leaks. This task must be carried out by qualified personnel.

For monthly maintenance, the entire fuel system can be leak tested with leak detection solution, and/or a methane detector. All joints and connections should be tested.

Leaks usually occur at fitting connections. When checking for leaks always use certified leak detecting equipment and solutions designed for use with stainless steel and brass such as Snoop[®] or FBI[®].

1. Apply a certified leak detecting solution and look for bubbling or foaming.
2. Examine connections for icing or signs of condensation around the tubing.
3. Check for signs of damaged or perforated tubing.

Leak Repair

⚠ WARNING

1. **Ensure the system is depressurized before repairing any leaks.**
2. **Maintenance and repair must be performed by qualified personnel.**

Perform leak repairs in the order shown below.

Note: Move on to the next repair only if the previous repair did not fix the leak.

1. If a leak is detected, depressurize the system.
2. Once the system is depressurized, tighten the leaky fittings. Repressurize the system.
3. When the system is pressurized, conduct a leak test.
4. If this does not stop the leak, depressurize the system again.
5. Remove fittings that are leaking and make sure the mating surfaces are clean. Check any O-rings for signs of damage.
6. Replace the leaking tubes and reinstall the fittings according to the Swagelok guidelines for tube fittings and SAE torque settings for O-ring boss fittings as specified in Table 3. Once the fittings have been reinstalled, repressurize the system and test for leaks.
7. If the leak cannot be repaired, the component should be replaced.

If replacement is necessary, obtain replacement parts, install them, perform a leak test and fix any leaks.

Table 3 Torque Specifications

SAE Torque Specs	
Fitting	Torque (ft-lbs)
7/16-20	15
1/2-20	18
9/16-18	26
3/4-16	51
7/8-14	74
1-1/16-12	125

If the procedures listed above do not fix the problem, contact Agility Fuel Systems Product Support Group.

8.7. Tube Fitting Assembly and Adjustment

CAUTION

Adjusting fittings requires accredited Swagelok® or Agility Fuel Systems fitting assembly training.

In order to achieve a safe, leak free seal, tubing connections must be fully bottomed in the fitting. Consider the following recommendations:

1. Tubing must be de-burred so that it sits flush in the fitting.
2. Tubing must be round; elliptical or warped tubing must not be used.
3. Tubing must have a minimum length straight section before a bend radius as specified.

Tightening Fitting Nuts

Swagelok recommends that fitting nuts should be tightened 1-1/4 turns beyond snug. Snug is defined as the point at which the tube cannot be rotated freely in the pre-set swaging tool or fitting body.

Swagelok fittings employ a two-ferrule design, the front ferrule provides the seal, and the rear ferrule provides a firm grip on the tubing.

8.8. Solenoid Valve Maintenance

⚠ WARNING

The solenoid valve generates considerable heat during normal operation and may cause burns on contact.

Principles of Operation

De-energized: The valve uses an armature and a pilot instead of a plunger. Pressure from the inlet port flows through the pilot guide surrounding the armature, and the pressure is stopped by the pilot at the orifice.

Energized: This valve operates on either 12V or 24V DC from the vehicle power supply. The armature is forced upwards and lifts the pilot from the seat of the orifice allowing pressure to flow from the inlet port to the outlet port.

Various types of solenoid valves have been used in Agility Fuel Systems CNG systems. To ensure maximum system reliability, we recommend the following preventative measure, depending on solenoid valve type.

⚠ DANGER ⚠ WARNING

Serious injury or death may result from improper removal of a pressurized in-tank solenoid or manual valve. Service must be performed by qualified natural gas service technicians.

8.8.1. Solenoid Valve Identification, AFC Solenoid Valve with Pigtail Leads



Figure 62 AFC solenoid valve with pigtail leads.

Pigtail Gen 1 Solenoid Valve, 12V	Complete Valve Part Number, 10300441	Coil Only Repair Kit 10300441
Pigtail Gen 1 Solenoid Valve, 24V	Complete Valve Part Number, 10300098	Coil Only Repair Kit 10306958

NOTE: For Freightliner only, an additional wire harness is needed, part number 10400183



The pigtail solenoid coil should be replaced with the new coil as follows:

Severe Duty: Every 6,000 miles or 12 months, whichever occurs first.

Normal Duty: Every 50,000 miles or 24 months, whichever occurs first.

8.8.2. Solenoid Valve Identification – AFC Solenoid Valve with Molded-In Connector



Figure 63 AFC valve with molded-in connector (with or without internal diode).

Solenoid Valve with Molded-In Connector, 12V	Complete Valve Part Number, 10300441	Coil Only Repair Kit 10300441
Solenoid Valve with Molded-In Connector, 24V	Complete Valve Part Number, 10300098	Coil Only Repair Kit 10306958

NOTE: For Freightliner only, an additional wire harness is needed, part number 10400183

The molded-in connector solenoid coil should be replaced as follows:

Severe Duty: Every 100,000 miles or 36 months, whichever occurs first.

Normal Duty: Every 200,000 miles or 72 months, whichever occurs first.

Refer to “AFC Solenoid Coil Replacement (12V or 24V),” Field Service Bulletin ENP-068

8.8.3. Solenoid Valve Identification – Emer Solenoid Valve



Figure 64 Emer solenoid valve.

Emer Mark 147 Solenoid Valve	Complete Valve Part Number, 10301026	Coil Only Repair Kit 10400304
	Jumper Wire Harness, Part Number 10402013	--

This Emer solenoid coil should be inspected and replaced if needed, as follows:

Severe Duty: Every 16,000 miles.

Normal Duty: Every 72,000 miles.

Refer to “Emer Mark 147 Solenoid Valve Coil Replacement,” Field Service Bulletin ENP-234

8.9. Removal Procedure for Regulator, High Pressure (HP) Filter and Solenoid Subassembly

NOTICE

To remove or replace either the regulator, high pressure filter or solenoid valve, all three must first be removed as a subassembly.

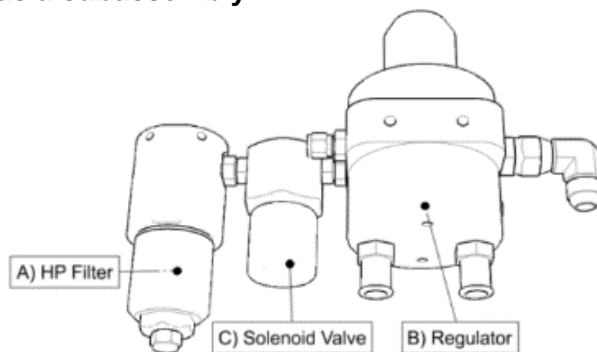


Figure 65 High pressure filter, solenoid and regulator subassembly.

1. Depressurize the system.
2. Disconnect exterior tube fittings from the HP filter, be careful not to bend or stress any plumbing components in the process.
3. Disconnect coolant lines from the regulator. Clamp or pinch off hoses to prevent coolant loss. Drain residual fluid into an appropriate container.
4. Disconnect electrical connections from solenoid valve.
5. Disconnect low pressure fuel line from regulator.
6. Carefully remove any mounting hardware connecting the subassembly to the FMM brackets.

⚠ CAUTION

1. Solenoid valves cannot be repaired internally; if the valve does not work, replace it.
2. Solenoid valve coils are designed to operate continuously for a lifecycle of 22,000 hours and generate significant heat. When a coil is energized for extended periods it will be hot. Although the coil is designed to operate under these conditions, smoke or the scent of burning insulation may be an indication of overheating and the coil should be replaced.

The high pressure solenoid valve operates electrically. By default it is in the “OFF/CLOSED” position.

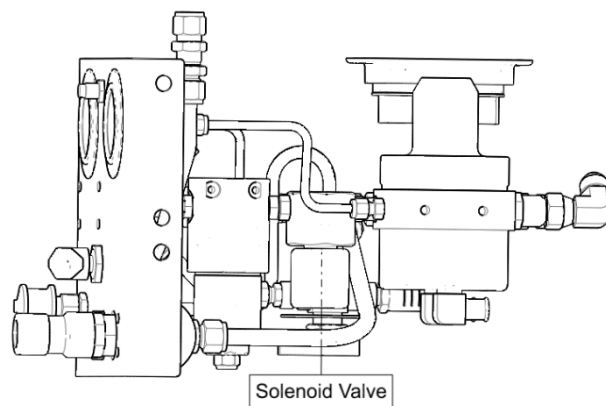


Figure 66 Solenoid valve location.

Solenoid Valve – Remove and Replace

The solenoid valve is located inside the FMM. Line pressure is rated to 4500 psi. To install a new solenoid proceed as follows:

1. If necessary remove shipping plugs from the inlet and outlet ports.
2. Check to ensure the O-rings are in good condition and free of contaminants. Check the valve ports as well, remove any foreign particles and contaminants.
3. Apply O-ring lubricant to the fittings, install initially by hand, then torque to 25-30 ft-lbs.
4. Connect the inlet and outlet fuel lines.

5. If the coil assembly is awkwardly positioned, reorient it before proceeding to the next step. Loosen the coil assembly nut and reposition the assembly by hand, then torque the nut to 43-55 in-lbs.
6. Plug the electrical connector into the wiring harness.
7. Open all cylinder manual shutoff valves.
8. Start the engine and let it idle for 5 minutes, then shut the engine off.
9. Perform a leak inspection on any section of plumbing that was serviced. Make sure that testing is done at 3600 psi.

⚠ CAUTION

Leaks may not appear immediately, allow a minimum of 10 minutes before confirming no leaks are present.

10. Fix any leaks.
11. If no leaks are found, the vehicle may be returned to service.

Table 6 Solenoid Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to operate	1. Check the electrical supply with a voltmeter. Voltage must match the nameplate rating.
	2. Check coils with an ohmmeter for an open or shorted condition.
	3. Make sure pressure matches the nameplate rating.
	4. If no apparent system problem exists, remove and replace the solenoid valve.
Valve is sluggish or inoperative, but there are no issues with the power supply and pressure complies with the nameplate rating.	1. If no apparent system problem exists, remove and replace the solenoid valve.

8.10. Pressure Regulator

Maintenance points on the regulator are limited to coolant hose connections to the regulator bowl and the incoming and outgoing fuel line connections. Check these items for leaks, and repair as needed. If the pressure regulator has failed, replace the regulator.

8.11. Valve Maintenance

Valves do not require regular maintenance. If leaks are found, depressurize the system and tighten or replace fittings or the valve as necessary.

8.12. Fill Receptacles

⚠ CAUTION

Fill receptacles are used solely on vehicles fueled by compressed natural gas. Receptacles are designed to operate with AGA/CGA NGV1 certified fueling nozzles. For

information on coupling and uncoupling procedures, consult the CNG fueling dispenser instructions.

1. External surfaces of the receptacles must be kept clear of contaminants and debris at all times. A dust cap is provided for this purpose.
2. External mounting hardware and dust caps should be checked periodically to ensure components are functioning properly without leaks. If functionality is compromised or a leak is detected consult a qualified technician. Only trained personnel should service or maintain a fueling receptacle.
3. A vehicle operator must not tamper or disassemble the receptacle or any component connected to the receptacle.

Transit (Fast) Fill Freeze-Up

Transit (fast) fill receptacles are prone to freezing during rapid filling procedures due to “wet” compressed natural gas conditions. Keep the 1/4-turn main shutoff valve in the “OFF/CLOSED” position until ice is no longer visible and the internal poppet assembly achieves a seal. Once sealed, the internal check valve will resume normal operation and gas will stop flowing from the receptacle.

9. Defueling Preparation and Procedures

A CNG vehicle may need to be defueled for maintenance or storage. Defueling a CNG fuel system requires careful planning, since the vehicle must be towed, rather than driven to be moved*. It is usually best to drive the vehicle to near-empty to minimize the amount of fuel to be vented to the atmosphere.

NOTICE

An Agility Fuel Systems Pony Tank may be used to supply fuel a vehicle temporarily so it may be driven for a short distance. The best and safest way to defuel a CNG system is to transfer fuel back to a dispensing station, if so equipped. Check with your CNG filling station for specific procedures. The following information is provided in the absence of procedures from local authorities. A typical venting facility appears below.

WARNING

Be sure to vent a CNG tank in an open area with good air circulation with no nearby sources of open flame, ignition or heat. Do not vent the system in an area where flammable gas is permitted to accumulate and potentially ignite.

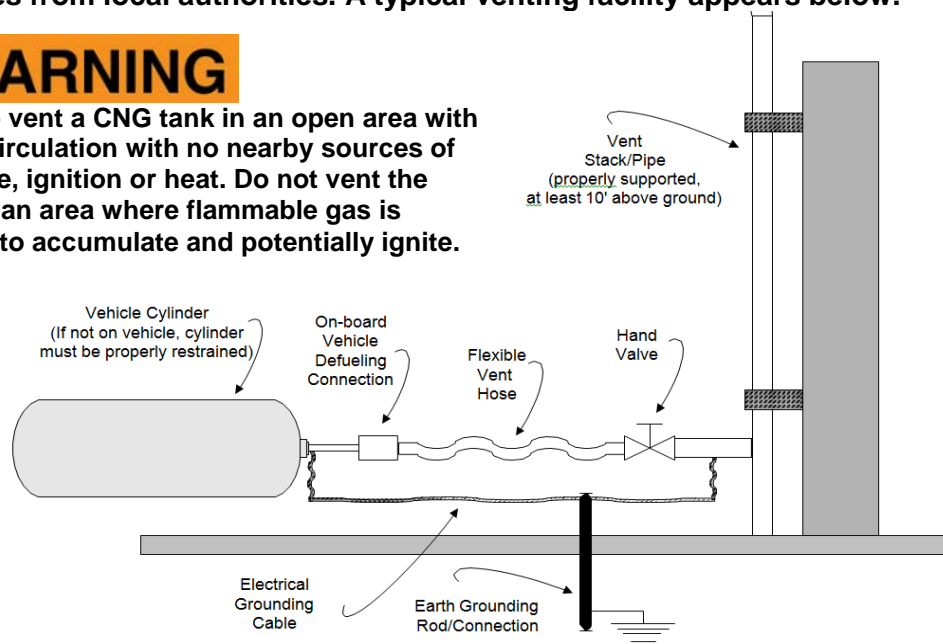


Figure 67 A typical venting facility.

⚠ CAUTION

1. **Atmospheric venting of natural gas to depressurize a cylinder must be done with care. Improper equipment or procedures raise the risk of fire.**
2. **Before depressurizing, ground the venting orifice with a minimum 3 gauge wire to an approved electrical ground system.**
3. **Freestanding cylinders must be restrained prior to venting procedures. Cylinders will contract and move if gas is released at a rapid rate.**
4. **Certain plastic-lined cylinders may be sensitive to rapid defueling, consult the cylinder manufacturer for guidance.**

9.1. Venting Facility Equipment

A vent pipe. This typically consists of a two-inch diameter steel pipe attached to a support structure. The pipe must extend a minimum of two feet higher than the support structure and a least 10 feet above ground level. The vent pipe must be connected to an electrical ground. There should be no ignition sources near the pipe.

- An electrical ground connection with a minimum 3 gauge or heavier stranded copper wire attached to a ground rod, or an equally suitable electrical ground. The other end should be securely fastened to both the venting pipe and cylinder valve.
- A high pressure electrically conductive flexible hose.
- A hand valve to control the flow of gas.

Additionally, it would be good practice to include the following items:

- A portable fire extinguisher in an easily accessible location at the defueling facility. The extinguisher should have a rating no less than 20-B:C.
- Large signage indicating “NO SMOKING” and “FLAMMABLE GAS.”
- A flame arrestor downstream of the hand valve.

9.2. Basic Rules for Defueling

- Only CNG qualified personnel should attempt these processes.
- Consume as much fuel as possible prior to defueling.
- You must have an approved place to put the fuel removed from the vehicle.
- Use a slow flow when transferring fuel to reduce static electricity/electrostatic discharge and prevent freezing.
- Notify nearby personnel prior to defueling
- Always ground the vehicle and the fuel system.
- Never defuel indoors.
- Always wear personal protective equipment.
- Be familiar with evacuation routes.

9.3. Defueling Options

There are three common defueling options: Vent to atmosphere, compressor transfer and return to supply.

In all cases, both vehicle and the fueling system must be grounded to prevent static electricity build-up.



Vent to Atmosphere

First, verify whether or not this method is legal. There may be local air quality regulations restricting the release of methane into the atmosphere. If atmospheric venting is acceptable in your area, then a venting facility compliant to regulations must be used.

Compressor Transfer

In this defueling method, a compressor at the fueling station extracts the gas from vehicle.

Return to Supply

The third method returns fuel to a distribution system. When using this process, pressure in the vehicle cylinder and the supply system pressure will equalize, so some pressure may remain in the vehicle fuel system.

9.4. General Defueling Procedure

NOTE

This procedure applies to vehicles equipped with a NGV1-style defuel receptacle.

1. Connect the ground wire from the vehicle to the vent stack system.
2. Attach the defuel hose to the vent stack system.
3. Attach the defuel nozzle to the defuel receptacle on the FMM.
4. Ensure the manual shutoff valve is OPEN.
5. Slowly open the defuel valve, and adjust for a slow and steady flow to avoid freeze-up.

10. Troubleshooting

The following section covers a variety of potential problems and solutions. The issues addressed in this section are unique to CNG storage systems; however, issues concerning other onboard systems may influence or directly cause problems with the CNG storage system.

NOTICE

For any issues not addressed in this manual, contact Agility Fuel Systems Product Support Group (PSG).

10.1. Using Cummins Fault Codes

Cummins fault codes related to fuel delivery can be helpful when diagnosing and troubleshooting the fuel system.

Fault Code	Fault Description	ECM Pin	Driver Warning	Effects	Possible Causes
2723	Engine Gas Control Valve Intake Pressure - Data Valid But Above Below Operating Range - Moderately Severe Level	17	Check Engine (Amber)	Possible reduced performance.	Agility: Gas pressure regulator failure Cummins: See Cummins troubleshooting
2722	Engine Gas Control Valve Intake Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level	17	Check Engine (Amber)	Possible reduced performance.	Agility: Gas pressure regulator failure Cummins: See Cummins troubleshooting
2991	Engine Gas Control Valve Intake Pressure - Data Valid But Below Normal Operating Range - Most Severe Level	17	Stop Engine (Red)	Progressive power derate increasing in severity from time of start. If engine protection shutdown feature is enabled, engine will shut down after 30 seconds of the red lamp flashing.	Agility: Gas pressure regulator or fuel flow restriction (plugged filters, damaged or kinked fuel lines, malfunctioning solenoid, partially closed valves) Cummins: See Cummins troubleshooting
2724	Gas Supply Pressure (Regulated) - Data Valid But Above Normal Operating Range - Moderately Severe Level	50	Check Engine (Amber)	Possible reduced performance.	Agility: Gas pressure regulator failure
2568	Gas Supply Pressure (Regulated) - Data Valid But Above Normal Operating Range - Most Severe Level	50	Stop Engine (Red)	Engine power derate.	Agility: Gas pressure regulator failure
2725	Gas Supply Pressure (Regulated) - Data Valid But Below Normal Operating Range - Moderately Severe Level	50	Check Engine (Amber)	Possible reduced performance.	Agility: Gas pressure regulator or fuel flow restriction (plugged filters, damaged or kinked fuel lines, malfunctioning solenoid, partially closed valves)

Table 4 Cummins fuel system related fault codes provide helpful clues for troubleshooting.

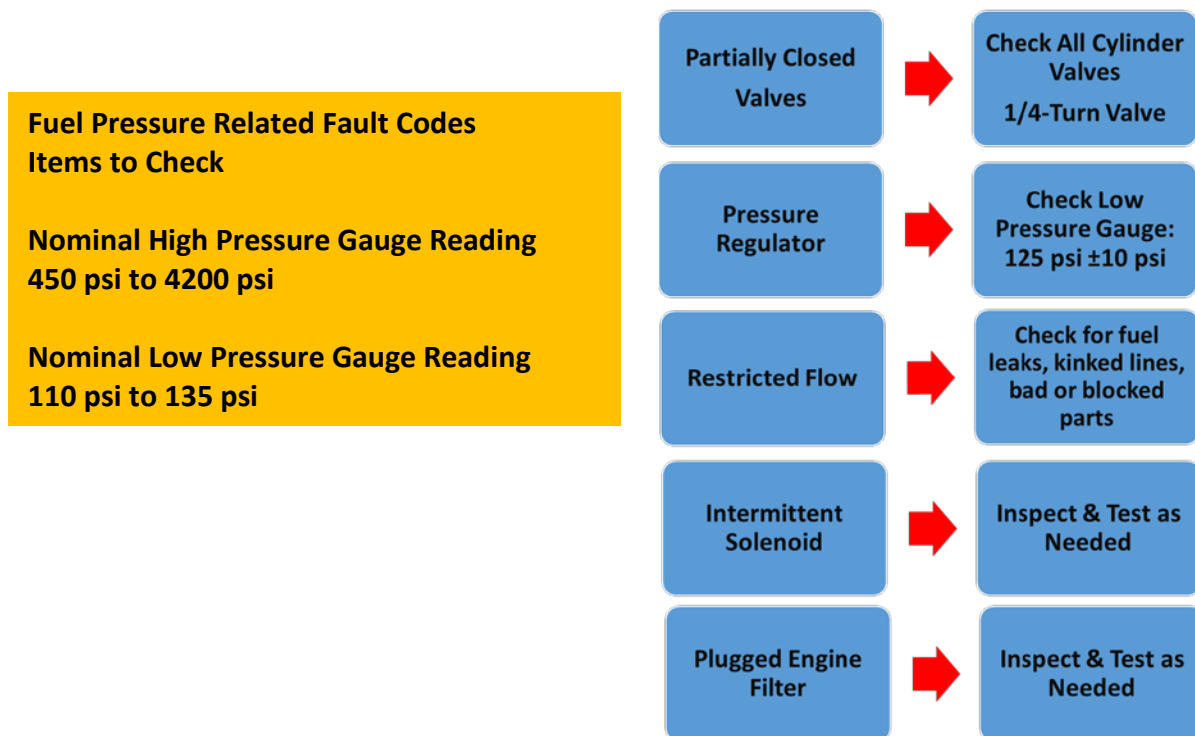


Figure 68 Agility Fuel Systems components to check when fuel pressure related fault codes are present.



10.2. Symptom Assessment

Here are some troubleshooting hints based on symptoms or conditions.

Engine – No Crank

Test 1: Does the crank signal pass through the Agility Electronic Control Unit (ECU) inside the FMM?

- Bypass the Agility ECU inside the FMM (jump blue and purple wires on the chassis side). [Some systems have reed switches wired directly through the OEM chassis wiring and will have a fuse and or a relay that will have to be jumped or checked.]

If no crank – OEM chassis issue, not fuel system - check key switch wiring

If engine cranks - Agility issue, proceed:

Test 2: Check reed switch, kill cap and/or proximity switch at each door and fuel cap, including auxiliary fill receptacles.

- Check the 2 single wires at the ignition switch (yellow and black) and (brown and black).
- Kill cap (single black wire). Unplug cap connector and attach to new ground.
- If more than 1 reed switch – Jump one at a time to chassis ground to find which reed switch is not working.
- Possible cause: Missing magnet or improper alignment of reed switch to magnet.
- Touch the reed switch inside the fill receptacle or door directly with test magnet and the engine should crank.

Engine - No Run

Test 1: Does the Agility fuel system maintain proper fuel pressure to the engine?

- The high pressure gauge must read more than 500 psi and the low pressure gauge must read about 125 psi, ± 10 psi.
- Make sure all valves are open (1/4 turn shutoff, all cylinder valves).
- With the ignition key on, open engine (low pressure) fuel filter petcock to allow gas to flow. Pressure should be maintained.

If fuel pressure is present, the no-run condition is an engine or chassis issue (not the fuel system).

If the checks fail, proceed:

Test 2: Chassis wiring power input to Agility Fuel Systems ECU:

- Check for power going into the FMM (black and red wires).
- Check the chassis wiring harness fuse – If the fuse is blown, test the solenoid coil before replacing the fuse (Test 3).

Test 3: Check the Agility ECU

- Check for power at the solenoid valve inside the FMM.
- Check solenoid mechanically by plugging in and unplugging several times with the ignition key in the **on** position, and listen for the solenoid valve clicking.
- **If solenoid is powered** and clicks when plugged in: It is a fuel regulator issue, see Test 4.
- **If solenoid is not powered**, check for a blown fuse in chassis and for possible shorted solenoid coil. Coil resistance check ($7.1 \pm .5$ ohms).
- **Replace the solenoid coil – see Section 8.8**

Test 4: Pressure Regulator Testing

- De-fueling is **not necessary** for this operation.
- It is **not necessary** to depressurize the system.
- It is not necessary to remove the regulator from the vehicle for this test.
- Cylinder pressure must be between 1,500 psi and 3,600 psi before starting the test.
- Build the test jig as shown in Figure 66. See ENP-088, “CNG Fuel Pressure Regulator Troubleshooting”
- Remove the maintenance cover from the FMM.
- Clamp or pinch off the coolant hoses near the regulator and remove the connections going to the regulator.



Figure 69 A shop-built regulator test jig.

- Install the pressure gauge jig between the two coolant ports.
- Observe the test jig gauge for 20 minutes to see if there is any pressure in the regulator.
- If pressure builds, replace the regulator -- the unit is not serviceable.

See “CNG Fuel Pressure Regulator Troubleshooting,” ENP-088, for more details.

ITEM	PROBLEM
1	After disconnecting fuel nozzle, fuel flows out of the fill receptacle
2	The main shutoff valve does not isolate fuel – engine continues to run even when valves have been turned to the OFF position
3	Too much pressure coming out of the regulator (should be approx. 125 psi)
4	Not enough pressure coming out of the regulator (should be approx. 125 psi)

ITEM	CAUSE	SOLUTION
1	O-rings frozen due to gas expansion	Wait for receptacles to warm up to ambient temperature and see if leak persists
	Debris in fill receptacle	<ol style="list-style-type: none"> 1. Depressurize fill manifold 2. Remove receptacle from the manifold 3. Inspect for blockage or damage 4. Reinstall or replace as needed 5. Test for leaks
	Check valve damaged	1. Follow steps above for the check valve
2	Valve seats are worn or debris is not allowing the valve to fully close	<ol style="list-style-type: none"> 1. Depressurize system 2. Remove the main shutoff valve 3. Replace valve seats per valve manufacturer instructions or replace the valve 4. Test for leaks
3	Regulator not working properly	<ol style="list-style-type: none"> 1. Depressurize system 2. Remove and replace the regulator
4	High pressure or low pressure filter is clogged	1. Replace filter element

Table 5 Additional troubles and solutions.

11. References and Service Bulletins

CNG Cylinder and System Inspection Regulations, Codes and Guidelines

This is not a comprehensive list. Other local, state or province regulations may apply. Check with your authority having jurisdiction (AHJ), usually the fire department, for more information.

- Federal Motor Vehicle Safety Standards (FMVSS) Standard 304, “Compressed Natural Gas Fuel Container Integrity”
- ANSI/IAS NGV2, “Basic Requirements for Compressed Natural Gas Vehicle Fuel Containers”
- ANSI NGV2-PRD-1, “Pressure Relief Devices for Natural Gas Vehicle (NGV) Fuel Containers
- ANSI NGV 3.1/CSA 12.3, “Fuel System Components for Compressed Natural Gas Powered Vehicles”
- Compressed Gas Association (CGA) Pamphlet CGA C-6.4, “Methods for External Visual Inspection of Natural Gas Vehicle Fuel Containers and Their Installations”
- National Fire Protection Association (NFPA) 52, “Vehicular Gaseous Fuel Systems Code”



- g. State of California Vehicle Code 2402.6, "Regulations and Standards: Compressed or Liquefied Gas and Liquefied Petroleum Gas" and 270909, "Transporting Liquefied Petroleum or Natural Gas"
- h. Cylinder manufacturer guidelines

Service Bulletins and Documents

The documents below include service procedures for specific Agility Fuel Systems fuel systems. Remember, only qualified CNG fuel system service personnel should repair or upgrade natural gas fuel systems.

- a. ENP-196, "CNG Fuel System Inspection Interval Recommendations for High Mileage, Heavy Duty Vehicles"
- b. ENP-118, "Routing and Clipping Manual"
- c. ENP-251, "CNG Flex Hose Visual Inspection and Leak Detection"
- d. ENP-088, "CNG Fuel Pressure Regulator Troubleshooting"
- e. ENP-357, "Behind the Cab Cabinet Isolator Inspection and Replacement"
- f. ENP-047, "Rail Mount Periodic Maintenance and Inspection Schedule"
- g. ENP-435, "CNG Side Mount Systems 22922600/22922700 Cylinder Mount Retrofit Procedure"
- h. ENP-384, "MDA-Series CNG Refuse Roof Mount System Upper Doors Rubbing Against Cylinders"
- i. ENP-007, "Truck and Tractor CNG Fuel System Operation Manual"
- j. CSA Group: Use the search function to find a "Certified CNG Cylinder and Fuel System Inspector" in your area: <http://www.csagroup.org/global/en/services/education-and-training/personnel-certification/people-search>

Agility Fuel Systems CNG Video Library

A great source of information on CNG fuel systems and how they work:

<http://www.agilityfuelsystems.com/agility-fuel-systems-academy-video-library.html>

Segment 1: Agility Natural Gas Fuel Training Introduction

Segment 2: Agility Fuel System Overview

Segment 3: CNG Fuel System

Segment 4: Fueling & De-Fueling CNG Fuel Systems

Segment 5: Daily CNG Fuel System Inspection

Segment 6: Pressure Relief Devices (PRD)

Segment 7: Depressurizing a CNG Fuel System

Segment 8: Servicing the High-Pressure Filter

Segment 9: Leak Detection and Repair

Segment 10: Hot Work

Segment 11: Troubleshooting CNG Fuel Systems

Segment 12: Agility Product Support

PRODUCT SUPPORT

Call the Agility PSG hotline for technical support, field service, training, and aftermarket parts.

Product Support Group

Hotline: (849) 267-7745

support@agilityfs.com - Contact Support (Service/warranty/technical support)

parts@agilityfs.com - Contact Parts (Parts sales)

Hours:

Monday through Friday
7AM to 4PM Pacific Time

[Product Warranty Registration](#)

[Operation Manuals](#)

[Product Notifications](#)

[Training Information](#)

[Videos](#)

Service/maintenance parts manuals are available for most systems. Please send a request to support@agilityfs.com and include the vehicle VIN and Agility Fuel Systems 8-digit system part number for your vehicle.

