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11-4-2014

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NO LETTER

PE14-020

11-4-2014

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NO LETTER

Agility Fuel Systems Product Support

Product Support Group (PSG)

Contact the Agility Fuel Systems PSG Hotline for Technical Support, Field Service, Training and Aftermarket Parts.

Please have chassis number and system serial number handy when inquiring

Product Support Group

Hours: Monday through Friday

7 AM to 4 PM Pacific Time

Hotline: 949-267-7745

Service/Warranty: support @agilityfs.com

Parts Sales: parts@agilityfs.com

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Agility Fuel Systems Routine Maintenance

Maintenance Schedule

Leak test with methane detector or solution	Monthly
Component inspection	Monthly
Drain high pressure filter	Every 1500 miles*
Replace high pressure filter element	Every 3,000 miles*
Check vent lines	Monthly, or immediately if vent caps are missing

*High pressure filter drainage and element changes may vary depending on fuel quality and operating conditions

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Agility Fuel Systems Training Information

Training

CNG Fuel System Training Available Upon Request

Introduction to CNG Fuel Systems
Overview & function of cylinders, fuel management module (FMM)

Operation
Filling, daily check, startup, fuel shutoff, emergency procedures

Maintenance
Depressurization, filter change, inspection requirements, intervals

Diagnostics
Troubleshooting and repairing components

Warranty Claim Procedures

Contact Product Support for more information:
949-267-7745, support@agilityfs.com

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Agility Universal CNG Operation Manual



Agility
fuel systems™

Universal CNG System Operation Manual




ENP-007
Rev. F, November 2013

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Glossary

AGA	American Gas Association
AHJ	Authorities Having Jurisdiction
ANSI	American National Standards Institute
ASM	Assembly
BOM	Bill of Materials
CAN	National Standards of Canada
CGA	Compressed Gas Association
CNG	Compressed Natural Gas
CSA	Canadian Standards Association
FMM	Fuel Management Module
HP	High Pressure
LP	Low Pressure
NFPA	National Fire Protection Association
NGV	Natural Gas Vehicle
OEM	Original Equipment Manufacturer
PRD	Pressure Relief Device
psi	Pounds per square inch (lb/in^2)

Proprietary Statement

Preface

This manual is designed as a supporting document to mechanics and operators trained in the operation procedures and maintenance of the compressed gas fuel system provided by Agility fuel systems.

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

OEM Replacement parts may be obtained by contacting Agility or approved distributors and retailers of Agility products.

CAUTION: 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.

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.

Table 1 Revision Level

	F	WY	11/26/13	Added defuel procedure
	E	WY	8/06/13	Revised title, moved Emergency Defuel Procedure to Section 1.6, corrected valve designations in Sect. 2, general edits
	D	AD	3/25/13	Added cylinder information
	C	AD	3/07/13	Added defuel procedure
	B	AD	2/06/13	Added safety information
	A	AD	7/05/12	Updated imagery
ECN #	REV	BY	DATE	DESCRIPTION

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1. Safety

In the interest of ensuring the safety of all personnel involved with compressed natural gas (CNG) fuel storage systems, this section outlines general guidelines that must be followed when operating and servicing equipment provided by Agility Fuel Systems.

1.1 Certified Personnel

CNG systems should be maintained and inspected exclusively by trained personnel with certifications in accordance with the applicable codes. As with all pressure vessels, CNG storage and fuel delivery systems are inherently dangerous and should be treated as such. Individuals involved in any aspect of CNG fuel system maintenance, emergency response, servicing, or testing must be properly trained and certified. Individuals who are not trained and certified in all aspects concerning CNG fuel delivery systems are not permitted to service, maintain, test, or inspect a system in any way.

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 that fire extinguishers are charged, up to date, and rated correctly.

3. In case of emergency, self-contained breathing apparatus should be on site in an easily accessible area.

4. Areas designated for CNG fueling systems must have adequate lighting that complies with NFPA code.

5. Protective footwear and eyewear should be worn by all personnel in close proximity to a CNG system.

6. When locating the source of a leak only use certified leak detecting solutions and equipment such as Swagelok Snoop®. Any other product or solutions are unacceptable.
7. Only use tools that are in good working order with proper calibration.
8. Wear appropriate attire while servicing or maintaining any CNG system.

1.3 General Safety Precautions

1. Follow all maintenance procedures in order; do not skip steps unless there is explicit permission to do so.

2. Never use an open flame as a source of illumination in proximity to a CNG system.

3. Any process or procedure that generates sparks, flames, or heated particles should not be practiced in areas designated for CNG.

4. If a CNG system does require a process or procedure that generates sparks, flames, or significant heat, conduct the procedure in an isolated area and make sure that the CNG system has been completely purged with an inert gas.

5. CNG fuel delivery systems are to be serviced in designated areas that comply with all federal, state, and municipal laws and regulations.

6. CNG servicing and fueling areas must be well ventilated as stipulated by federal, state, and municipal law.

7. Perform all maintenance and service procedures in a dust free environment.

8. Never attempt to depressurize or vent a system by loosening a fitting.

1.4 CNG Vehicle Safety Precautions

WARNING: Strict compliance with proper safety and handling practices is essential when operating this compressed natural gas fuel system.

The following safety precautions are vehicle specific and 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. Ensure that all systems are grounded before transferring CNG fuel from one vehicle to another. Transferring CNG may cause a buildup of static electricity which could discharge and ignite the fuel.

4. Never attempt to open system components that are under pressure.

5. System pressure must not exceed 3000 psi for public vehicles in Canada.

6. For all other vehicles the system pressure must not exceed 3600 psi (i.e. Private captive fleets).

7. Do not smoke or produce an open flame within 30 feet of a CNG vehicle or a CNG dispensing/filling station.

8. Always ground a vehicle prior to defueling.

9. If a CNG vehicle has been out of service for an extended period of time, turn tank valves to the "OFF/CLOSED" position and run the engine until it stalls. This will burn the residual fuel in the closed off lines.

CAUTION: this procedure is not the same as depressurizing the system. For depressurizing see Section 3.4.

1.5 Codes and Compliances

For complete and detailed information concerning CNG codes and regulations please refer to the following:

USA:	NFPA 52
Canada:	CAN/CGA B109
North America:	ANSI/AGA NGV 3.1/CGA 12.3 and NGV 12.3-M95

1.6 First Responder Guide

1.6.1 Identifying a Natural Gas Vehicle

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

Figure 1 CNG Diamond

Figure 2 LNG Diamond

Natural gas possesses unique hazards that are not present in gasoline or diesel fuel. The primary concern is that CNG is in a gaseous state at room temperature and pressure. For storage purposes natural gas must be either compressed to 3600 psi (CNG) or cooled to a liquid state at -260°F (LNG). Agility Fuel Systems

minimizes these potential hazards through state of the art design and testing practices.

1.6.2 General Information

The storage tanks for CNG fuel are housed in steel or aluminum frames that are bolted to the truck body or chassis. These structures are designed to protect the cylinders in the event of 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 fuel system. During regular operation all cylinder valves are open, although some operators prefer to close one cylinder and use it as a reserve tank. The fuel management module (FMM) is equipped with a 1/4-turn shutoff valve which isolates the fuel storage system from the engine for emergency situations. It is not to be used to introduce high pressure gas to downstream components that have been previously depressurized.

1.6.3 Emergency Response for Gas Leaks

Warning: CNG storage pressure can be up 4250 psi. DO NOT cut fuel supply plumbing.

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

1. Do not approach the vehicle if any sources of ignition are present, including but not limited to: fire, sparks, electrostatic charges, lights, electronic devices. Do not smoke or allow anyone else to smoke in the vicinity of the vehicle. Avoid using road flares.
2. Turn the ignition switch off, set the parking brake, and turn off the battery at the main disconnect.
3. 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.
4. Make sure that traffic and pedestrians steer well clear.
5. Keep the vehicle doors open for air circulation.
6. If the vehicle is indoors, open windows and doors to allow ventilation. Avoid turning on any lights or electronics which may spark. Pay special attention to overhead sources of ignition; natural gas is lighter than air.
7. Beware that gas may continue to leak once ignition is turned off and the manual shutoff valves are closed.
8. Check the fuel system again for leaks.

1.6.4 Vehicle Fire Procedures

In the event of a CNG fire it is imperative that the vehicle operator acts quickly and efficiently by observing to the following steps:

1. Evacuate the area.
2. Get passengers out of the vehicle as quickly as possible.
3. Extinguish the fire using an appropriately rated fire extinguisher. Note a CNG fire is similar to a gasoline fire. However if the fire is not extinguished quickly the CNG cylinder pressure relief devices (PRDs) may activate to relieve excess pressure from the cylinders. PRDs typically activate between 212-220°F and will cause CNG to exit rapidly from the storage tanks. Escaping CNG may ignite and add to the fire. DO NOT attempt to extinguish a natural gas fire with water, this will cause the gas to vaporize. Use dry powder or Purple-K-Powder.

1.6.5 Emergency Shut Down Procedure

To completely shut down a CNG storage system observe the following steps:

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

1.6.6 Emergency Venting/Defuel Procedure

If an emergency arises in which the fuel must be purged immediately without following proper procedure, an emergency vent can be performed as follows:

1. Ensure that an electrical ground connection has been established between the cylinders, the vent system, and earth ground.
2. Connect the on-board defueling connection to the vent system using a high pressure flexible hose; consult the vehicle manufacturer for information.
3. Slowly open the hand valve to release the gas. Adjust the hand valve to achieve a steady flow of gas out the vent pipe. Allow the transfer of fuel at a slow pace to prevent freezing. No gas flow may indicate a normally closed solenoid valve on the cylinder. Consult the vehicle manufacturer for information to open electronic solenoids.
4. Allow the on-board storage system to vent completely.
5. When completed disconnect all connections.

Return to Service

If the vehicle has been subjected to a fire or collision exceeding 5 mph, the fuel storage system must be inspected by a certified inspector before it can be returned to service.

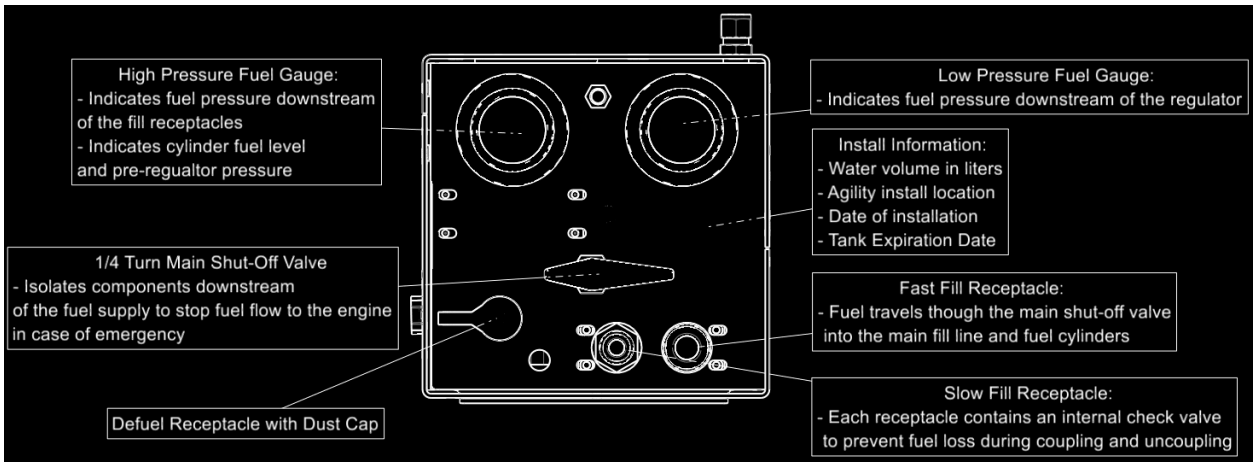


Figure 3 FMM Details

2. Fuel System Components and Specifications

This section illustrates component specifications. All figures and illustrations are intended for reference only and do not necessarily reflect the exact configuration for any given system. In principle the plumbing and fuel management module layouts are consistent across platforms; however there may be some variance depending on the options and configuration requirements. Please contact Agility for the latest version of this document.

2.1 Fuel Specifications

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

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

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 Superstructures

The fuel system structures and components are designed to meet or exceed all safety and vehicle standards. The systems are shipped as complete units ready to be bolted on and connected for turn-key operation. Figures 4 through 7 illustrate the array of available configurations depending on the desired application.

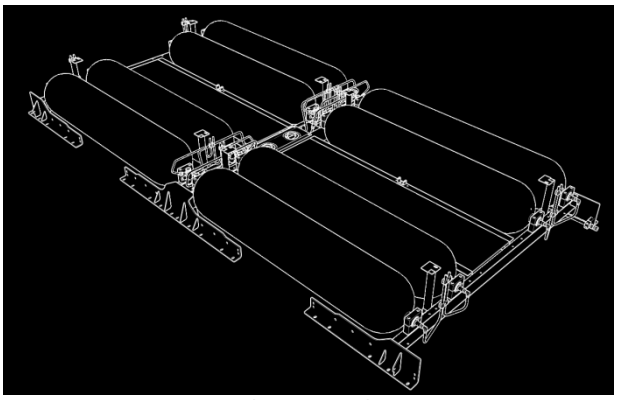


Figure 4 Roof Mount Configuration

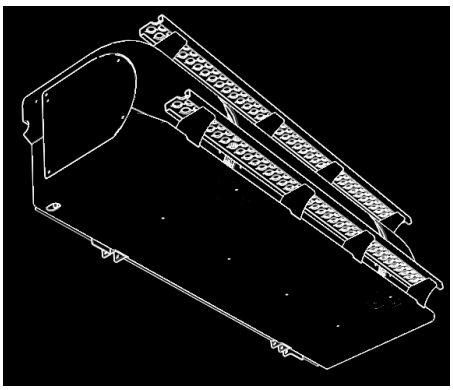


Figure 6 Side Mount Configuration

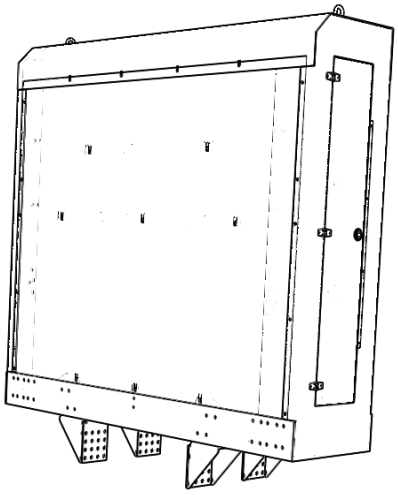


Figure 5 Behind the Cab Configuration

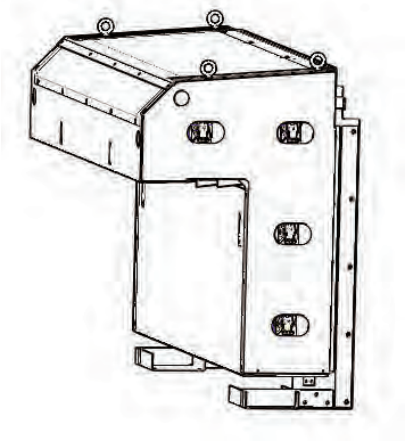


Figure 7 Front of Body Configuration

2.3 Fuel Management Module (FMM)

The fill panel control interface illustrated in Figure 8 is accessible by opening the fill panel access door at the rear passenger side of the vehicle.

Table 3 FMM Faceplate BOM

FMM Faceplate	
1	Emergency Shut-off Valve
2	Transit (Fast) Fill Receptacle
3	NGV1 Fill Receptacle
4	Defuel Receptacle
5	High Pressure Gauge
6	Low Pressure Gauge

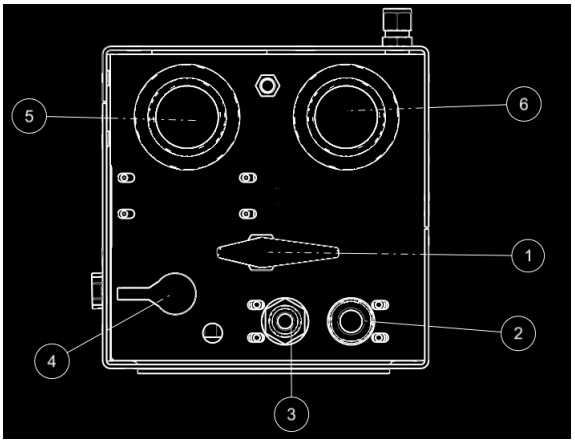


Figure 8 FMM Faceplate

Figure 9 illustrates key plumbing components and connections inside the fill panel.

Table 4 FMM Components BOM

FMM Components	
1	High Pressure Connection to Cylinders
2	High Pressure Filter
3	Solenoid Valve
4	Pressure Regulator
5	Coolant Ports
6	Low Pressure Fuel Line
7	Defueling Valve
8	Manifold

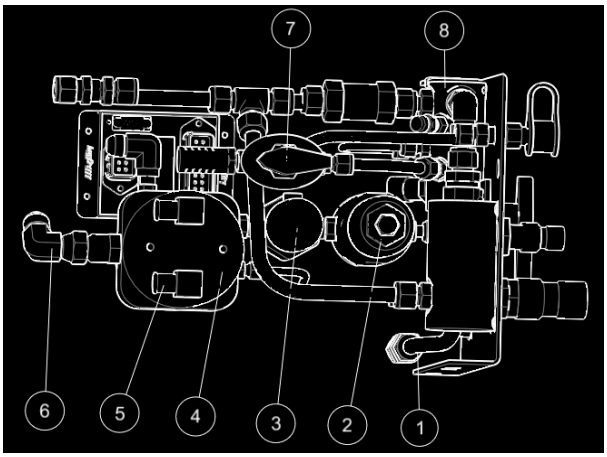


Figure 9 FMM Components (Bottom View)

2.4 Gauges

FMMs typically have two gauges, a high pressure gauge measuring the pressure in the tanks and a low pressure gauge downstream of the regulator.

Figure 10 High Pressure Gauge

The high pressure gauge reads 0 to 5000 psi. When tanks are filled to capacity, maximum allowable pressure is typically 3600 psi. However this number may vary based on federal and local regulations. Some jurisdictions stipulate that maximum pressure may not exceed 3000 psi. Some jurisdictions allow for over-filling of the tanks to 1.25 times service pressure (4500 psi) so that when the gas cools

to ambient temperature the pressure will be at the maximum allowable limit of 3600 psi.

Figure 11 Low Pressure Gauge

The low pressure gauge is located downstream of the pressure regulator. The output of the regulator is calibrated to 125 psi; during regular operation the low pressure regulator should read the same.

2.5 Filters

Agility CNG systems have two filters, one for high pressure and another for low pressure. The high pressure filter is located in the FMM and the low pressure filter is located in the engine bay.

2.5.1 High Pressure Filter

The high pressure coalescing filter can be found in the FMM, downstream of the manifold and main shutoff valve and upstream of the solenoid valve. The high pressure filter purifies the fuel by removing moisture and contaminants.

The high pressure filter element has an efficiency rating of 1 micron. It should be changed with every oil change or once every 3000 miles, whichever occurs first.

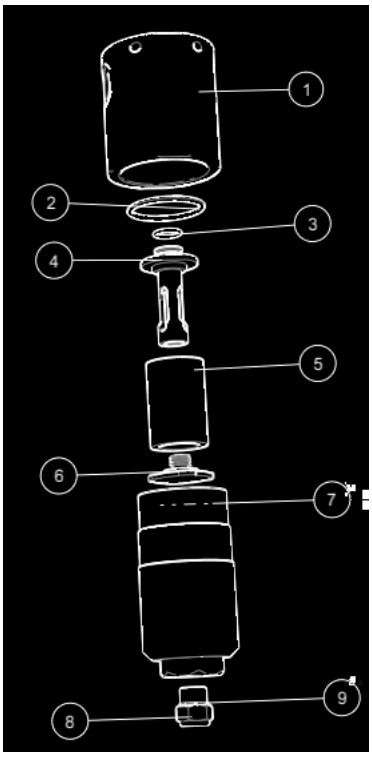


Figure 12 High Pressure Filter

Table 5 High Pressure Filter BOM

HP Filter Assembly BOM		
Item	Part Number	Description
1	20100106	Filter Housing
2	10500022	Filter Bowl O-Ring
3	10500017	0-Ring
4	20100108	Element Housing
5	20100109	Filter Element
6	20100110	Element Base
7	20100107	Filter Bowl
8	10200266	Hex Head Plug
9	10500014	Hex Head Plug O-ring

2.5.2 Low Pressure Filter

The low pressure coalescing filter can be found downstream of the main shutoff valve, high pressure filter, and regulator. The low pressure filter removes residual contaminants and oil from the fuel before it enters the engine.

The operating range of the low pressure filter is -43°F to +250°F. The filter is 99.9% efficient for 0.3 micron liquid droplet and 100% efficient for

25 micron particles. The filter is the spin-on variety with a 1-1/2-16 UN-2B thread.

The filter is sealed with a lubricated gasket. The filter functions similarly to an automotive oil filter with a drain cock at the bottom of the drain sump.

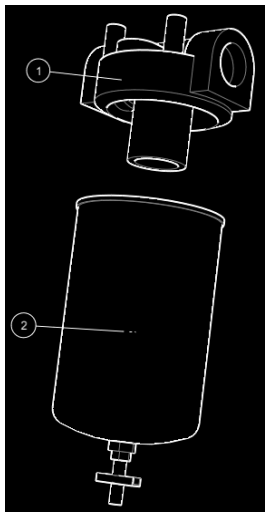


Figure 13 Low Pressure Filter

Table 6 Low Pressure Filter BOM

Low Pressure Filter Assembly		
Item	Part Number	Description
1	10300017	Filter Housing
2	10300018	Filter Element

2.6 Solenoid Valve

CAUTION: The solenoid valve generates considerable heat during operation and may cause burns on contact with unprotected skin.

2.6.1 Principles of Operation

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

Energized: this valve operates using 24 Volts DC (22 Watts) from the onboard 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.

Solenoid Valve Specs
Operating Range: -40°C to 105°C
Max Operating Pressure: 3600 psi
Resistance: 28.5±2 Ohms @ 20°C Rated 200°C

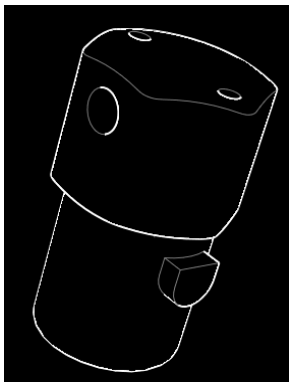


Figure 14 Solenoid Valve

2.7 Pressure Regulator

Regulator Specs
Set Point: 125 psi @ 3000 psi inlet pressure
PRD: 200 ± 40 psi Crack Pressure
Maximum Pressure: 3600 psi
Minimum Pressure: 250psi
Coolant Temperature Range: -40°F to +250°F

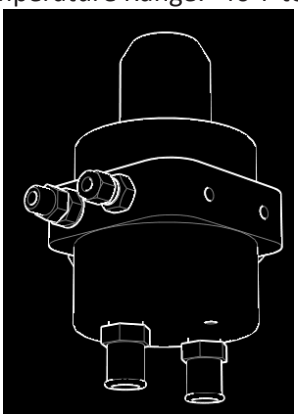


Figure 15 Pressure Regulator

2.8 Cylinders

Cylinders vary in size and volume depending on the system. All cylinders are designed, manufactured, inspected, and qualified in accordance with NGV-2 2007.

Cylinder Specs
May vary depending on application, generally cylinders are rated to 3600 psi and 20 years of useful service life.

Service Life: 20 Years

Service Pressure: 3600 psi @ 70°F

2.9 Valves

The Agility FMM uses several valve types. Depending on the system configuration, valve appearance and performance may vary.

2.9.1 Bleed Valve

The bleed valve is used to equalize pressure in the FMM to ambient pressure for maintenance and purging. It is operated by loosening the hex nut at the top.

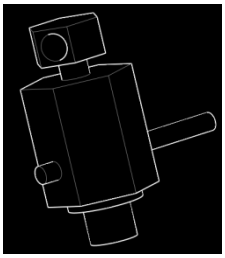


Figure 16 Bleed Valve

2.9.2 Check Valve

The check valve is a one-way valve designed to prevent backflow when fueling.

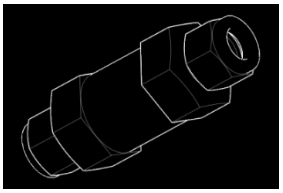


Figure 17 Check Valve

2.9.3 Defuel Valve

This valve is used in conjunction with the defueling receptacle.

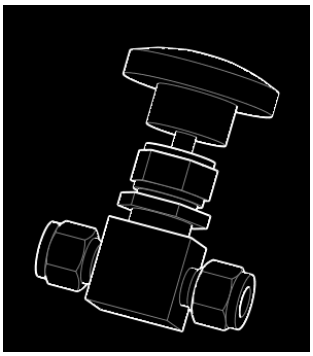


Figure 18 Defuel Valve

2.9.4 Emergency Shutoff Valve

The emergency shutoff is not to be used to repressurize downstream components.

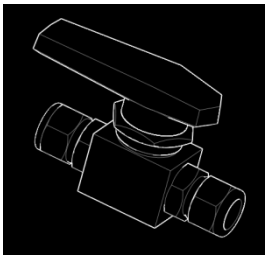


Figure 19 Emergency Shutoff Valve

2.10 Pressure Relief Devices

The pressure relief devices (PRD) are activated in the event of a fire to prevent over-pressurizing in the fuel tanks. The PRDs used on this system have been designed in accordance with PRD-1, and meet or exceed the basic requirements for fuel container pressure relief devices onboard Natural Gas Vehicles.

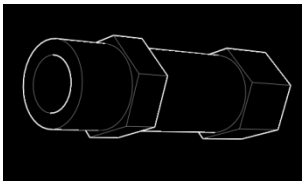


Figure 20 PRD

2.11 Fill Receptacles

Depending on the application fill receptacles may be standard NGV1 or transit fill. All have built-in check valves to prevent fuel loss during coupling and uncoupling procedures.

2.11.1 NGV1 Fill Receptacle

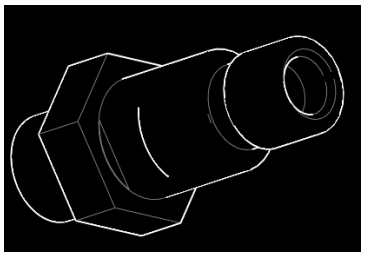


Figure 21 NGV1 Fill Receptacle

Fill Receptacle Specs

Design Pressure: 5000 psi
Flow Rate: 1500 SCFM @ 3000 psi
Temperature Range: -40°F to 250°F

2.11.2 Transit Fill Receptacle

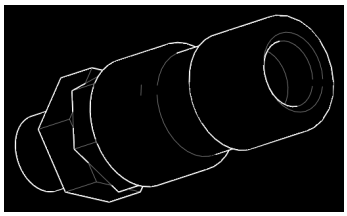


Figure 22 Fill Receptacle

Transit (Fast) Fill Receptacle Specs

Design Pressure: 5000 psi

Min. Flow Rate: 5000 SCFM @ 3000 psi

Temperature Range: -40°F to 250°F

2.12 Fittings and Connections

2.12.1 Tubing

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.

2.12.2 Fittings

This system is plumbed with Swagelok® stainless steel compression tube fittings. The stainless steel fittings are designed specifically for use in CNG applications.

2.12.3 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. For these reasons it is mandatory that maintenance personnel receive proper training from an authorized Swagelok® distributor prior to utilizing Swagelok® tube fittings on a CNG system.

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

2.12.4 Fitting Safety Considerations:

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.

3. Operation and Maintenance

Routine maintenance of the compressed natural gas fuel system will ensure that the system and all of its components continue functioning properly.

WARNING: System components must not be under pressure during servicing to prevent serious injury or death.

WARNING: This manual is intended as a supplement to training in operation and maintenance of the CNG fuel system. Attempting to operate or maintain the CNG fuel system without proper training is dangerous.

CAUTION: Do not expose plastic or elastomeric materials to commercial cleaning products. CNG components should be washed with a diluted soap solution and rinsed thoroughly to remove deposits.

CAUTION: CNG components and fittings are designed to be used exclusively in CNG applications. Parts must be ordered directly through Agility Fuel Systems or through an approved Agility OEM dealer. Any other parts may be unsafe and will void the warranty. All replacement parts and components must receive approval from Agility prior to installation.

3.1 Starting the Vehicle

Starting a natural gas vehicle requires a delay between the battery power being turned on and the starter motor being activated.

1. Ensure that the system has been properly leak tested, this can be accomplished by following the Testing for Leaks procedure described in Section 4.2.3.
2. Ensure that the blue plastic caps are installed on all exposed vent lines. Vent lines are located at the rear of the fill panel and at both ends of the cylinders. If the blue caps are missing follow the Draining Vent Lines procedure in Section 4.13.2 and contact Agility fuel Systems for replacement caps.
3. Ensure that the cylinder shutoff valves (one on each cylinder) are "OPEN" and the manual shutoff valve is turned to the "ON" position.
4. Ensure that the standard manufacturer recommended pre-vehicle start-up procedures are followed.
5. Start the engine.
6. If the vehicle is starting from cold, let the engine idle for five minutes. This will allow coolant to warm the fuel and ensure that the low-pressure lines (down-stream 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.

Maintenance Schedule

Table 7 Maintenance Schedule

Item	Frequency
Storage System:	
Leak Test with Methane Detector	Every month
Component Inspection	Every month
Drain Filter	Every 1500 miles
Replace Filter Element	Every 3000 miles
Check Vent Lines	Every month (or immediately if blue vent cap is missing)
Cylinders	Inspect compressed gas cylinders as outlined by cylinder manufacturer

3.2 Leaks

Refer to Depressurizing (Section 3.4) and Repressurizing (Section 3.5) before performing leak repairs.

3.2.1 Tube Bottoming Requirements

 **CAUTION: Adjusting fittings requires accredited Swagelok® or Agility training.**

In order to achieve a safe, leak free seal tubing connections must be flush and fully bottomed in the fitting. Please 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.

3.2.2 Tightening of 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.

3.2.3 Testing for Leaks

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

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

Generally speaking, leaks will 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®.

To Find a Leak

1. Apply a certified leak detecting solution and look for bubbling or foaming at the site of the leak.

2. Examine connections for icing or signs of condensation around the tubing.

3. Check for signs of damaged or perforated tubing.

3.2.4 Tightening Leaky Fittings

1. If a leak is detected, depressurize the system.

2. Once the system is depressurized, tighten the leaky fittings. Repressurize the system.

3. Once the system is pressurized, conduct a leak test.

4. If this does not stop the leak, depressurize the system again and then follow the leak repair procedures.

3.2.5 Testing Pressure

If any components are loosened or replaced, an excessive amount of fuel is being consumed, or the vehicle was involved in an accident, a pressure test using nitrogen is required before re-filling with natural gas.

Pressure Test Using an Inert Gas (Nitrogen)

1. Before proceeding with the nitrogen pressure test, ensure that the system has been depressurized.

2. Once the system is fully plumbed or repaired, ensure that the engine ignition is in the "OFF" position (use OEM lockout procedure), and the vehicle is at least 15 feet away from an open flame or source of ignition.
3. Ensure that the cylinder shutoff valves (one per cylinder) are in the "OFF/CLOSED" position.
4. Turn the manual shutoff valve to the "ON/OPEN" position.
5. Connect the pressure testing equipment to the system fueling receptacle using a NGV1 fueling nozzle plumbed to a nitrogen source with a flex hose rated to the system service pressure of 3600 psi and a pressure regulator. Slowly fill the system with nitrogen to a pressure of 100 psi. While filling the system, listen for leaks. Stop if leaks are detected.
6. Perform the 100 psi leak test using leak detection solution or an equivalent alternate method.

WARNING: **Be careful not to bleed the nitrogen too fast as this could cause injury.**

7. If a leak is detected, disconnect the nitrogen fill line from the system fueling receptacle, depressurize the system by venting the nitrogen with the bleed valve and follow the steps in Section 3.2.6, "Repairing a Leak."
8. If no leak is detected, slowly increase the pressure to 1500 psi. Increase the pressure at no more than 500 psi per minute until a system pressure of 1500 psi is reached.
9. Perform the 1500 psi leak test using leak detection solution or an equivalent alternate method.
10. If a leak is detected, disconnect the nitrogen fill line from the system fueling receptacle, depressurize the system by using the bleed valve, and fix the leak.
11. If no leak is detected, continue to slowly increase the pressure to 3625 psi. Increase the pressure at no more than 500 psi per minute.
12. Once the system is pressurized to 3625 psi, perform the 3625 psi leak test.
13. If a leak is detected, disconnect the nitrogen fill line from the system fueling receptacle, depressurize the system by using the bleed valve, and repair the leaks.
14. After all the nitrogen leak tests have been performed, the pressure shall remain constant at 3625 psi for 10 minutes with no signs of a pressure drop. If the system pressure drops in this 10 minute time frame, observe where the leaks are occurring, depressurize the system by using the bleed valve, and repair the leaks.

CAUTION: DO NOT TURN THE ENGINE ON to activate the primary solenoid lock-off valve for the next part of the test – make sure to use an external 24 volt power supply, do not use the vehicle's onboard power supply.

15. At this point, the system has been properly pressure tested up to the primary solenoid lock-off valve (item C in Figure 24). To test the connections down-stream of the solenoid valve, apply a 24 volt power supply to open the valve. This will allow nitrogen to flow through the rest of the system and up to the secondary solenoid shutoff valve at the engine. Conduct a leak test using a leak detection solution at all connections downstream of the fuel outlet (low pressure) line, item 6 in Figure 9.
16. If a leak is detected, disconnect the nitrogen fill line from the system fueling receptacle, depressurize the system by using the bleed valve, and repair the leak.

Repeat the Testing Pressure procedure from step 15.

17. Once the 100 psi, 1500 psi and 3625 psi tests have been performed and successfully passed, the nitrogen can be vented to the atmosphere using the bleed valve.

 **CAUTION: Ensure that all the safety guidelines from the Safety section are followed prior to filling the system with CNG.**

3.2.6 Repairing a Leak

 **WARNING: Ensure that the system is depressurized before repairing any leaks.**

During the leak test or pressure test, leaking could be caused by several problems. To repair a leak found during either test, perform the repairs in the order shown below.

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

1. Tighten the fittings that are leaking and then follow the "Testing Pressure" procedure in Section 3.2.5.
2. Remove the fittings that are leaking and check that the mating surfaces are clean. If present check the O-rings for signs of damage.
3. 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 8. Once the fittings have been reinstalled follow Section 3.2.5, "Testing Pressure."
4. If the leak cannot be repaired, the component should be replaced.
5. If replacement is necessary, ensure correct replacement parts are requisitioned and install the new parts.

If the repairs listed in section 3.2.6 do not fix the problem, contact Agility Fuel Systems Product Support at +1-949-267-7745.

Table 8 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

3.3 Inspecting Components

A visual inspection of the components ensures that the components are not damaged:

- Ensure that all PRD vent lines have blue end caps securely in place. A PRD vent line with a missing end cap may indicate that a PRD has activated. If a PRD has activated, contact Agility Fuel Systems product support.
- Ensure that all natural gas system components are solidly mounted.
- Ensure that all fuel supply tubes and flexible lines are in good condition.
- Ensure that no fuel leaks are present.
- Ensure there are no coolant leaks at the hose connections going to the high-pressure regulator.
- Visually inspect structural components for any signs of wear or cracks.
- Visually inspect rubber for wear and cracks.
- Inspect fastened joints for loose fasteners.
- Inspect mounting bolts for damage.
- Inspect mounting bolts placed through rubber for proper torque:
    - 3/4-in. bolt: 320 ft-lbs
    - 5/8-in. bolt: 185 ft-lbs
    - 1/2-in. bolt: 90 ft-lbs

3.4 Depressurizing CNG Systems

1. Ensure that the vehicle is turned off.
2. Turn the cylinder shutoff valves (one on each cylinder) clockwise to the "OFF/CLOSED" position.
3. Ensure that the manual shut off-valve is in the "ON/OPEN" position.
4. Turn on the vehicle and run the engine until it stops.
5. Ensure that the vehicle is off and that the proper vehicle lock-out procedures are followed.
6. Check the gauges on the fill panel to ensure that all the pressure is relieved.
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 illustrated in Figure 23.

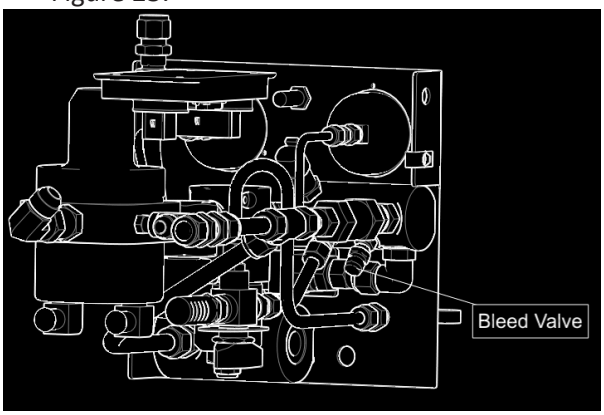


Figure 23 Bleed Valve

9. The system is now fully depressurized up to the primary solenoid lock-off valve (item C in Figure 24). There may be pressure remaining downstream of the solenoid valve. Be careful when loosening fittings for the first time because a small amount of gas may leak out of any fitting downstream of the solenoid lock-off valve, which is normal.

3.5 Repressurizing System

1. Ensure that the vehicle is off and remove the keys from the ignition.
2. Ensure that the bleed valve is closed and torqued to 4-5 ft-lbs.
3. Ensure that the filter bowl and the drain plug are installed and tightened.
4. Re-install the fill panel cover (if removed).
5. Ensure that the manual shutoff valve is still turned to the "ON/OPEN" position.
6. Slowly turn the cylinder shutoff valves (one on each cylinder) counter-clockwise to the "ON/OPEN" position.
7. Ensure that the pressure test procedure was performed if any parts were loosened or replaced.
8. Start the engine.

3.6 Gauge Considerations

Maintenance

Pressure gauges are maintenance free and do not require recalibration. If a gauge is leaking from the fittings, address the leak in the same fashion as any other leak. However if a gauge leaks internally, ceases to function, loses its glycerin filling, or reads incorrectly contact Agility for a replacement.

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

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

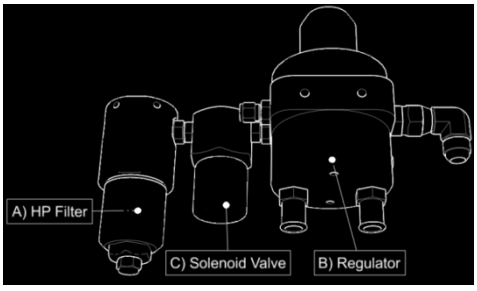


Figure 24 HP Filter, Solenoid, Regulator Subassembly

Refer to Figure 24 for reference.

1. Depressurize the system as described in Section 3.4

2. Disconnect exterior tube fittings from the HP filter (A), be careful not to bend or stress any plumbing components in the process.

3. Disconnect coolant lines from the regulator (B), to prevent coolant from overflowing drain residual fluid into an appropriate container.

4. Disconnect electrical connections from solenoid valve (C)

5. Disconnect low pressure fuel line from regulator (B)

6. Carefully remove any mounting hardware connecting the subassembly to the FMM brackets.

3.8 Maintaining the HP Filter

Regular filter element replacement is an important step towards maintaining the integrity of a CNG fuel system and ensuring maximum operating performance.
In general, high pressure filter elements should be replaced every 3000 miles. In addition, the filter housing must be drained of fluid every 1500 miles. The frequency of filter element replacements could increase or decrease depending on the cleanliness of the equipment used at fueling stations and the quality of the fuel.

3.8.1 Draining the High Pressure Filter

1. Depressurize the system, as instructed in Section 3.4.
2. Slowly remove the drain plug (hex cap) with an 11/16-in. wrench. See Figure 25.
3. Drain until there is no residual liquid left.
4. Inspect the O-ring on the drain plug and replace if necessary.
5. Replace the drain plug and torque to 26 ft-lbs.

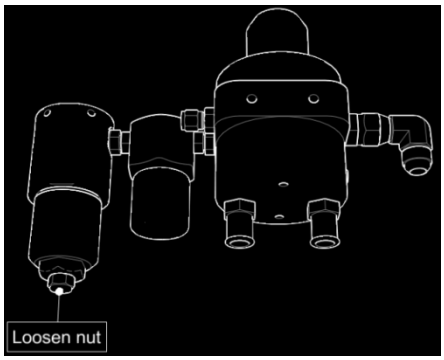


Figure 25 Drain Plug (Hex Cap)

3.8.2 Replacing Filter Element

To replace the filter element inside the Agility filter (element part number 10300024):

1. Depressurize the system.
2. Drain the filter.
3. Unscrew the filter bowl by using a filter bowl removal tool or a 1-1/4-in. wrench.
4. Remove and replace the old filter element.
5. Inspect the O-ring on the filter element holder for damage and replace it if necessary.
6. Reinstall the bowl and tighten to 40 ±1 ft-lbs.

Table 9 HP Filter Torque Specifications

HP Filter Torque Specs (ft-lbs)	
Filter Housing	40
Hex Head Plug	25-30
Flow Ports In/Out	25-30

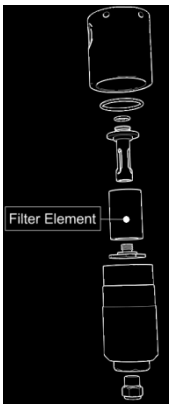


Figure 26 Filter Element

3.9 Maintaining LP Filter

3.9.1 Filter Replacement and Service

The filter manufacturer recommends purging on a daily basis, draining every 3 months of active service, and replacing every 12 months of service. Depending on the fuel quality and characteristics, drainage and replacement may be required more frequently than the prescribed schedule.

3.9.2 Draining Low Pressure Filter & Replacing the Filter Housing

1. Follow steps 1-3 as described in the Draining the High Pressure Filter section.

2. Once the system has been depressurized, the filter housing may be drained by turning the drain cock counter-clockwise until it stops or liquid begins draining. Once liquid has ceased to drain, turn the drain cock clockwise until fully seated hand tight.

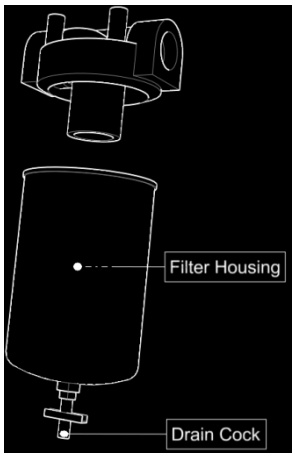


Figure 27 Low Pressure Filter Drainage

3. To replace the filter element, loosen the filter housing by turning it counter-clockwise. This step may require a strap wrench or grip pad. Dispose of the filter element as dictated by local regulations.

4. Install the new filter. The filter gasket is pre-lubricated at the factory, no additional lubrication is required. Tighten the new filter housing by hand until gasket contact is achieved, then turn the housing another 3/4-turn. Be careful to avoid cross threading.

3.9.3 Replacing LP Filter Assembly

1. Depressurize the system (Section 3.4). Before proceeding further make sure the work space is clean to avoid contamination.

2. Use a 1/2-in. wrench to remove the three 5/16-18 fasteners that affix the filter assembly to the mounting bracket. Carefully remove the filter assembly. Notice the orientation at the top of the large flow ports, the new filter assembly will be oriented the same way with the arrow (→) pointing towards the engine.

3. Double check flow direction and reinstall the new filter assembly to the bracket along with the three 5/16-18 fasteners. Torque to 7 ft-lbs.

4. Check the two 1-15/16-in. connectors for damage, debris, and contaminants. Check the condition of the O-rings, replace if necessary. Lubricate the O-rings accordingly and thread the fitting into its port. Be careful to avoid cross threading, torque to 20 ft-lbs.

5. Reinstall all fittings and components previously removed and ensure they are properly tightened.

6. Once the filter has been replaced and all components reinstalled, the system must be repressurized and leak tested.

7. If a leak is detected, depressurize the system and fix the leak. Repeat re-pressurization and conduct another leak test.

3.10 Solenoid Valve

The high pressure solenoid is a two-way valve that operates electrically. By default it is in the "OFF/CLOSED" position.

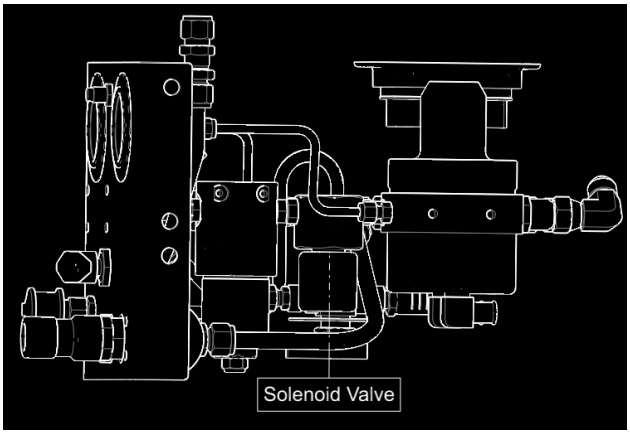


Figure 28 Solenoid Valve

3.10.1 Installation Instructions

The solenoid valve is located inside the Fuel Management Module as seen in Figure 28. 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 then tighten the fittings by hand to avoid cross threading. Once the fitting are properly aligned torque them to 25-30 ft-lbs.

4. Connect the inlet and outlet fuel lines.

5. If the coil assembly is awkwardly oriented, reorient it before proceeding to the next step. This can be accomplished by loosening the coil assembly nut and repositioning the assembly by hand. Once satisfied, re-torque the nut to 43-55 in-lbs.

6. Plug the electrical connector back 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 that no leaks are present.

10. If a leak is detected, see Section 3.2. After the system has been depressurized loosen the leaking connection and visually inspect the fittings and O-rings for damage. If necessary replace the damaged fittings or O-rings and repeat steps 2-11.

11. If no leaks are detected, the vehicle may be returned to active service.

CAUTION: This valve cannot be repaired internally; if the valve ceases to function, replace the valve.

3.10.2 Coil Temperature

CAUTION: 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 should be replaced.

Table 10 Solenoid Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to operate	1. Check the electrical supply with a voltmeter. Voltage must be in accordance with nameplate rating.
	2. Check coils with an ohmmeter for an open or shorted condition.
	3. Make sure the pressure complies with 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.

3.11 Pressure Regulator

3.11.1 Coolant Bowl Installation

1. Depressurize the system.

2. Remove the regulator, solenoid, and high pressure solenoid subassembly, see Section 3.7, “Removal Procedure for Regulator, High Pressure Filter (HP), and Solenoid Subassembly” for details.

3. Remove the old coolant bowl and discard the large O-ring found in the groove of the regulator body. Clean the groove surface in preparation for the new O-ring.

4. Lubricate the new O-ring with the lubricant provided, then install it. Use the remaining lubricant inside the bowl.

5. Orient and install the bowl onto the regulator.

6. Install the small O-ring in the screw pocket of the bowl.

7. Install bowl retention screw with 7/32-in. hex driver. Torque to 60± 6 in-lb.

3.12 Cylinders

CAUTION: Cylinders that have been involved in an incident that registers at level 2 or 3 should be depressurized prior to inspection.

3.12.1 Inspecting Cylinders

The composite containers on the vehicle are manufactured to comply with FMVSS 304, NAI/IAS, or the CSA B51 Part 2 specifications and must be inspected by a certified cylinder inspector every 3 years or 36,000 miles, whichever comes first. The inspector should provide a report for each cylinder and place an inspection label on each of the cylinders. Containers must also have permanent labels in accordance with applicable regulations. These labels provide valuable information to both the inspector and the manufacturer.

Tanks should be inspected immediately if:

1. The vehicle has been in an accident.

2. The fuel container 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 tank has been transferred to another vehicle or the tank installation has been altered significantly.

CAUTION: Failure to perform regular inspections or emergency inspections in the case of suspected damage may put the vehicle and its operator at risk of serious injury or death.

The system owner/operator should be questioned if there are any known incidents or conditions which may have caused damage to the fuel container. The owner/operator should keep records of any unusual observations as well the service history of the container and any repairs that have been carried out since the container was last inspected.

3.12.2 Venting/Defueling Notes

The following information is provided in the absence of formalized procedures from local authorities and governing bodies. Figure 29 shows a typical venting facility.

CAUTION: Atmospheric venting of natural gas to depressurize a cylinder must be done with care. Improper equipment or procedures raise the risk of fire.

Before depressurizing, ground the venting orifice with a minimum 3-gauge wire to an approved electrical ground system

STOP 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.

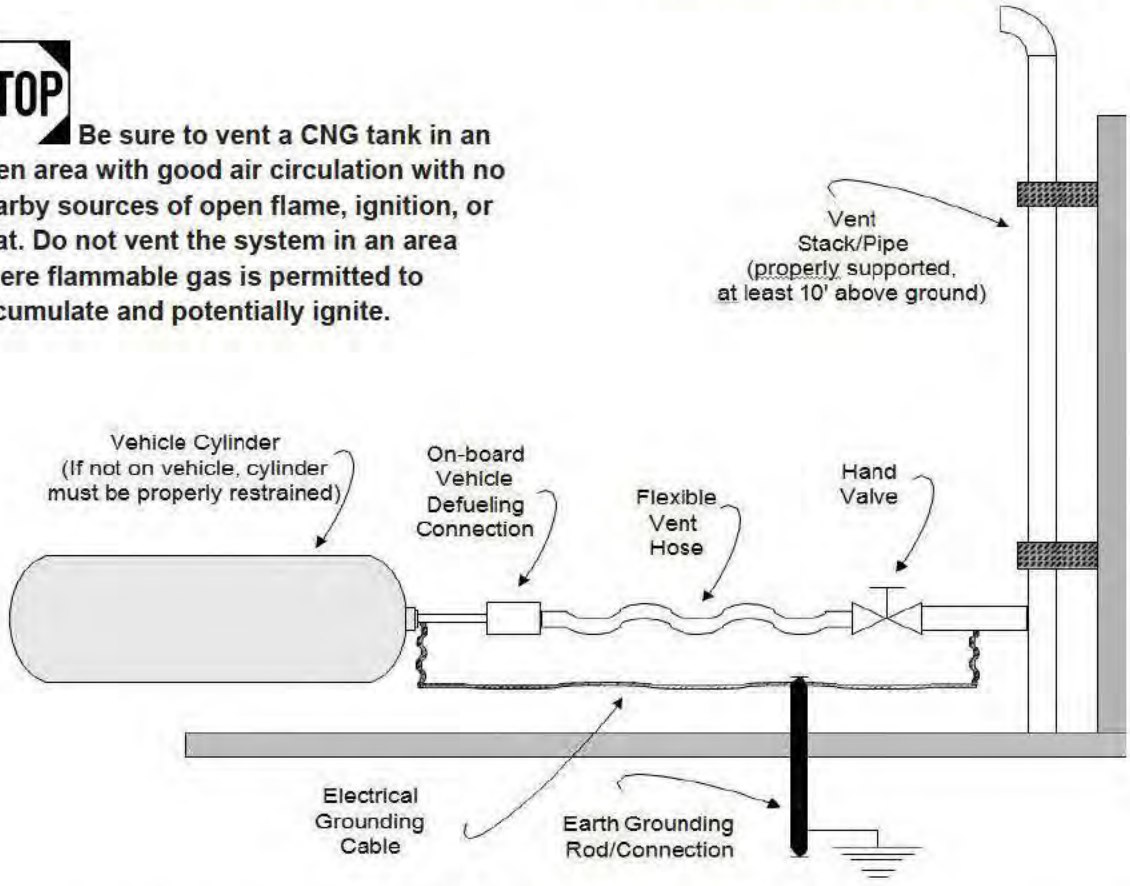


Figure 29. Typical Atmospheric Venting Equipment

A venting facility should include the minimum equipment:

- An on-board defueling connection, installed on the vehicle. Consult the vehicle manufacturer for further information.
- A vent pipe on the premises. 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 in proximity to the pipe.
- An electrical ground connection with a minimum 3 gauge or heavier stranded copper wire attached at one end 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.

 **CAUTION: Freestanding cylinders must be restrained prior to venting procedures. Cylinders will contract and move if gas is released at a rapid rate.**

 **CAUTION: Certain plastic-lined cylinders may be sensitive to rapid defueling, consult the cylinder manufacturer for guidance.**

3.13 Valve Maintenance

Valves do not require regular maintenance. If a malfunction should occur, consult Section 3.2 on Leaks and replace the valve if necessary.

3.14 Pressure Relief Devices (PRDs)

The pressure relief devices used on this system have been designed in accordance with PRD-1, and meet or exceed the requirements for fuel container pressure relief devices onboard Natural Gas Vehicles.

3.14.1 PRD Inspection

Prior to installation visually inspect the PRD for any visible signs of damage or manufacturing defects. PRDs must not have any aesthetic or structural deficiencies. Remove any visible contaminants, debris, and moisture from the inlet port of the PRD.

PRDs do not have consumable parts and require no additional maintenance other than visual inspections. PRDs that do not pass visual inspection must be replaced.

3.14.2 Draining Vent Lines

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

WARNING: Ensure that you loosen or remove the drain vent lines and NOT the fuel lines. Loosening or removing fuel lines can result in serious injury because they contain high pressure gas.

NOTE: The COMPRESSED FUEL line is the tubing that is CLOSEST to the handle on the valve. If uncertain, trace the line in question. If it connects to a 3/4-in. fuel supply line, it is a high pressure fuel line and should not be handled unless the system is depressurized. Vent lines are open on one end with a blue cap.

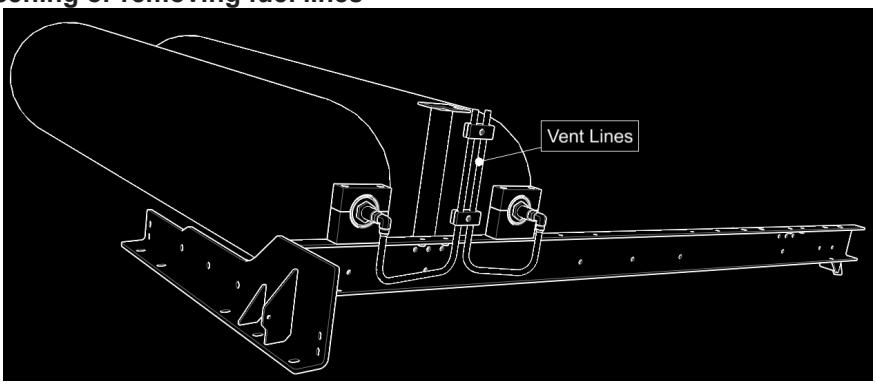


Figure 30 Vent Lines

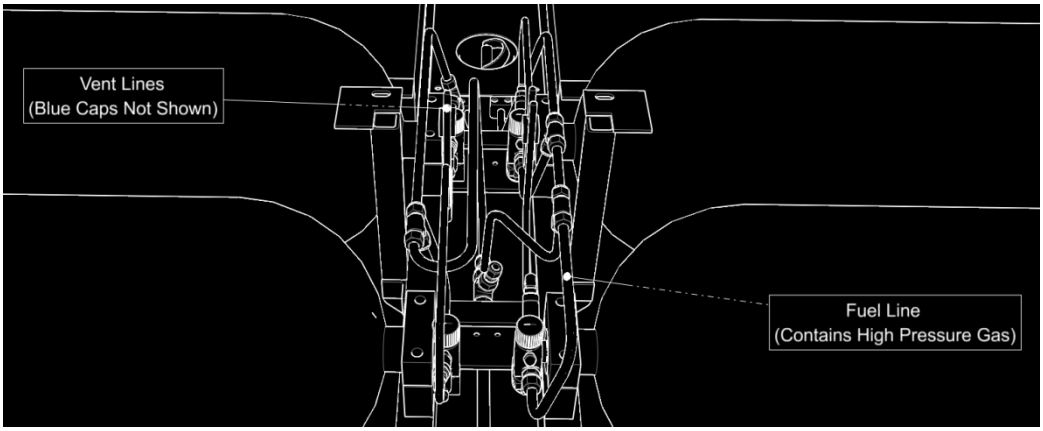


Figure 31 Vent Lines and Fuel Lines

3.15 Fill Receptacles

3.15.1 Fill Receptacle Maintenance

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 accredited personnel should service, maintain, remove, or install a fueling receptacle.

3. A vehicle operator must not tamper, alter, disconnect, or dissemble the receptacle or any component connected to the receptacle.

CAUTION: Only qualified technicians are permitted to perform mechanical procedures to the receptacles.

WARNING: Installations shall be conducted in accordance of the regulations stipulated by the authorities having jurisdiction (AHJ). Only qualified technicians are permitted to install and remove receptacles. The receptacles connect to the Fuel Management Module via straight threads to the female SAE port.

3.15.2 Receptacle Removal and Installation

1. Depressurize the system as described in Section 3.4, “Depressurizing System.”

2. Remove the receptacle. The boss O-ring should be removed and replaced regardless of condition.

Each receptacle assembly comes complete with an O-ring and a dust cap. Do not substitute other manufacturer’s components or hardware.

3. Inspect the receptacle for signs of excess wear or damage.

4. Inspect the adapter shaft and the port to ensure the threads are free of debris and contaminants. Lubricate the O-ring with an approved lubricant or lubricate the adapter shaft with hydraulic oil at the O-ring interface. Install the receptacle.

5. Torque the adapter shaft into the port (30-35 ft-lbs).

6. Visually inspect the interface to ensure the O-ring has not been damaged.

7. Check the seal for leaks with an approved leak testing product. Follow approved leak testing procedures as described in Section 3.2, “Leaks.”

3.15.3 Transit (Fast) Fill Freeze-Up

Transit (fast) fill receptacles are prone to freezing during rapid filling procedures due to “wet” compressed natural gas conditions.

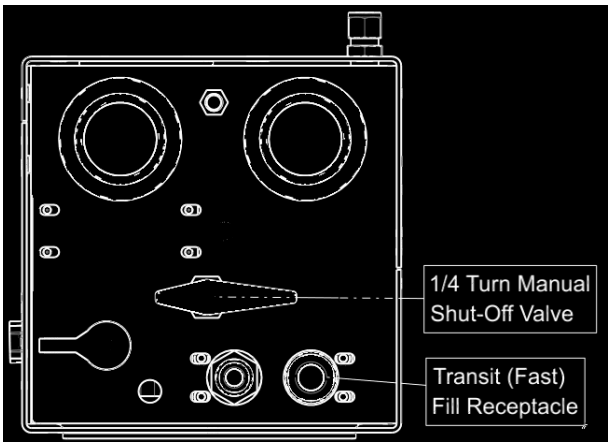


Figure 32 Transit (Fast) Fill Freeze-Up

To remedy the issue, 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 cease to escape from the receptacle.

WARNING: The receptacle is to be used solely on vehicles fueled by compressed natural gas. The receptacle is designed to operate in conjuction with AGA/CGA NGV1 certified fueling nozzles. For information on coupling and uncoupling procedures please consult the CNG fueling dispenser the instructions.

NOTE: Receptacles come with protective caps that prevent contaminants and debris to enter the system and cause internal components to wear prematurely.

3.16 Welding Procedure

For any welding in or near a CNG storage system, consider the following recommendations:

1. Ensure the vehicle is in a well-ventilated area. Do not park the vehicle in an area where natural gas may accumulate.
2. Turn all cylinder shutoff valves to the closed position.
3. Make sure the manual shutoff valve on the FMM is turned to the "ON" position.
4. Turn on the vehicle and run the engine until it stops.
5. Ensure the vehicle is off and proper vehicle lock-out procedures have been followed.
6. Check gauges on FMM to ensure all pressure has been relieved.
7. Remove access cover to fill panel.
8. Slowly relieve excess pressure using the bleed valves.
9. The system is now fully depressurized up to the primary solenoid lock-off valve. There may be residual pressure downstream of the solenoid valve.
10. To remove gas downstream of the primary solenoid lock-off valve, disconnect the electrical connector from fuel panel and use a 12 volt power source to active the solenoid lock-off valve.

CAUTION: With the bleed valve still in the open position any remaining gas trapped between the solenoid and the engine block will flow through the bleed valve. Ensure that the operator is well clear of the direction of gas flow.

11. Slowly undo the fittings between the low pressure fuel hose and low pressure coalescing filter.

CAUTION: This fitting is still under pressure. Place a metal shield between the fitting and operator in case the fitting

becomes a projectile. Use caution and loosen slowly.

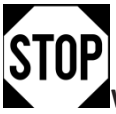
12. Let the vehicle sit for a minimum of 10 minutes in a well-ventilated area. Natural gas is lighter than air, and may become trapped in pockets underneath the chassis.
13. Disconnect the main vehicle battery. Use a 12 volt power supply to open the solenoid and disconnect remaining electrical connectors from the FMM.
14. Isolate tanks using a metal shield or welding blanket. Isolation must ensure no path for sparks to hit the cylinder. If the cylinder is hit by a spark the vehicle must be taken out of service and inspected.
15. Perform the welding procedure.

3.16.1 To Repressurize After Welding

1. Make sure vehicle is turned off and keys removed from the ignition.
2. Ensure bleed valve is closed.
3. Ensure low pressure coalescing filter is reconnected.
4. Perform a leak test as described in Section 3.2.3, “Testing for Leaks.”
5. Reconnect the electrical connectors and main vehicle battery.
6. Re-install the FMM cover.
7. Slowly turn the cylinder shutoff valves to the “ON” position.
8. Start the engine.

4. Defueling Preparation and Procedures

A CNG vehicle may need to be defueled for maintenance or storage at some point. 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.



WARNING: Use a slow flow when transferring fuel to reduce static electricity/electrostatic discharge and to avoid freezing.

Basic Rules for Defueling

- Only CNG certified 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
- 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

4.1 Defueling Requirements

There must be an approved place to put the natural gas fuel removed from the vehicle. 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.

4.1.2 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.

4.1.3 Compressor Transfer

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

4.1.4 Returning to Supply

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

4.2 A Typical Venting Facility

A typical venting facility is described in Section 3.12.2 (Figure 29).

4.3 General Defueling Procedure

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

Figures 33 and 34 show a typical Fuel Management Module and its major components and functions.

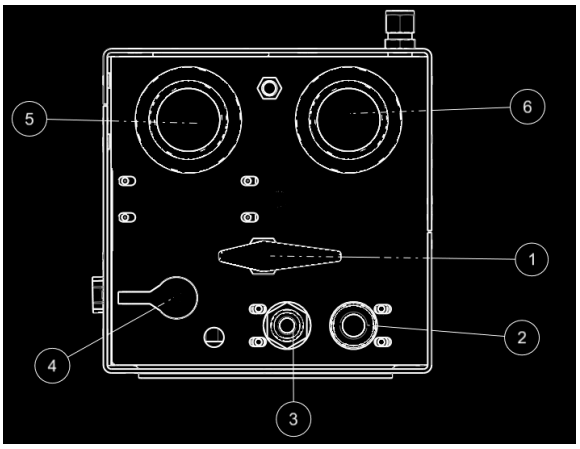


Figure 33 FMM Panel, Front View: (1) Emergency Shutoff Valve; (2) Transit (Fast) Fill Receptacle; (3) NGV1 Fill Receptacle; (4) Defuel Receptacle; (5) High Pressure Gauge; (6) Low Pressure Gauge

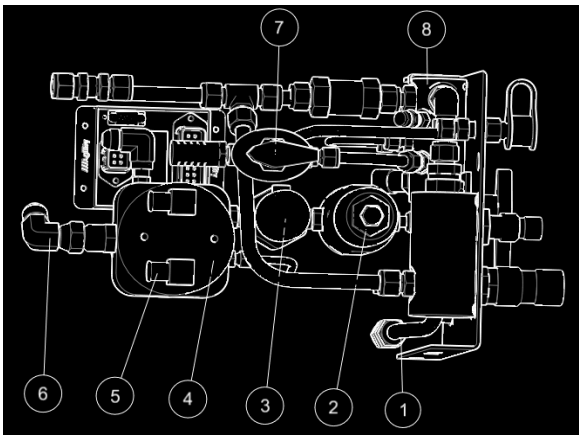


Figure 34 FMM Components, Overhead View: The Defuel Valve is Usually Located Inside the FMM

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.

5. Troubleshooting

The following section covers a variety of potential problems and their respective 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.

For any issues that are not addressed in the Operation Manual or for warranty information please contact Agility Fuel Systems product support at +1-949-267-7745.

Table 11 Troubleshooting Problems

Troubleshooting Problems	
ITEM #	PROBLEM
1	After disconnecting the nozzle fuel continues to flow out of the fill receptacle
2	The main shut-off valve does not isolate the fuel (the vehicle continues to run even when the valves have been turned to the "off" position)
3	There is too much pressure coming out of the regulator (should be 125 PSI)
4	There is not enough pressure coming out of the regulator (should be 125 PSI)

Table 12 Troubleshooting Solutions

Troubleshooting Solutions		
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	1. Follow fill manifold depressurization procedures 2. Carefully remove receptacle from the manifold 3. inspect receptacle for blockage or damage 4. Reinstall or replace receptacle as necessary 5. Test and check for leaks as previously described
	Built-in check valve damaged	1. Follow steps 1-3 as listed above 2. Visual inspect the check valve for damage 3. Reinstall or replace check valve as necessary 4. Test and check for leaks as previously described
2	Seats in the valve are worn or debris is not allowing the valve to fully close	1. Follow depressurization procedures 2. After it is determined that there is no pressure in the system, remove the leaking fill manifold main shut-off valve 3. Replace valve seats as per manufacturer recommendations, or replace the component 4. Leak test as previously described
3	Regulator is not working properly	1. Remove and replace regulator following procedures listed for regulator maintenance
4	High pressure filter is clogged or low pressure filter is clogged	1. Perform maintenance for filter element replacement. Follow filter maintenance procedures

5.1 Troubleshooting Diagrams

Table 13 Low Pressure Fuel Light Troubleshooting

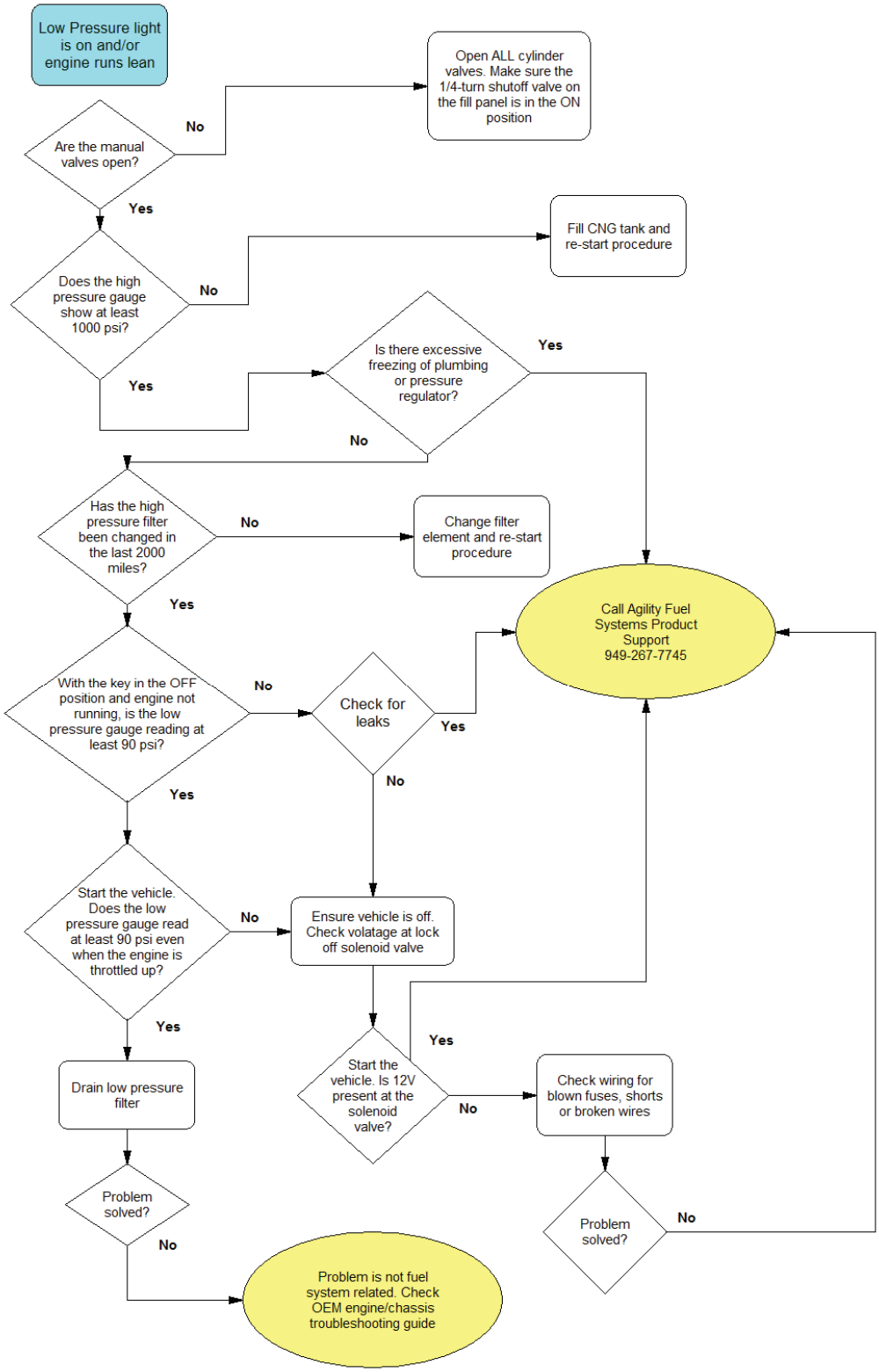
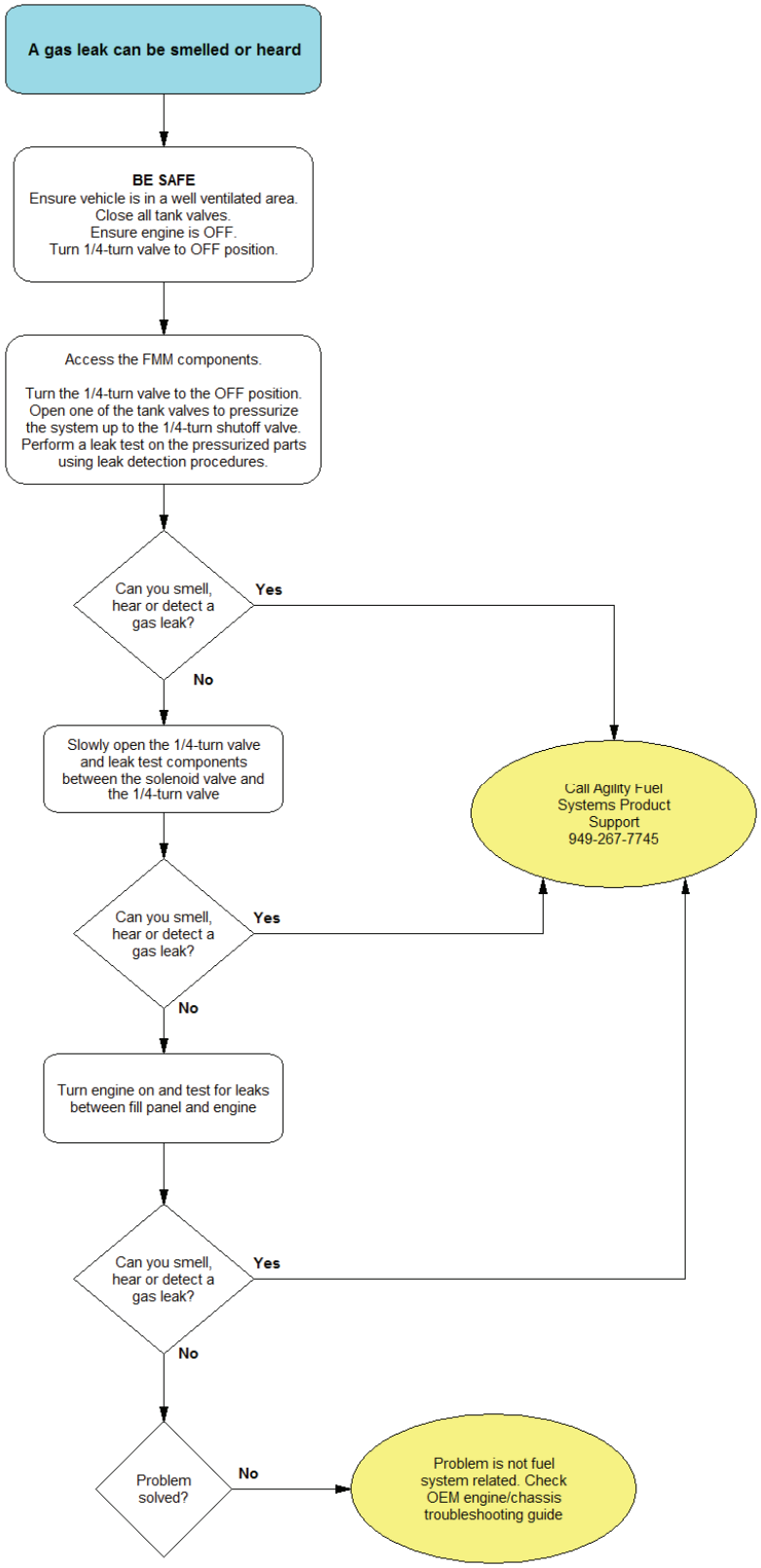


Table 14 Gas Leak Troubleshooting



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Business Class M2 M2 Driver's Manual CNG Section

16

Natural Gas Vehicle

Natural Gas Vehicle

Natural Gas Vehicles, General Information

The vehicle can be equipped with a compressed natural gas (CNG) fuel system, or a liquefied natural gas (LNG) fuel system. CNG is made by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. LNG is created by condensing natural gas into a liquid by cooling it to approximately -259°F (-162°C).

When vaporized at ambient temperatures, natural gas is less dense than air, and it rises and disperses. However, LNG is intially heavier than air due to its cryogenic temperature. When released in large amounts, it may drop or pool on the ground before its temperature rises enough to vaporize. Cold atmospheric conditions may prevent natural gas from dispersing quickly when released in large amounts.

Natural gas is nontoxic, but it can cause asphyxiation if present in very large concentrations.

CNG often contains an odor-producing chemical, while LNG does not have any odor. Users of natural-gas-fueled vehicles should never expect to detect natural gas leaks by scent.

For natural gas to burn, it must first vaporize, then mix with air in the proper proportions (flammable range is 5 to 15% by volume in air), and then be ignited.

A typical natural gas fuel system consists of:

- Fuel supply cylinders that store compressed gas at high pressure (CNG), or a tank that stores liquefied gas at an extremely low temperature (LNG).
- A vaporizor or heat exchanging device that changes LNG to gaseous form (LNG fuel systems only).
- Pressure relief and manual fuel shutoff valves.
- A filling connection with a check valve that prevents the gas from flowing back out of the fuel filling line.
- High-pressure and low-pressure fuel filters.
- A pressure control regulator that reduces the high fuel tank or cylinder pressure to the lower pressure needed for the engine.
- A fuel contents gauge that indicates the fuel supply in the tank or cylinders.

Natural Gas Vehicles, Safety Precautions

⚠ DANGER

Natural gas is highly flammable. Failure to observe the following safety precautions could lead to the ignition of the natural gas, which could cause serious bodily injury or death.

Follow these safety precautions when operating or repairing a natural gas vehicle.

- Do not start the engine if a natural gas leak is detected.
- Do not transfer CNG from one vehicle to another, as a buildup of static electricity could cause a spark and ignite the fuel.
- Do not attempt to cut any fuel supply piping components.
- Avoid open flames or sparks near a natural gas vehicle.
- Cover eyes and exposed skin when working on a natural gas fuel system or fueling a natural gas vehicle.
- Permit no smoking or other ignition sources within thirty feet of a natural gas vehicle.
- Have CO_2 fire extinguishers (ABC minimum) located in a highly visible and easily accessible location.
- Use Purple-K powder (PKP) or a similar dry powder to extinguish an LNG fire. Do not attempt use water around an LNG fire.
- Always purge the fuel lines before performing maintenance or repairs on a natural gas fuel system. To purge the lines, close the manual fuel shutoff valve, and start the engine. Let the vehicle idle until the fuel lines are empty and the engine stops.
- Always use a natural gas detector to test the system for leaks, whether an odor is present or not. Routinely inspect the fuel filtering and regulating mechanisms, and the fuel lines. A

bubble solution can be used to pinpoint the exact location of leaks.

- Always tighten fasteners and fuel connections to the required torque specification. Overtightening or undertightening could cause leaks.
- Close the fuel shutoff valve(s) before performing maintenance and repairs.
- Do not store a natural gas vehicle indoors for any extended period of time. Do not bring a natural gas vehicle indoors unless the workshop is equipped with a methane detection and ventilation system.

In Case of Emergency

If a vehicle has sustained damage or a leak has been discovered:

1. Turn the ignition switch off, set the parking brake, and disconnect the battery.
2. Remove all ignition sources from the area surrounding the vehicle.
3. If it is safe to do so, close all fuel shutoff valves.
4. Open the vehicle doors to introduce fresh air.
5. Use a natural gas detector to identify leaks in the fuel system.

Natural Gas Fuel Tank Filling Procedures

CNG Vehicle Fueling

CNG is moved from the fuel station storage tanks to the vehicle cylinders through a metered dispenser. During fueling, as pressure inside of the vehicle cylinders increases, so does the temperature. The dispenser shuts off when it determines the CNG cylinders are full.

CNG fuel cylinders cannot be filled to their full capacity of 3600 psi (24 800 kPa) in cooler weather. Since temperature change causes gas to expand and contract, less pressure in the cylinders on a cold day is equal to the same amount of gas at a higher pressure on a warm day. The fuel station dispenser has a temperature-pressure compensating device, which accounts for ambient temperature during fueling. See **Table 16.1** for approximate full cylinder pressures at various temperatures.

CNG Temperature/Pressure Compensation Values		
Temperature: °F (°C)	Fill Station Pressure Set Point	
	3000 psi (20 684 kPa) Set Point	3600 psi (24 821 kPa) Set Point
100 (37.8)	3415 (23 546)	4086 (28 172)
90 (32.2)	3276 (22 587)	3909 (26 952)
80 (26.7)	3138 (21 636)	3754 (25 883)
70 (21.1)	3000 (20 684)	3600 (24 821)
60 (15.6)	2861 (19 726)	3445 (23 752)
50 (10)	2723 (18 774)	3288 (22 670)
40 (4.4)	2584 (17 816)	3131 (21 587)
30 (-1.1)	2446 (16 865)	2973 (20 498)
20 (-6.7)	2307 (15 906)	2814 (19 402)
10 (-12.2)	2169 (14 955)	2655 (18 306)
0 (-17.8)	2031 (14 003)	2495 (17 202)
-10 (-23.3)	1893 (13 052)	2336 (16 106)
-20 (-28.9)	1755 (12 100)	2180 (15 031)
-30 (34.4)	1616 (11 142)	2024 (13 955)
-40 (-40)	1477 (10 184)	1868 (12 879)

Table 16.1, CNG Temperature/Pressure Compensation Values

Use the following steps to fuel a CNG vehicle.

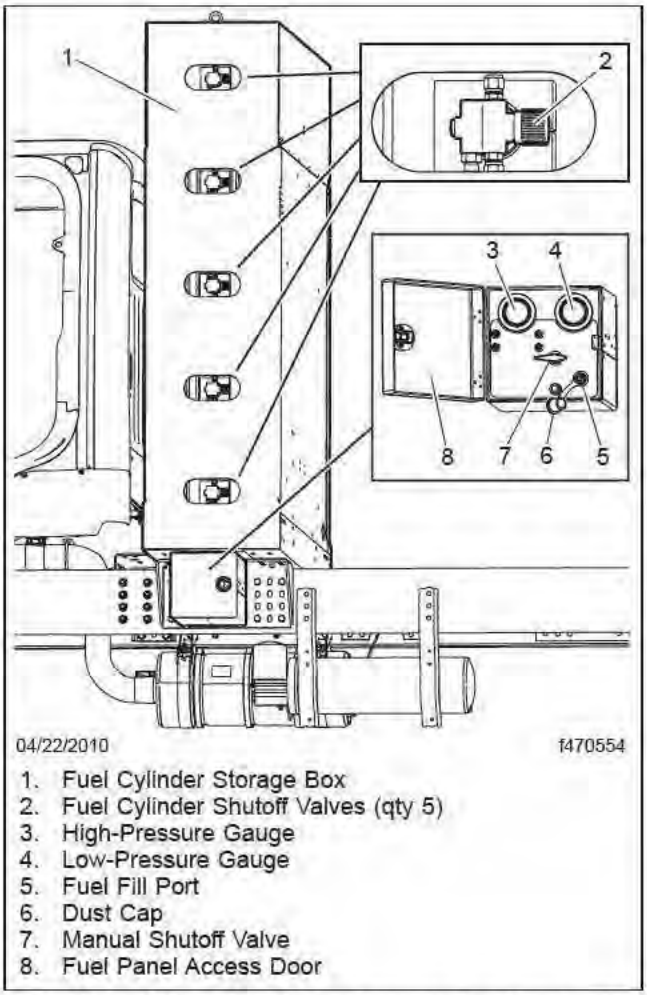
1. Shut down the engine and apply the parking brake.

IMPORTANT: Close all windows and doors during the fueling process. Keeping windows and doors closed allows for easier leak detection inside the cab after fueling.

⚠ WARNING

Natural gas fuel tanks, lines, and valves are always pressurized. Always observe safety precautions. Failure to do so could lead to loss of control over a filling hose or to ignition of the natural gas, which could cause serious bodily injury, death, or severe property damage.

2. Ensure all fuel cylinder shutoff valves are open. See **Fig. 16.1**.
3. Ensure the vehicle fuel system main shutoff valve is open.
4. Open the CNG fuel panel access door and remove the dust cap from the vehicle fuel fill port.



1. Fuel Cylinder Storage Box
2. Fuel Cylinder Shutoff Valves (qty 5)
3. High-Pressure Gauge
4. Low-Pressure Gauge
5. Fuel Fill Port
6. Dust Cap
7. Manual Shutoff Valve
8. Fuel Panel Access Door

Fig. 16.1, CNG Fuel Cylinder Storage Box (5-cylinder system shown)

5. Ensure the O-ring is present inside the fuel fill port. If the O-ring has been dislodged or is missing, the station dispensing nozzle will not connect securely to the fill port.
6. Turn the selector knob on the service pump to the VENT position, if equipped.
7. Connect the quick coupling on the dispensing nozzle securely to the vehicle fuel fill port.
8. Turn the selector knob on the service pump to the FILL position, if equipped.

IMPORTANT: If at any time the service pump or vehicle begins to vent CNG uncontrollably, notify a station attendant or activate the service station emergency shut-off switch to cease the flow of CNG.

9. Switch on the service pump. A slight hissing noise may be heard as the fuel cylinders fill.
10. Watch the pressure gauge on the service pump. When the gauge reads approximately 3600 psi (24 800 kPa), or when the fill pressure stops climbing, the CNG cylinders are full. The service pump will shut itself down automatically. See **Table 16.1** for pressure compensation values based on ambient temperatures.
11. Move the selector knob on the service pump to the VENT position, if equipped. A short hiss will be heard as a small amount of natural gas is vented into the hose.

⚠ WARNING

Do not attempt to remove the fill station nozzle from the tank fill fitting until venting of pressure is noted. If no venting occurs, ask for assistance from the station attendant. Removing an unvented coupling could result in an uncontrolled hose, which could lead to property damage or personal injury.

12. Remove the station dispensing nozzle from the vehicle fill port.
13. Install the dust cap on the vehicle fuel fill port and close the fuel panel access door.

LNG Vehicle Fueling

The LNG fuel tank is designed to be filled from any LNG fuel source that has a 100 micron or finer fuel filter and a fuel delivery pressure between 120 and 225 psi (827 and 1551 kPa).

The LNG fuel tank is designed to be top-filled through a single hose with no vent return. As cold LNG is sprayed into the vapor space of the tank, the cold liquid condenses the vapor and creates space for itself inside the tank, eliminating any need to vent during the filling process.

The LNG tank is equipped with a small internal ullage tank for vapor space, which allows for fuel expansion and increases vehicle standby time. When an LNG tank is full, fuel can continue to flow into the ullage tank. However, if the ullage tank is completely filled during fueling, standby time will be reduced to

zero and the primary relief valve will open almost immediately after fueling, allowing excess LNG vapor to escape. If fueling is stopped when the ullage tank is empty (i.e., the fuel tank has sufficient vapor space to accommodate fuel expansion due to temperature increase), the vehicle will have approximately one week of standby time before venting will occur.

Use the following steps to fuel an LNG vehicle.

1. Shut down the engine and apply the parking brake.

IMPORTANT: Close all windows and doors during the fueling process. Keeping windows and doors closed allows for easier leak detection inside the cab after fueling.

⚠ WARNING

Liquefied natural gas is a cryogenic liquid stored at approximately -259°F (-162°C). Cryogenic burns can be caused by coming into contact with the pressurized liquid stream, or by coming into contact with fuel system components that have been cooled to cryogenic temperatures. Always wear gloves and a face shield, and cover exposed skin when fueling.

2. Remove the fuel fill fitting dust cap. See Fig. 16.2.

3. Using compressed air, remove any dirt, debris, or water that may have collected in the fuel fill fitting and the station dispensing nozzle. Contaminants in the fuel system can cause drivability problems.

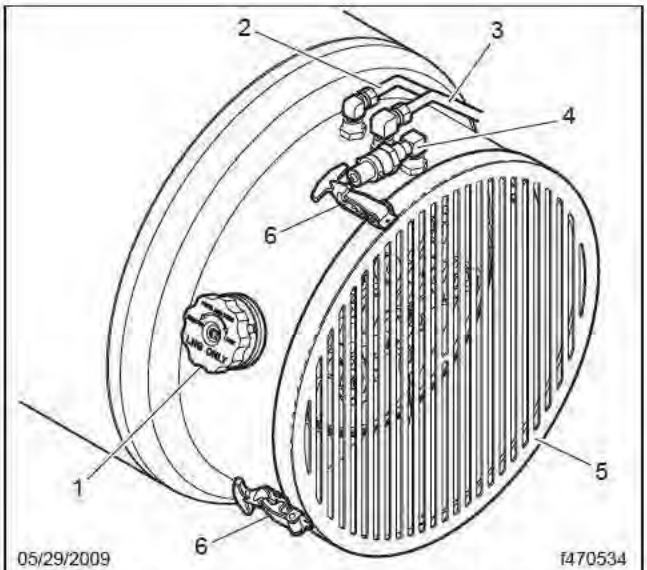
⚠ WARNING

Natural gas fuel tanks, lines, and valves are always pressurized. Always observe safety precautions. Failure to do so could lead to loss of control over a filling hose or to ignition of the natural gas, which could cause serious bodily injury, death, or severe property damage.

4. Connect the station fueling nozzle to the tank fuel fill fitting.

5. Connect an electrical ground clamp and cable to the fuel tank.

IMPORTANT: An LNG tank which is first installed, or is on a vehicle that has not been operated in approximately ten days, is considered to be a hot tank. When fueling a hot tank, LNG entering the tank will immediately vaporize, causing tank pressure to spike above 250 psi (1724 kPa) and automatically shutting down the station fuel pump. To prevent the pump from shutting down, connect a vent line to the fill vent fitting on the LNG tank to capture escaping vapor, then open the shroud cover and open the vapor shutoff valve (Fig. 16.3, Item 2).

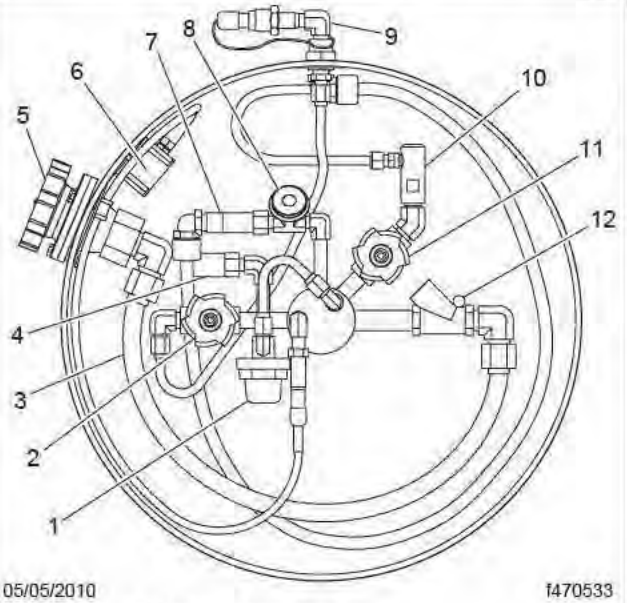


1. Fuel Fill Fitting
2. Fuel Outlet Line
3. Primary Relief Vent Line
4. Fill Vent Fitting
5. Shroud Cover
6. Shroud Cover Latches

Fig. 16.2, LNG Fuel Tank

6. Open the station's fill valve, if equipped, and start fueling. Monitor the flow or line pressure as filling progresses. When filling begins, line pressure will spike quickly until the vehicle tank cools down. The flow and pressure will then remain stable during the remainder of the filling procedure.

IMPORTANT: When fueling a hot tank, initially put 5 to 10 gallons (19 to 37 liters) of LNG in the tank and manually stop the fueling process. Drive the vehicle for 15 to 20 minutes to cool the tank and reduce tank pressure, then continue fueling the tank to full.



1. Pressure Control Regulator
2. Vapor Shutoff Valve
3. Fuel Fill Hose
4. Secondary Relief Valve (red cap)
5. Fuel Fill Fitting
6. Fuel Level Sender Box
7. Primary Relief Valve
8. Tank Pressure Gauge
9. Fill Vent Fitting
10. Excess Flow Valve
11. Fuel Shutoff Valve (liquid)
12. Fill Check Valve

Fig. 16.3, LNG Fuel Tank Plumbing Components

7. When the tank is full, the line pressure will rapidly spike and the flow rate will fall. When a pressure rise or flow rate drop is observed, close the station's fill valve, if equipped.

NOTE: Do not over-fill an LNG tank. If the ullage tank is completely filled during fueling, tank standby time will be reduced to zero and the primary relief valve will open almost immediately after fueling.

8. Disconnect the station hose from the tank fuel fill fitting.
9. Disconnect the electrical ground clamp and cable from the fuel tank.
10. Install the dust cap on the tank fuel fill fitting.

Natural Gas Detection System

A gas detection system is used in all Daimler Trucks natural-gas-fueled vehicles. This system has a sensor in the engine compartment and one in the cab, both situated in high areas to detect natural gas buildup as a result of leaks.

The AMGaDS III Plus is a natural gas detection system. This device is meant to serve as a supplemental warning only. It is not intended to replace standard safety practices that should be conducted around flammable gases.

IMPORTANT: To function properly, the gas detection system must be powered at all times. The gas detection system is directly powered by the batteries, and can only be powered off by disconnecting the batteries.When servicing a natural-gas-fueled vehicle, disconnect the batteries only when necessary, and do not leave the batteries disconnected for extended periods of time.

The lower flammability limit (LFL) is the smallest amount of the gas that supports a flame when mixed with oxygen and ignited. Zero percent (0%) LFL indicates a gas-free atmosphere. One hundred percent (100%) LFL indicates that gas concentration has reached its lower flammability limit (5% gas in air by volume). The red warning light and audible alarm located in the overhead console activate when a sensor detects gas fumes in concentrations above 50% LFL, and should allow ample time to utilize safety procedures. However, individuals with special needs should review the system with a professional safety engineer.

Alarm Procedure

Before operating the vehicle, the driver must be familiar with the procedures as shown on the interior sticker on the overhead panel (**Fig. 16.4**) and the exterior sticker on the door (**Fig. 16.5**).

IMPORTANT: If an audible alarm activates, do not operate any electrical switch, including lights. Avoid causing sparks and stay away from arcing switches and equipment. Do not use a telephone, including cellular phones or any types of portable communication or electronic devices that have a battery.

Fig. 16.4, Interior Warning Sticker

Fig. 16.5, Exterior Warning Sticker

If the vehicle is in motion when the audible alarm activates, bring it to a safe stop, shut down the engine, and exit the vehicle. *Do not open the hood.*

If outside the vehicle when the audible alarm activates, *do not open the cab door or hood.*

In the event of an audible alarm, immediately follow these procedures, as allowed by conditions:

1. Immediately shut off all engines. Extinguish any cigarettes, pilot lights, flames, or other sources of ignition in the area and adjacent areas.
2. Manually close all fuel shutoff valves, including those on the LNG tank or CNG cylinders.
3. If the vehicle is indoors (as in a service shop), immediately open windows and doors to provide extra ventilation to the area. Do not start the engine or any other type of equipment until the gas leak is corrected and the area cleared of natural gas.
4. Evacuate the area.
5. Check the fuel lines, LNG tank/CNG cylinders, and fittings to locate the leak. After the area is cleared of natural gas and the alarm is no longer active, have the vehicle inspected by a qualified technician.

IMPORTANT: Do not consider the area clear until all alarm indicators are off, and the alarm panel light returns to green.

Sensors

Gas detection sensors are located on the cab overhead console and in the engine compartment on the frontwall. The sensors are located in high areas, where rising gas vapors will pass by or accumulate.

If the system detects that one of the sensors has been disconnected or has malfunctioned, the sensor fault light for that zone will illuminate. A failed sensor may trigger and lock on an alarm. If a fault condition or locked alarm continues after the sensor's connection and wiring integrity has been verified, replace the sensor.

The sensors are sensitive to all hydrocarbon vapors. An alarm may be triggered by the use of chemicals such as cleaners, paint, polish, lacquer, gasoline, silicone, silicone spray, or other harsh chemicals. The sensors will also detect hydrogen fumes from an overcharged battery. If a sensor sends an alarm, but no gas fumes are present, check for recent use of chemicals or a battery charger.

NOTICE

Silicone-based chemicals and cleaners will permanently disable the sensors. When cleaning the vehicle, cover the sensors with a plastic covering. Keep the sensors covered until the area has been cleared of any cleaning fumes.

Harsh chemicals and extremely high temperatures may damage the sensor.

Puncture of or damage to the seal located inside the sensor housing will significantly shorten the sensor life.

Frequent exposure to high concentrations of gas will accelerate sensor deterioration.

Overhead Console

The overhead console consists of an alarm panel on the right side and the control module on the left side.

The alarm panel has a green light, a red light, a buzzer, and a sensor. See **Fig. 16.6**. It is located within view from outside of the vehicle. The large green light is continuously illuminated during normal operating conditions.

Before entering the vehicle, always verify that the green light is illuminated. If the green light is not illuminated, do not enter the vehicle. Complete the alarm procedure previously outlined.

The alarm panel meets the California Highway Patrol Title 13-2008 and NFPA 52 2010 requirements. All drivers and technicians using it should be trained regarding the red and green lights, and the audible warning.

The control module, located on the left side of the overhead console, contains the status lights and control buttons for the system. The areas that the sensors monitor are defined as Zone 1 (cab) and Zone 2 (engine compartment). The control module has lights assigned to each zone that will illuminate if a sensor detects a trace level leak (between 20% and 30% LFL), a significant level leak (above 50% LFL), or if a sensor is disconnected or malfunctioning.

- Trace Level: If either sensor detects gas fumes at a concentration greater than 20% to 30% LFL (1% gas in air by volume), the amber light next to the *Trace* indicator for that zone will flash. There is no buzzer alarm for a trace level detection, and the large green light on the alarm panel will remain illuminated.
- Significant Level: If either sensor detects gas fumes at a concentration greater than 50% to 60% LFL (2.5% gas in air by volume), the small red light next to the *SIGNIFICANT* indicator for that zone will flash. After approximately 15 seconds, the large green light on the alarm panel will switch off, the red light will illuminate, and the buzzer will sound. All alarm indicators will remain on as long as fumes are detected.
- Sensor Fault: If the system detects that either of the sensors has been disconnected or has malfunctioned, an amber light next to the *Sensor Fault* indicator for that zone will illuminate.

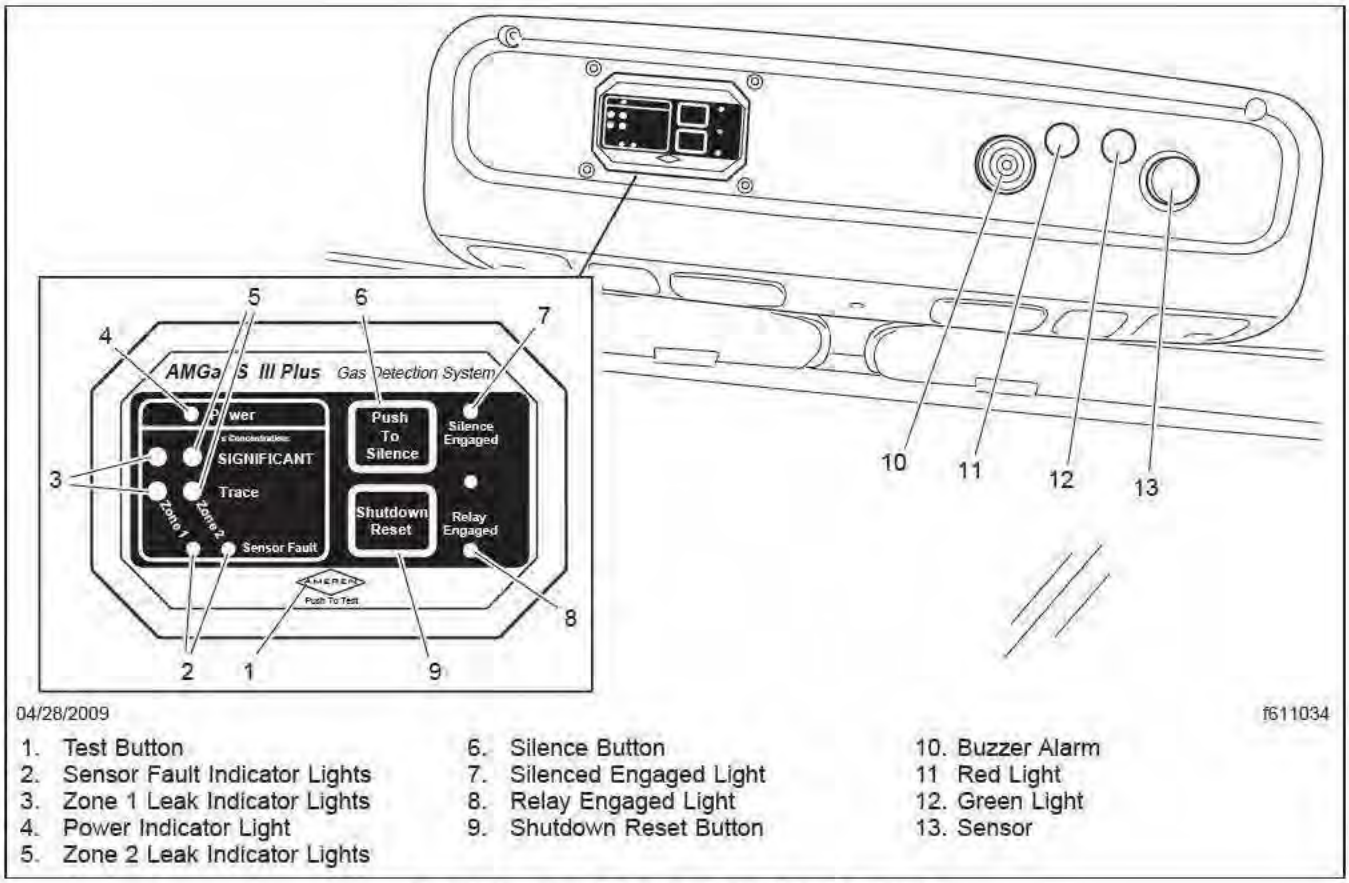
The control module also has buttons used to test or reset the the control module after an alarm. Red lights next to each button indicate when they are engaged.

- Shutdown Reset: If an alarm has been activated and the *Relay Engaged* light is illuminated, the *Shutdown Reset* button will reset the internal relay. Press the *Shutdown Reset* button only after the gas has cleared, the buzzer has turned off, and the alarm panel light has returned to green.
- Push To Silence: If an alarm has been activated, the *Push To Silence* button will silence the buzzer.

See **Table 16.2** for the functions of all lights and buttons on the overhead console.

Testing

Daimler Trucks North America strongly recommends that all operators follow California Code of Regulations (CCR) inspection requirements, regardless of where the vehicle is operated. Per Title 13 CCR § 935 (2), gas detection systems should be tested three times per calendar year at equal intervals. The testing procedure should simulate the same operating environment in which the vehicle is used, with the same gaseous fuel.



1. Test Button
2. Sensor Fault Indicator Lights
3. Zone 1 Leak Indicator Lights
4. Power Indicator Light
5. Zone 2 Leak Indicator Lights
6. Silence Button
7. Silenced Engaged Light
8. Relay Engaged Light
9. Shutdown Reset Button
10. Buzzer Alarm
11. Red Light
12. Green Light
13. Sensor

Fig. 16.6, AMGaDS III Plus Overhead Console

Control Module Functions			
Item	**Display**	**Function**	**Action Required**
Green Power Light	Illuminated	System is on.	None required.
	Unlit	Detection system is not functioning.	Ensure the batteries are connected and replace any blown fuses. If the gas detection system is still not functioning, replace the system immediately.
SIGNIFICANT Gas Concentration Lights	Red (illuminated)	Dangerous gas concentration detected.	Suspend vehicle operation immediately and follow alarm procedures.
Trace Gas Concentration Lights	Amber (flashing)	Minor gas concentration detected.	Use caution and monitor the system.
Sensor Fault Lights	Off	Sensor is functioning properly.	None required.
	On	Sensor has malfunctioned.	Replace the sensor immediately.

Control Module Functions			
Item	**Display**	**Function**	**Action Required**
Shutdown Reset Button	—	Resets the system after an alarm activation.	Press to reset the system only after the gas has cleared, the buzzer has turned off, and the alarm panel light has returned to green.
Relay Engaged Light	On	Relay is engaged and test or alarm is being cleared.	Press the *Shutdown Reset* button.
	Off	Normal condition.	None required.
Test Button	—	Tests the overhead console operation and circuitry.	Press and hold for one minute to to activate a test of all overhead console components.
Silence Button	—	Silences the alarm buzzer.	Press to silence the alarm buzzer.
Silence Engaged Light	On	Indicates the buzzer is active but silenced.	Suspend vehicle operation immediately and follow alarm procedures.
	Off	Normal condition.	None required.

Table 16.2, Control Module Functions

Test results validating the performance of the gas detection system within the parameters established by the component manufacturer and NFPA 52 2010 should be maintained as a permanent part of the vehicle service records. Use of alcohol, propane, and other harsh liquids or gases are not acceptable methods for testing.

Always test the system and sensors after any component has been replaced, or if the vehicle has been involved in an accident or fire. Ensure that the gas detection system is wired directly to the battery.

It is recommended that the highest level of safety validation be utilized if there are multiple validation requirements in the state or locality where the vehicle is operated or domiciled.

Overhead Console Test

Press and hold the *Push To Test* button for one minute. The system will proceed with a self-diagnostic test that will include illumination of the *Trace* and *SIGNIFICANT* gas concentration lights, and the sensor fault lights. Verify the large red light and buzzer activate, and that all lights illuminate or flash to ensure that all bulbs are operational.

Sensor Test

The gas detection system sensors must be tested using certified test gas, which can be purchased as part of a test kit. Testing with alcohol or heavy gases such as butane or propane does not satisfy CCR § 935 (2) or NFPA 52 regulations.

Expose each sensor to certified test gas for at least thirty seconds. The system will proceed through the alarm procedure consistent with a significant leak and the buzzer will sound after approximately fifteen seconds. If a sensor fails to respond after exposure to the test gas, replace the sensor.

Natural Gas Engine Starting

NOTE: Before starting the engine, read **Chapter 3** for detailed information on how to read the instruments and **Chapter 4** for detailed information on how to operate the controls. Read the operating instructions in the engine manufacturer's operation manual before starting the engine.

1. Before engine start-up, complete the engine pre-trip and post-trip inspections and maintenance procedures in **Chapter 11**.
2. Ensure the fuel shutoff valve is open.
3. Set the parking brake.
4. Ensure that the transmission shift control is in Neutral (N), Park (P), or the Park Brake (PB) position.

5. Without starting the engine, turn the ignition switch to the ON position (Fig. 16.7). The electronic gauges on the instrumentation control unit (ICU) will complete a full sweep of their dials, the warning and indicator lights will illuminate, and the buzzer will sound for three seconds.

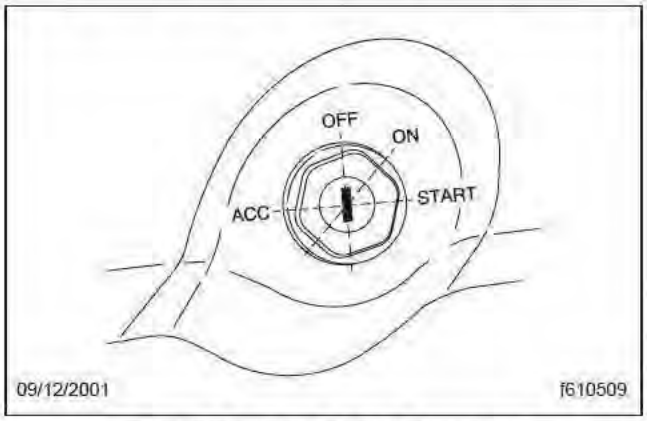


Fig. 16.7, Ignition Switch Positions

6. Turn the ignition switch to the START position.

   Press down on the clutch pedal, if equipped, but do not press down on the accelerator pedal.

   Release the key the moment the engine starts.

7. Bring the engine up to operating speed gradually as it warms up and develops stable oil pressure. If the vehicle has not been operated previously in a 24-hour period, allow the vehicle to idle for five minutes.

NOTICE

Do not rev the engine if the oil pressure gauge indicates no oil pressure. Shut down the engine within approximately ten seconds to avoid engine damage.

8. Check the oil pressure gauge for any drop in lubricating oil pressure or mechanical malfunction in the lubricating oil system.

Major Repair and Replacement of Natural Gas Components

If a natural-gas-fueled vehicle is involved in an accident, remove the fuel tank or cylinders from service and have them inspected by a qualified technician.

Replace any leaking or damaged fuel tanks/cylinders and fuel lines; repair or replace leaking or damaged fittings. Install parts and components in accordance with the manufacturer's instructions.

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Business Class M2 Workshop Manual CNG Section

General Description

IMPORTANT: The compressed natural gas (CNG) fuel system should be routinely inspected for gas leakage. Use a natural gas detector to check fuel cylinders, fuel filtering and regulating mechanisms, and fuel lines. Replace leaking fuel cylinders; repair or replace any lines, devices, or connections that are leaking.

CNG is made by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. When vaporized at ambient temperatures, natural gas is less dense than air, and it will rise and disperse. Cold atmospheric conditions may prevent natural gas from disbursing quickly when released in large amounts.

Natural gas is nontoxic, but can cause asphyxiation at high enough concentrations simply by excluding adequate oxygen to sustain life.

Commercial CNG normally contains an odor-producing chemical. However, a natural gas detector is recommended for leak checking.

For natural gas to burn, it must first vaporize, then mix with air in the proper proportions (flammable range is 5 to 15% by volume in air), and then be ignited.

The CNG fuel system consists of:

- Fuel cylinders that store CNG at high pressure
- Pressure relief and manual fuel shutoff valves
- A filling connection with a check valve that prevents the gas from flowing back out of the fuel filling line
- A high-pressure fuel filter
- A pressure control regulator that reduces the high fuel cylinder pressure to the lower pressure needed for the engine
- A gas-air mixer to produce a flammable mixture for the engine
- A dash-mounted fuel contents gauge that indicates the available fuel supply in the cylinders

Related Information and Websites

Detailed CNG fuel system repair, replacement, and troubleshooting information can be obtained from the fuel system manufacturer.

Agility Fuel Systems
1815 E Carnegie Avenue
Santa Ana, CA 92705
949-267-7738

www.agilityfuelsystems.com

Agility Customer Support, 949-267-7745.

Information about Cummins CNG engines can be accessed at: Cummins Westport **http://www.cumminswestport.com**

The following documents and websites provide additional information about CNG and CNG fuel systems:

- NFPA 52 ***Vehicular Gaseous Fuel Systems Code, 2010***: **www.nfpa.org**
- Society of Automotive Engineers ***Recommended Practice for Compressed Natural Gas Vehicle Fuel***: **standards.sae.org/j1616_199402/**
- Compressed Gas Association: **www.cganet-.com**

Safety Precautions

⚠ WARNING

Compressed natural gas is highly flammable. Failure to observe the following precautions could lead to the ignition of the natural gas, which could cause severe property damage, bodily harm, or death.

Whenever gas is smelled, immediately shut off all engines and ignition sources. Avoid causing sparks, and stay away from arcing switches and equipment. Extinguish cigarettes, pilot lights, flames, and other sources of ignition in the area and adjacent areas. Immediately provide extra ventilation to the area. Do not start any equipment until the gas leak is corrected and the area cleared of natural gas.

Periodic inspections of the compressed natural gas (CNG) fuel cylinders are required by law to ensure continued safety. Each fuel cylinder should be visually inspected at specified intervals for external damage and deterioration. See the *Business Class M2 Maintenance Manual* for inspection schedule information.

If a cylinder receives an impact or has deep scratches or gouges, it should be inspected before refilling. The inspection should be performed by a qualified person, in accordance with the manufacturer's established inspection criteria and Compressed Gas Association procedures.

Always use a natural gas detector to check for leaks.

Servicing Precautions

Observe the following safety precautions when servicing CNG-powered vehicles:

- Always purge the fuel lines before performing maintenance or repairs on a CNG fuel system. Do not transfer CNG from one vehicle to another, as a buildup of static electricity could cause a spark and ignite the fuel.
- Only vent CNG outdoors in a safe location.
- Close the fuel cylinder shutoff valves before performing maintenance and repairs. Open the valves only if CNG is needed to operate the engine or to check for leaks.
- Repair work on a CNG fuel system should be performed only by qualified technicians trained in automotive CNG system repair.
- Always tighten fasteners and fuel connections to the required torque specification. Overtightening or undertightening could cause leaks.
- Cover eyes and exposed skin when working on a CNG fuel system or fueling a CNG vehicle.

Workshop Precautions

Do not store a CNG vehicle indoors for any extended period of time.

Observe the following safety precautions when CNG vehicles are inside a workshop:

- Use only safety fluorescent extension shop lights.
- Ensure the shop ceiling is equipped with a vent system that will allow gas to escape and dissipate.
- Ensure the shop is equipped with an alarm system that activates when gas concentration in the air becomes dangerous.
- Have CO_2 fire extinguishers (ABC minimum) located in a highly visible and easily accessible location.
- Permit no smoking or other ignition sources within thirty feet of a CNG vehicle.
- Avoid open flames or sparks near a CNG vehicle.
- Close the fuel cylinder shutoff valves when storing the vehicle inside. Open the valves only if CNG is needed to operate the engine or to check for leaks.

Major Repair and Replacement of Parts

Replace any leaking or damaged fuel cylinders and fuel lines; repair or replace leaking or damaged fittings. Install parts and components in accordance with the manufacturer's instructions.

Any and all replacement parts (valves, fittings, hoses, etc.) of the CNG fuel system must be designed specifically for CNG automotive use, and must be offi-

cially approved and rated for the pressures and conditions that pertain.

Gas Detection System

A gas detection system is used in all Daimler Trucks CNG-fueled vehicles. The system has a sensor in the engine compartment and one in the cab, both situated in high areas to detect natural gas buildup as a result of leaks. The system is meant to serve as a supplemental warning only. It is not intended to replace standard safety practices that should be conducted around flammable gases.

IMPORTANT: To function properly, the gas detection system must be powered at all times. The gas detection system is directly powered by the batteries, and can only be powered off by disconnecting the batteries. When servicing a natural-gas-fueled vehicle, disconnect the batteries only when necessary, and do not leave the batteries disconnected for extended periods of time.

Venting

⚠ WARNING

Compressed natural gas is highly flammable. Do not attempt to transfer compressed natural gas (CNG) from one vehicle to another, as a buildup of static electricity could cause a spark and ignite the fuel, which could cause bodily injury, death, or severe property damage.

IMPORTANT: Only vent compressed natural gas (CNG) outdoors in a safe location.

The fuel cylinder shutoff valves are installed in line from top to bottom. Closing a fuel cylinder shutoff valve will cut off the flow of CNG from that cylinder and all of the fuel cylinders positioned above it in the storage box.

Compressed natural gas can be vented from the fuel cylinders in two ways.

- Run the engine until it stops.
- Open the CNG bleed valve on the manifold.

If only one cylinder needs to be purged, close the fuel shutoff valves on the fuel cylinders positioned above it. Then, either run the engine until the cylinders are empty and the engine stops, or open the bleed valve and allow the CNG to vent. At this time, all CNG in the venting cylinder and the cylinders in line below it will have vented.

CNG Fuel Tank Removal and Installation

⚠ WARNING

Compressed natural gas is highly flammable. Refer to the safety precautions listed in Subject 100 before servicing the vehicle. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily injury, death, or property damage.

NOTE: The tanks can be removed with CNG present in the tanks. Tanks must be stored outdoors, or in an approved facility with proper ventilation, and a natural gas safety monitoring system.

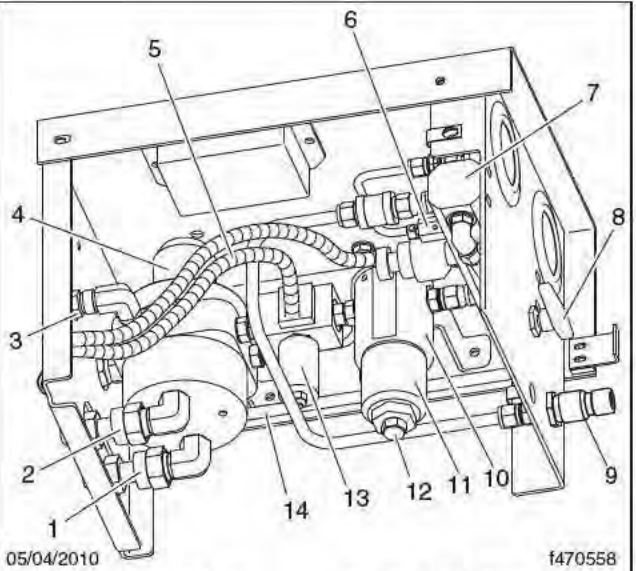
Back-of-Cab-Mounted Tank Removal

1. Park the vehicle on a level surface, shut down the engine, and set the parking brakes. Chock the tires.
2. Depressurize the CNG system. Follow the instructions in **Subject 110**.

IMPORTANT: Some residual pressure and gas from the low-pressure side of the system may escape when loosening the fittings. Be prepared for this, and observe all safety precautions.

NOTE: The fuel management module (FMM), coolant hoses, natural gas fuel lines, and wire harnesses are located in the lower area of the cabinet on vehicles with only a back-of-cab installation. See **Fig. 1**.

3. Disconnect CNG fuel lines.
4. Cap or plug all open fuel lines and fittings to prevent system contamination.
5. Position the lifting device as needed and connect the chain or sling to the eyelets on the top of the cabinet. Apply enough pressure to prevent the cabinet from tipping when loosened.
6. Remove the mounting bracket bolts. See **Fig. 2**.
7. Using safe lifting procedures with a forklift or hoist, lift the tank up off the frame rails and out or backwards to clear the chassis.



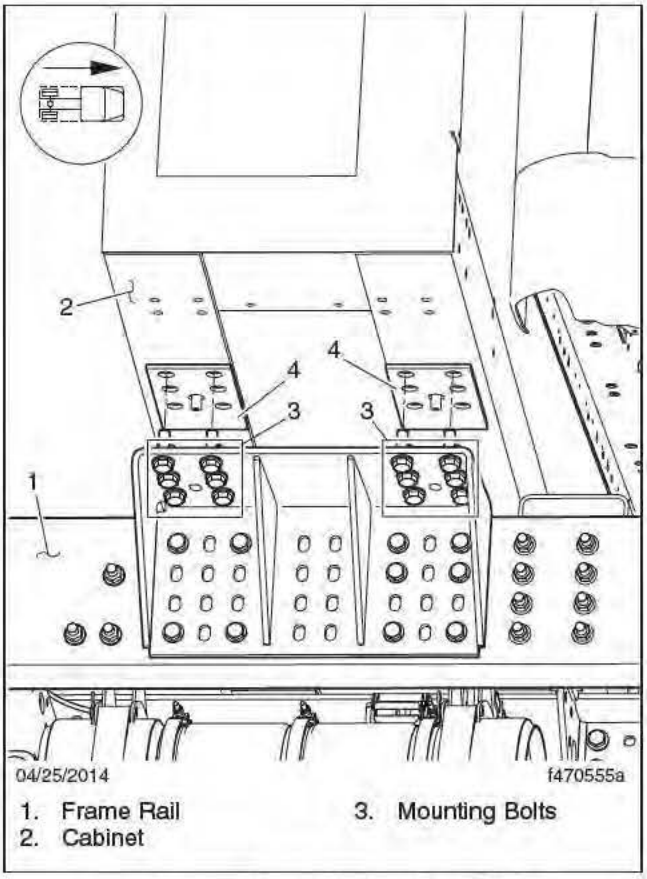
1. Coolant Inlet Port
2. Coolant Outlet Port
3. Pressure Relief Valve
4. Pressure Regulator
5. Wiring Harness
6. Manifold Bleed Valve
7. Manifold
8. Manual Fuel Shut-Off Valve
9. Fuel Fill Port
10. Filter Housing
11. Filter Bowl
12. Filter Drain Plug
13. Solenoid Valve
14. Fuel Line To Cylinders

Fig. 1, Back-of-Cab Plumbing and Wiring

Back-of-Cab Mounted Tank Installation

1. Using an appropriate lifting device, position the cabinet on the frame rails and align the mounting bracket holes on the cabinet with the holes in the mounting brackets on the frame rails.
2. While still supported with the lifting device, install the mounting bolts with washers from the bottom of the cabinet. See **Fig. 2**. Tighten the nuts 160 lbf·ft (217 N·m).
3. Remove lifting device.
4. Connect the coolant hoses.
5. Connect the CNG fuel lines. Tighten the fittings to the specifications shown in **Table 1**.
6. Connect the wiring harnesses.
7. Secure any mounting that was removed.

CNG Fuel Tank Removal and Installation



1. Frame Rail
2. Cabinet
3. Mounting Bolts

Fig. 2, Back-of-Cab Cabinet Installation

8. Pressurize the system.
9. Check for leaks per the manufactures specifications. Repair any leaks as needed.

⚠ WARNING

Compressed natural gas is highly flammable. Refer to the safety precautions listed in Subject 100 before servicing the vehicle. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily injury, death, or property damage.

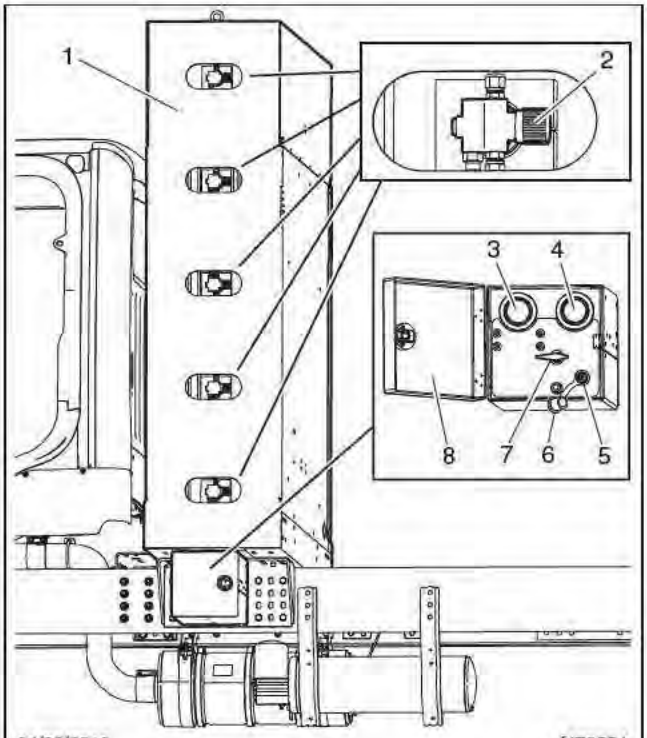
Welding

IMPORTANT: Follow all local, state, and federal guidelines regarding usage and venting of compressed natural gas (CNG).

1. Park the vehicle on a level surface, shut down the engine and set the parking brake. Chock the tires.
2. Close the CNG fuel cylinder shutoff valves. See Fig. 1.
3. Start the engine and let it idle until the fuel lines are empty and the engine stops. The gauges on the fuel panel should now read at or near 0 psi (0 kPa).
4. Close the manual fuel shutoff valve on the fuel panel.
5. Remove and save the two capscrews that secure the access cover to the fill panel, then remove the access cover. See Fig. 2.
6. Slowly open the bleed valve on the manifold to relieve remaining fuel pressure within the system. See Fig. 3.

IMPORTANT: Some pressure may remain in the fuel system between the solenoid valve and the engine. Use caution when loosening fittings, as a small amount of gas may leak out.

7. Disconnect the wiring harness from the solenoid valve.
8. Use a remote 12-volt power source to activate the solenoid valve to drain any compressed natural gas remaining in the fuel system between the solenoid valve and the engine.



1. Fuel Cylinder Storage Box
2. Fuel Cylinder Shutoff Valves (5 valves on a 5-tank system)
3. High-Pressure Gauge
4. Low-Pressure Gauge
5. Fuel Fill Port
6. Dust Cap
7. Manual Shutoff Valve
8. Fuel Panel Access Door

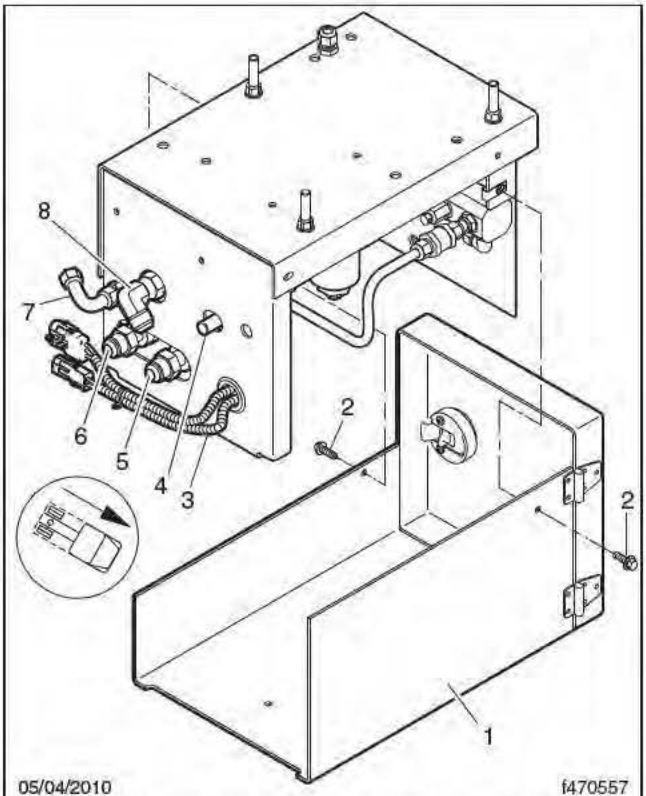
Fig. 1, CNG Fuel Cylinder Storage Box (5-cylinder system shown)

NOTICE

Disconnect the battery power and ground cables and any electronic control units (ECUs) installed on the vehicle. Electric currents produced during electric welding can damage various electrical components on the vehicle, such as alternator diodes and ECUs. Freightliner vehicle components that typically use ECUs include electronic engine, electronic automatic transmission, and antilock braking system (ABS).

For any ECU with a battery power harness, disconnect its ground terminal from the chassis ground, and disconnect its power terminal from

Welding a CNG Vehicle



NOTE: CNG fuel panel may be located on the right side of the vehicle.

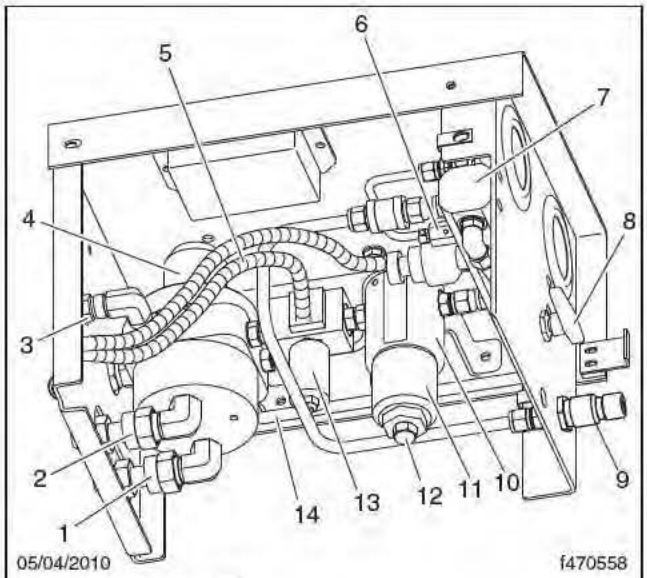
1. Fuel Panel Access Cover
2. Capscrews (qty 2)
3. Wiring Harness
4. Pressure Relief Valve and Cap
5. Coolant Outlet Line
6. Coolant Inlet Line
7. Fuel Inlet Line (from fuel cylinders)
8. Fuel Outlet Line (to engine)

Fig. 2, CNG Fuel Panel Assembly

the battery positive post, or disconnect the main connection at the ECU.

9. Shut down all vehicle electrical systems and disconnect the battery.
10. Let the vehicle sit in a well-ventilated area for at least 10 minutes.

IMPORTANT: Do not weld in areas directly adjacent to CNG tanks. Avoid direct heat exposure on tanks.



1. Coolant Inlet Port
2. Coolant Outlet Port
3. Pressure Relief Valve
4. Pressure Regulator
5. Wiring Harness
6. Manifold Bleed Valve
7. Manifold
8. Manual Fuel Shutoff Valve
9. Fuel Fill Port
10. Filter Housing
11. Filter Bowl
12. Filter Drain Plug
13. Solenoid Valve
14. Fuel Line to Cylinders

Fig. 3, CNG Fuel Panel Components

11. Cover the CNG tanks and fuel lines with a metal shield or welding blankets to prevent sparks or residue from contacting CNG equipment.
12. Complete all necessary welding, then remove the protective welding blankets or metal shield.
13. Start up the vehicle electrical system and connect the battery.
14. Connect the electrical harness to the solenoid valve.
15. Close the bleed valve on the manifold and open the manual fuel shutoff valve on the fuel panel.
16. Open the fuel cylinder shutoff valves.
17. Start the engine and check for gas leaks in the fuel system.

Using a methane detector, leak test all fuel system components. A bubble solution can be used to pinpoint the exact location of leaks.

Repair or replace any leaking components.

18. Using the two capscrews removed previously, install the access cover on the fill panel.

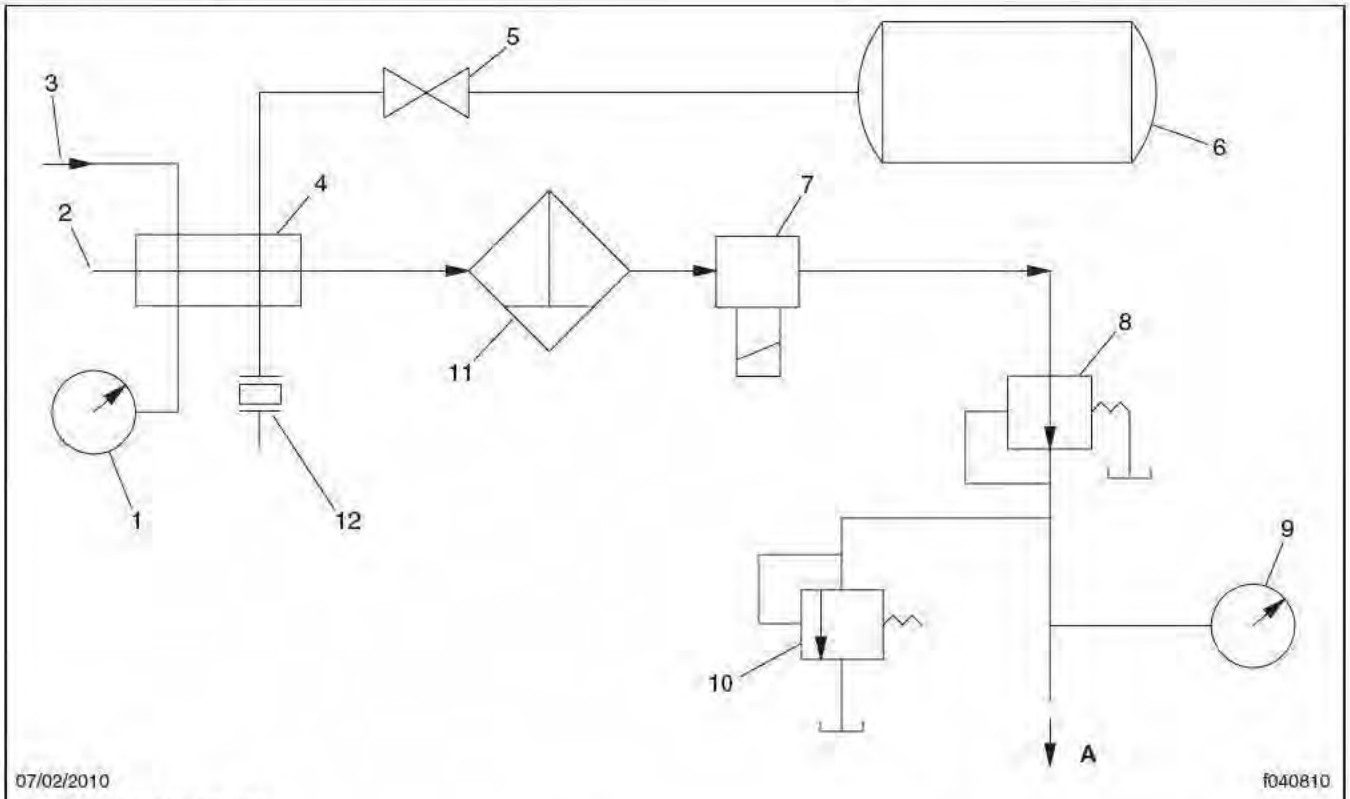
CNG System

See Fig. 1 for a schematic of CNG fuel system components.

See Fig. 2 for a flow chart to troubleshoot problems with an engine running lean.

See Fig. 3 for a flow chart to troubleshoot a faulty dash-mounted fuel gauge reading.

See Fig. 4 for a flow chart to troubleshoot a compressed natural gas leak in the fuel system.



A. Fuel flow to engine.

1. High-Pressure Gauge
2. Bleed Port
3. Fuel Fill Port
4. Manifold
5. Shutoff Valve
6. CNG Fuel Cylinder(s)
7. High-Pressure Solenoid Valve
8. Pressure Regulator
9. Low-Pressure Gauge
10. Pressure Relief Valve
11. High-Pressure Fuel Filter
12. Pressure Transducer

Fig. 1, CNG Fuel System Schematic (typical)

Troubleshooting

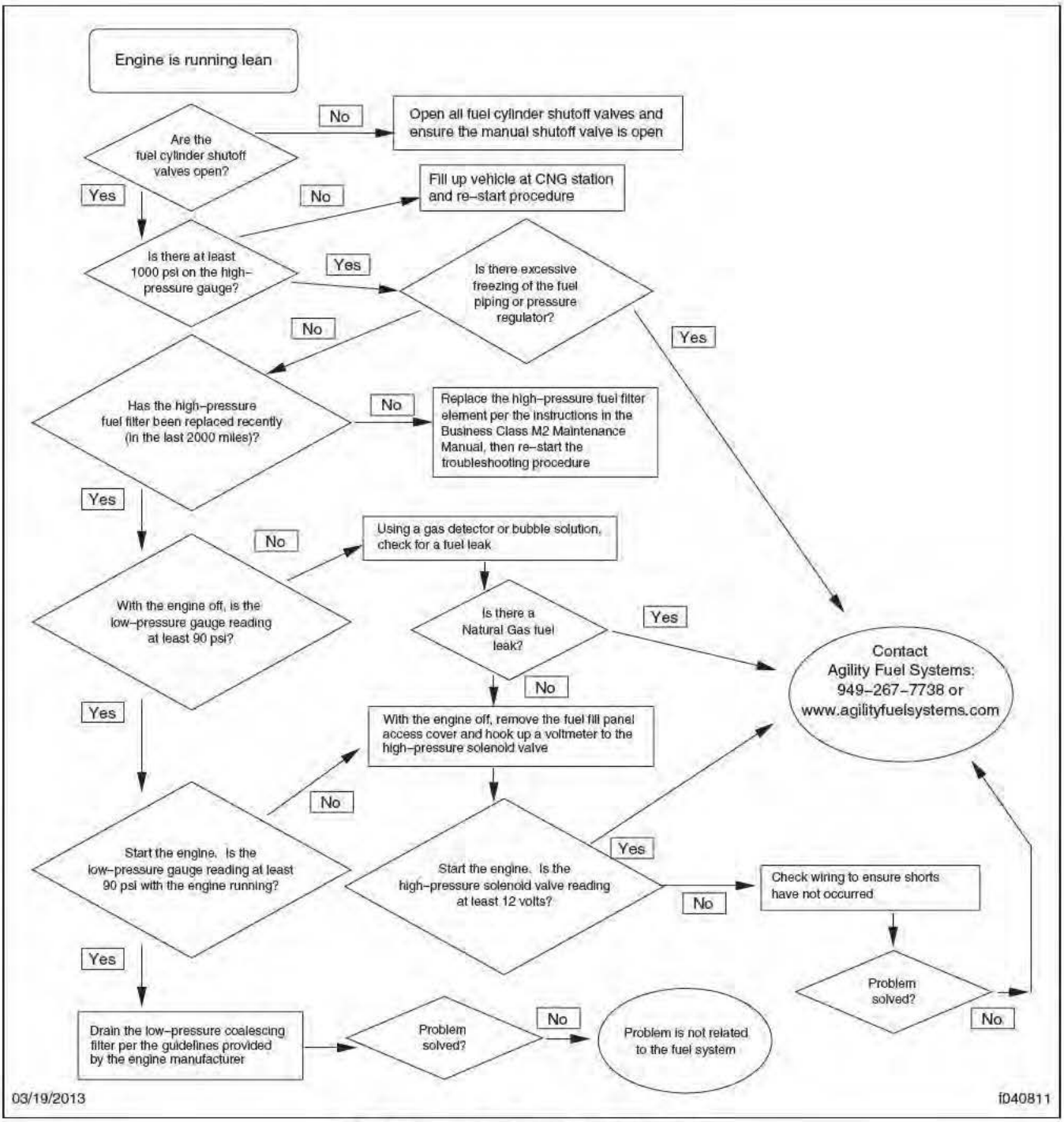


Fig. 2, Flow Chart: Engine Running Lean

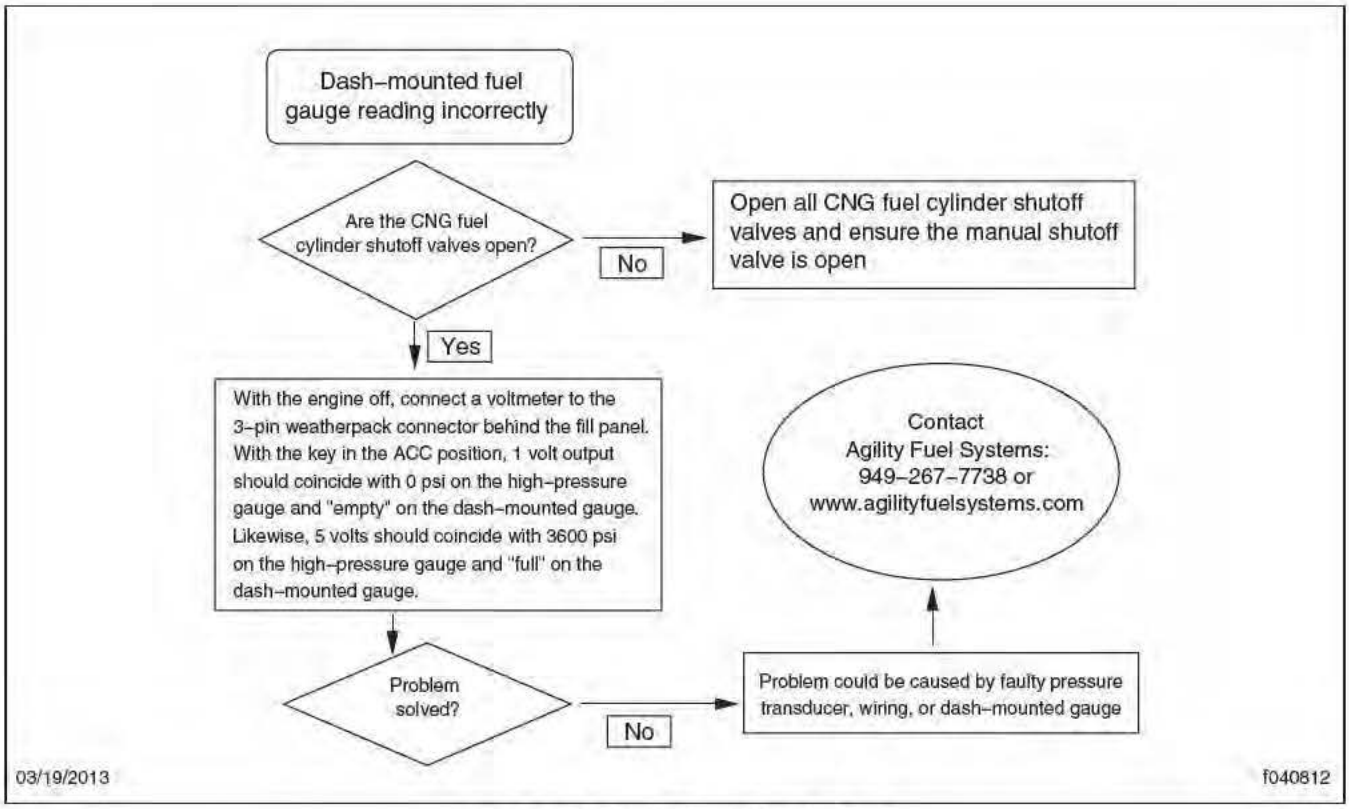


Fig. 3, Flow Chart: Faulty Dash Gauge

Troubleshooting

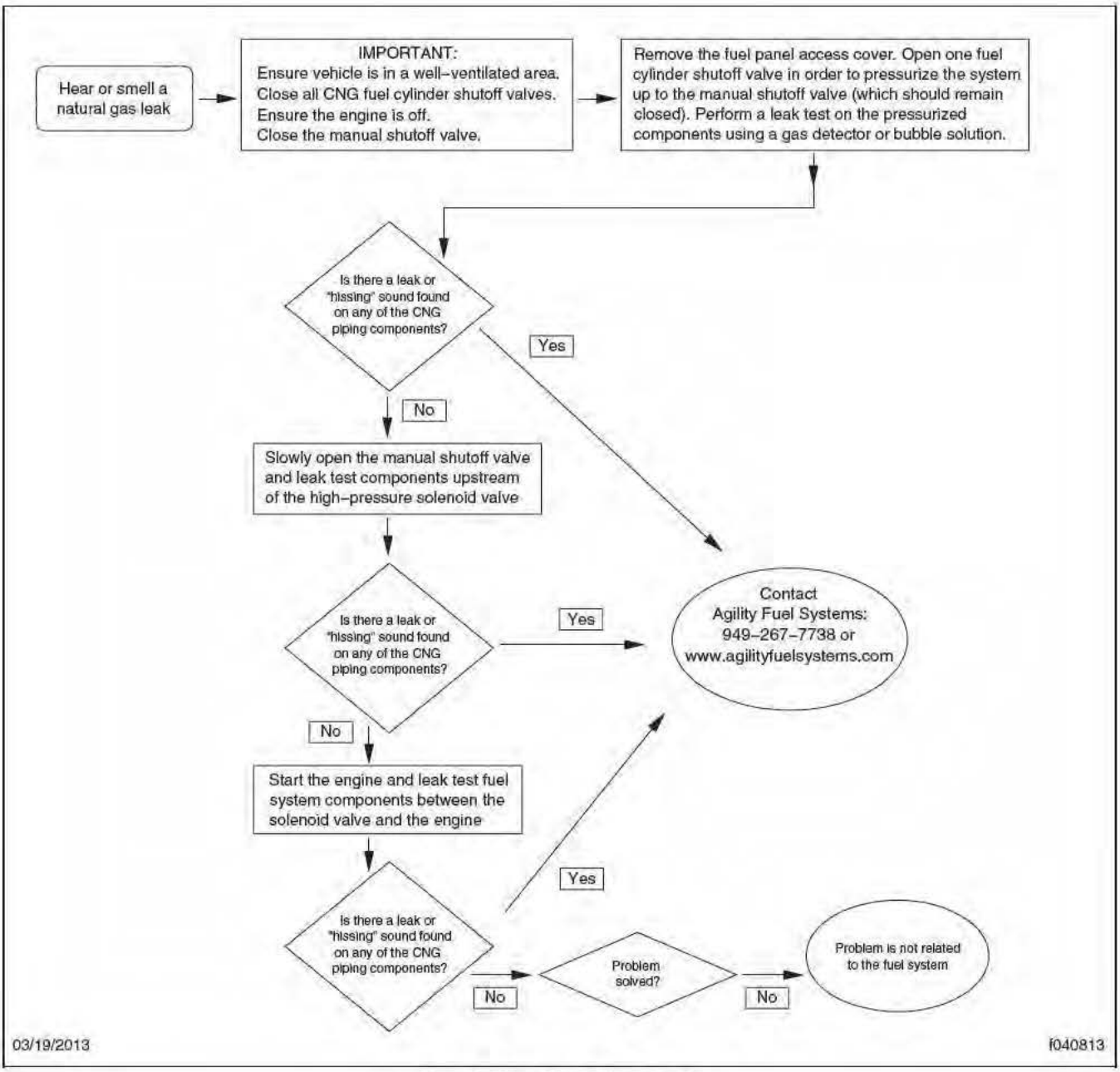


Fig. 4, Flow Chart: Gas Leak

Methane Detection System

⚠ WARNING

Compressed natural gas is highly flammable. Refer to the safety precautions listed in Subject 100 before servicing the vehicle. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily injury, death, or property damage.

The Business Class M2 is equipped with a two-zone natural gas detection system. One sensor is located in the cab overhead panel in the control panel, the other sensor is located on the frontwall in the engine compartment. The system is powered directly from the vehicle batteries and is active at all times, unless the batteries are disconnected. When the system has power, and is operating normally with all sensors confirmed operational, and no leaks detected, the green "Power" LED, and the large green light are on. When the presence of gas is detected in any zone, an indicator LED will illuminate depending on the level of gas detected. If a problem with a sensor or wiring occurs, a "Fault" LED will illuminate for the zone that is affected. When a fault is present, no detection is operational in that zone. The following troubleshooting tables show all the different possible light combinations, what they indicate, the troubleshooting procedures, and the suggested remedy. For vehicle-specific wiring diagrams, refer to G06-89262 in EZWiring™.

IMPORTANT: Before performing any troubleshooting, allow the system 60 seconds to complete the initialization process.

Green "Power" Light On

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Front Panel Indication	Troubleshoot	Remedy
The green "Power" LED on the main panel and the large green LED are on. The system has power and is operating normally. In this state the panel and all sensors are confirmed operational.	System is operating normally.	No repair needed.

Troubleshooting

No Lights on Front Panel

03/06/2014

Front Panel Indication	Troubleshoot	Result	Remedy
No lights are illuminated on the panel. The panel has no power. No gas detection or warning is possible.	Are all of the connectors plugged in at the back of the panel?	Yes	Go to next the step.
		No	Plug in the connector. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
	Is there power (9-14 vdc) and ground at the panel?	Yes	Replace the panel.
		No	Go to the next step.
	Check the terminal on the back of the panel for loose or improperly installed pins. Were there any bad pins?	Yes	Repair and Go to next the step. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to the next step.
	Is the fuse blown or missing at the power-net distribution box (PNDB)?	Yes	Replace the fuse. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Does the circuit have continuity or high resistance?	Yes	If it has continuity, and still has no power go to PNDB troubleshooting.
		No	If there is no continuity, or high resistance Go to next the step.
	Check connectors at the fire wall and PNDB. Have any of the cables been pinched, cut, or damaged?	Yes	Replace the damaged cable(s).
		No	Contact the vendor.

Amber "Sensor Fault" Light On

03/20/2014 f470623

Front Panel Indication	Troubleshoot	Result	Remedy
The amber "Sensor Fault" light indicates that there is a problem in the zone specified. In this case zone 1 and 2. When a fault light is on, detection is not possible in any zones where a fault is present.	Check the sensor connections at the back of the panel and at the sensors. Are the connectors loose or damaged?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Check the pins in the connectors on the panel and in the sensors. Are the pins loose or damaged?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	If both "Sensor Fault" lights are on, skip this step and proceed to the next step. Swap the zone that is reporting a sensor fault by switching the connectors at the rear of the panel. Did the other light illuminate?	Yes	If the fault moves with the cable, proceed to the next step.
		No	If it stays, replace the panel. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
	Check for continuity in the harness. Is there high resistance in the sensor harness?	Yes	Replace the harness.
		No	Replace the sensor, unless it is both, then replace the panel.

Troubleshooting

Amber "Trace" Light Flashing

03/20/2014 f470624

Front Panel Indication	Troubleshoot	Result	Remedy
The flashing amber "Trace" light indicates that a trace amount of gas (greater than 20% and less than 50%) has been detected in the specified zone, in this case zone 2.	Using an approved NG testing method, check all fuel fittings and fuel lines for leaks. Verify that pressure relief devices are not venting or leaking. Is there a gas leak?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Are any nuisance gases present? Nuisance gases can be caused by cleaners, paint, polish, lacquer, gasoline, strong adhesives, fiberglass repair, etc.	Yes	Clear the area of contaminants and check again. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Check the connectors and pins on the panel and sensors. Are they damaged?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Swap the zone that is reporting a sensor fault by switching the connectors at the rear of the panel. Did the other light illuminate?	Yes	If the fault moves with the cable, proceed to the next step.
		No	If it stays, replace the panel. If the problem is resolved, no further work is needed.
	check continuity and resistance in the sensor harness. Is the harness good?	Yes	Replace the sensor.
		No	Replace the harness.

⚠ WARNING

The following tests should only be performed after determining that it is safe to do so.

Remove all personnel from the area. Ventilate the area. Manually shut off the source of gas (propane/CNG/LNG, etc.).

Have the problem repaired by qualified personnel before further operation of the vehicle.

Do not perform "SIGNIFICANT" and "Trace" diagnosis, until the non-presence of gas is confirmed and the panel has had constant power for 60 seconds of calibration.

Red "SIGNIFICANT" Light, Amber "Trace" Lights, and Buzzer 1

03/20/2014 f470625

Front Panel Indication	Troubleshoot	Result	Remedy
The red "SIGNIFICANT" light and amber "Trace" lights and buzzer 1 indicate that a significant level of combustible gas (greater than 50% lower explosive limit (LEL)) has been detected in the applicable zone. In this case zone 2. Remove all personnel from the area. Ventilate the area. Manually shut off the source of gas (propane/CNG/LNG, etc.). Have the problem repaired by qualified personnel before further operation of the vehicle. Do not perform "SIGNIFICANT" and "Trace" diagnosis, until the non-presence of gas is confirmed and the panel has had constant power for 60 seconds of calibration.	Is the "Amerex Push to Test" button being held?	Yes	Let go.
		No	Go to next the step.
	Using an approved NG testing method, check all fuel fittings and fuel lines for leaks. Verify that pressure relief devices are not venting or leaking. Is there a gas leak?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Are any nuisance gases present? Nuisance gases can be caused by cleaners, paint, polish, lacquer, gasoline, strong adhesives, fiberglass repair, etc.	Yes	Clear the area of contaminants and check again. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Check the connectors and pins on the panel and sensors. Are they damaged?	Yes	Repair as needed. If the problem is resolved, no further work is needed.
		No	Go to next the step.
	Swap the zone that is reporting a sensor fault by switching the connectors at the rear of the panel. Did the other light illuminate?	Yes	If the fault moves with the cable, proceed to the next step.
		No	If it stays, replace the panel. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
	Check continuity and resistance in the sensor harness. Is the harness good?	Yes	Replace the sensor.
		No	Replace the harness.

Troubleshooting

Red "SIGNIFICANT" Light, Amber "Trace" Lights, and Buzzers 1 and 2

03/20/2014 f470626

Front Panel Indication	Troubleshoot	Result	Remedy
The red "Significant" light and amber "Trace" lights along with buzzers 1 and 2 indicate that a significant level of combustible gas (greater than 50% LEL) has been detected in the applicable zone, in this case zone 2. Remove all personnel from the area. Ventilate the area. Manually shut off the source of gas (propane/CNG/LNG, etc.). Have the problem repaired by qualified personnel before further operation of the vehicle. The large red LED and buzzer 2 indicates the significant gas detection has been present for over 15 seconds and the relay has engaged. Do not perform "SIGNIFICANT" and "Trace" diagnosis, until the non-presence of gas is confirmed and the panel has had constant power for 60 seconds of calibration.	Is the "Amerex Push to Test" button being held and has it been held continuously for 15 seconds causing the relay to trip?	Yes	Release the button, and press the "Shutdown/Reset" button to reset the relay. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Using an approved NG testing method, check all fuel fittings and fuel lines for leaks. Verify that pressure relief devices are not venting or leaking. Is there a gas leak?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Are any nuisance gases present? Nuisance gases can be caused by cleaners, paint, polish, lacquer, gasoline, strong adhesives, fiberglass repair, etc.	Yes	Clear the area of contaminants and check again. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Check the connectors and pins on the panel and sensors. Are they damaged?	Yes	Repair as needed. If the problem is resolved, no further work is needed.
		No	Go to next the step.
	Swap the zone that is reporting a sensor fault by switching the connectors at the rear of the panel. Did the other light illuminate?	Yes	If the fault moves with the cable proceed to the next step.
		No	If it stays, replace the panel. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
	Check continuity and resistance in the sensor harness. Is the harness good?	Yes	Replace the sensor.
		No	Replace the harness.

Red "Relay Engaged" LED, Large Red LED, and Buzzer 2

03/20/2014 f470627

Front Panel Indication	Troubleshoot	Result	Remedy
The red "Relay Engaged" LED and the large red LED along with buzzer 2 indicates that a significant level of gas (greater than 50%) was detected at some point. The significant gas level is no longer present, as the "SIGNIFICANT" LED and "Trace" LED are no longer illuminated. The panel relay has engaged and must be reset by pressing the "Shutdown/ Reset" button. Do not troubleshoot the system until the reason for the significant alarm is understood.	Has the "Amerex Push to Test" button been pressed and held for 15 seconds causing the relay to trip?	Yes	Press the "Shutdown/Reset" button. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Using an approved NG testing method, check all fuel fittings and fuel lines for leaks. Verify that pressure relief devices are not venting or leaking. Is there a gas leak?	Yes	Repair as needed. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Are any nuisance gases present? Nuisance gases can be caused by cleaners, paint, polish, lacquer, gasoline, strong adhesives, fiberglass repair, etc.	Yes	Clear the area of contaminants and check again. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
		No	Go to next the step.
	Check the connectors and pins on the panel and sensors. Are they damaged?	Yes	Repair as needed. If the problem is resolved, no further work is needed.
		No	Go to next the step.
	Swap the zone that is reporting a sensor fault by switching the connectors at the rear of the panel. Did the other light illuminate?	Yes	If the fault moves with the cable, proceed to the next step.
		No	If it stays, replace the panel. If the problem is resolved, no further work is needed. If the problem still exists, go to the next step.
	Check continuity and resistance in the sensor harness. Is the harness good?	Yes	Replace the sensor.
		No	Replace the harness.

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11-4-2014

DATA TO ODI

NO LETTER

CNG System Inspections

CNG Cylinder & System Inspection

WARNING

If a CNG-fueled vehicle has been involved in an accident or fire, the system and cylinders must be inspected by a certified (CGA C-6.4) or other qualified CNG fuel system inspector.

Refer to Field Service Bulletin ENP-196, "CNG Fuel System Inspection Interval Recommendations for High Mileage, Heavy Duty Vehicles"

Agility fuel systems™

Field Service Bulletin

CNG Fuel System Inspection Interval Recommendations for High Mileage, Heavy Duty Vehicles

ENP-196
July 23, 2014

1. Introduction

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 also not be appropriate.

The Federal Motor Carrier Safety Administration (FMCSA – part of the U.S. Department of Transportation, DOT) does not currently have out of service (OOS) inspection criteria for natural gas fuel systems, but is currently considering adding them.

A. Vehicle safety-related agencies state:

a) **Federal Motor Vehicle Safety Standards (FMVSS) 304:** (Labeling requirements) – CNG containers should be visually inspected … every 36,000 miles or 36 months, whichever comes first...
b) **American National Standards Institute (ANSI)/Canadian Standards Association (CSA) NGV2:** Each container shall be visually inspected at least every 36 months, or at the time of any re-installation, for external damage and deterioration…
c) **National Fire Protection Agency (NFPA) 52:** Recommends the same interval as the FMVSS, stating containers should be visually inspected … every 36,000 miles or 36 months, whichever comes first...

B. According to the Canadian Natural Gas Vehicle Alliance, and the CSA Group, who offers certifications on CNG cylinder inspections, 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

Fig. 1 A typical CNG cylinder manufacturer's label showing visual inspection interval information. The wording is from FMVSS 304 "…every 36 months/36,000 miles…"

Fig. 2 A CNG cylinder inspection record label used to document completed inspections.

Fig. 3 An Agility Fuel Systems CNG cylinder inspection record decal (part number 10602107) on a fuel management module door.

Where possible, Agility Fuel Systems recommends a practical alternative schedule for detailed fuel system inspections – selected by the fleet manager or vehicle owner.

Use either:

1. **the common recommendation of every 3 years or 36,000 miles, whichever occurs first, OR**
2. **after every 1 year or 100,000 miles, whichever occurs first**

In addition, Agility recommends a **daily walk-around visual inspection** be performed, regardless of which detailed fuel system inspection schedule is followed.

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 (CGA C-6.4) or other qualified CNG fuel system inspector.

2. Affected Units

This procedure applies to all Agility Fuel Systems CNG-fueled vehicles.

3. Daily Walk Around Visual Inspection

Inspect the following items each day before vehicle operation:

1. Make sure all manual tank valves and the red-handled emergency shutoff valve on the FMM are in the OPEN position.
2. Check the high pressure gauge to make sure enough fuel is on-board, and re-fuel if necessary.
3. Drain the low pressure filters per the engine manufacturers' recommendation.
4. Turn the ignition key to the on position, and watch the low pressure gauge. It should show about 125 psi.
5. Check the dashboard fuel gauge to make sure it is functioning.
6. Check the entire fuel system for any signs of damage or wear. Include checks for:
   a. Major leaks – Smell for gas, frost or ice on plumbing tubing and components
   b. PRD components - Make sure all PRD vent line caps are in place and PRD lines are not kinked, plugged or damaged
   c. Structural damage - Housings, covers, fasteners, fuel cylinder mounting points.
7. If any system components or structural parts are damaged, perform a detailed inspection.

If all is well, the vehicle is cleared for operation. If anything is wrong, a qualified CNG system technician should make the necessary repairs.

4. Detailed Fuel System Inspection

At 12 months/100,000 miles whichever occurs first **or** 36 months/36,000 miles whichever occurs first, a certified (CGA C-6.4) or other qualified CNG Fuel System Inspector shall perform the following in addition to the daily inspection items above:

1. Check cylinder shields and covers for damage.
2. Make sure cylinders are mounted securely. Check mounts, brackets, rubber isolators, and all fasteners.
3. Verify cylinder labels are in place and make sure cylinder service life has not expired.
4. Inspect cylinder valves and PRDs for leaks and damage.
5. Inspect all plumbing tubes, hoses and fuel flow components for leaks.

6. Examine all cylinders for damage using the cylinder manufacturer's guidelines. Inspection records should be kept with vehicle records, and the system label should be updated to reflect the current inspection status.

If all is well, the vehicle is cleared for operation. If anything is wrong, a qualified CNG system technician should make the necessary repairs.

5. CNG Fuel System Maintenance Items

Remember, the above applies to CNG fuel system inspections, not service intervals to the maintenance items, such as fuel filters. Refer to Service Bulletin ENP-114, "CNG System High Pressure Filter Maintenance" for HP filter maintenance instructions.

6. References

Agility Fuel Systems
http://www.agilityfuelsystems.com/

Agility Fuel Systems on YouTube
https://www.youtube.com/channel/UCH1-yzuKiwz9kyAEJmdrLxg

Natural Gas Vehicle Institute - NGVi
http://www.ngvi.com/

CSA Group
http://shop.csa.ca/en/canada/page/home

Clean Vehicle Education Foundation - CVEF
http://www.cleanvehicle.org/index.shtml

If you have any questions, contact Agility Fuel Systems Product Support at 949-267-7745 or support@agilityfs.com.

Agility Fuel Systems
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Revision State				
--	--	WY	7/23/14	Initial release
ECN#	**REV**	**BY**	**DATE**	**DESCRIPTION**

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NO LETTER

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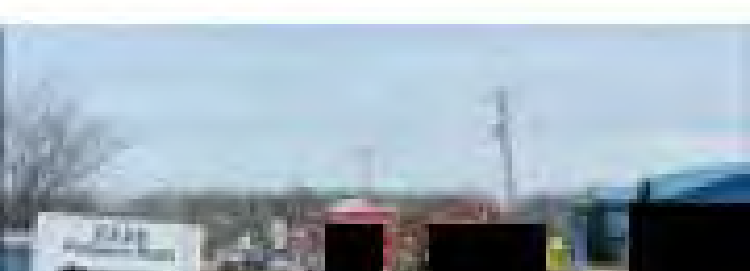
Headline



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NO LETTER

Man_dead_after_natural_gas_truck_explodes_in_Howard[1]

Man dead after natural gas truck explodes in Howard

Written by Press-Gazette Media
Apr. 4, 2014 |

postcrescent.com

HOWARD — A truck driver was killed and another man was critically injured Thursday when a truck's fuel system exploded near an industrial park, officials said.

Ed Janke, public safety director of the village of Howard, said the explosion — reported around 1:30 p.m. — appears to be the result of a shifting load compromising the truck's fuel system.

The Brown County Sheriff's Office said the truck had slowed for a turn when the its load of heavy equipment moved forward and penetrated the truck's compressed natural gas fuel system, causing it to explode.

"The truck slowed to turn into a driveway and the load shifted inside, apparently, and that compromised the compressed natural gas fuel system on the truck," Janke said. "The fuel system subsequently detonated."

The male driver was pronounced dead at the scene and a male passenger was thrown from the cab and transported to a hospital with what are described as critical injuries, the Brown County Sheriff's Office said in a written statement.

About an hour after the original report, the truck's cab sat cocked forward on its chassis near the corner of Pamperin and Cornell roads in the Howard Industrial Park. Crews remained on the scene into late afternoon.

Several businesses in the area were evacuated as a precaution, but Janke said later that people have been allowed to return to work.

The truck is owned by Ace Manufacturing Industries Inc., which is located on Pamperin Drive. It was operating between two Ace Manufacturing Industries Inc. facilities in the area, Janke said.

"This is the first time I have seen the catastrophic release of a compressed fuel system like that," Janke said. "We were very concerned about additional explosions. We weren't sure what caused the original explosion, so we created a safe area."

A hazardous material team was called to the scene, evaluated the area for any danger and determined no threat remained. The Brown County Sheriff's Department is investigating the incident.

A number of people at the scene talked about how they heard a loud boom and followed the firefighters to see the source of the noise.

"I was just sitting watching a baseball game and I heard a big ka-boom," said [redacted], who lives about a mile from the scene. "I knew it wasn't thunder. I didn't know what the heck it was.

"It was a big boom. It was loud enough it made my heart shudder."

PE14-020

11-4-2014

DATA TO ODI

NO LETTER

PE14-020

11-4-2014

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NO LETTER

INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

ON-SITE COMPRESSED NATURAL GAS VEHICLE EXPLOSION INVESTIGATION

FOR THE OFFICE OF DEFECTS INVESTIGATION (ODI)
CASE NUMBER - [redacted]
LOCATION - WISCONSIN
VEHICLE - 2014 FREIGHTLINER M2 112
INCIDENT DATE - April 2014

Contract Number: [redacted]

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

1. Report No. [redacted]	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle On-Site Compressed Natural Gas Vehicle Explosion Investigation Vehicle - 2014 Freightliner M2 112 Location - Wisconsin		5. Report Date: August 2014 6. Performing Organization Code
7. Author(s) Special Crash Investigations Team 2		8. Performing Organization Report No.
9. Performing Organization Name and Address Transportation Research Center Indiana University 501 South Madison Street, Suite 105 Bloomington, Indiana 47403-2452		10. Work Unit No. (TRAIS) 11. Contract or Grant No. [redacted]
12. Sponsoring Agency Name and Address U.S. Department of Transportation (NVS-411) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. Type of Report and Period Covered Technical Report Crash Date: April 2014 14. Sponsoring Agency Code

15. Supplementary Notes

On-site compressed natural gas vehicle explosion investigation involving a 2014 Freightliner M2 112.

16. Abstract

This on-site investigation focused on the Compressed Natural Gas (CNG) fuel system of a 2014 Freightliner M2 112. One of the vehicle's five CNG fuel cylinders was punctured by the left fork of an unsecured Yale Type E forklift located in the cargo box of the Freightliner, resulting in an explosion of the fuel cylinder. There was no fire. This incident occurred on a two-lane roadway in an industrial park. The Freightliner was a two-door straight truck equipped with a CNG fuel system, consisting of five CNG fuel cylinders stacked vertically and secured within an aluminum cabinet located between the truck cab and cargo box. The cylinders had been filled the previous evening and the truck was used in the morning on the day of the incident. While the specific fill level of the CNG tanks is not known, it was reported by an investigator from the Clean Vehicle Education Foundation that the CNG cylinders were nearly full at the time of the incident. A restrained [redacted]-year-old male driver and a restrained [redacted]-year-old male front right passenger occupied the vehicle. The Freightliner was traveling east and was transporting an unsecured Yale Type E forklift. The Freightliner's driver was braking to initiate a right turn into a driveway when the forklift was displaced forward as a result of the deceleration and the forks impacted and pierced the front panel of the cargo box. The left fork then impacted and ruptured the lowest of the five CNG fuel cylinders resulting in a explosion. The driver sustained fatal injuries and expired at the scene. The front right passenger sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where he was admitted for one day.

17. Key Words		18. Distribution Statement	
Compressed Natural Gas Explosion	Motor Vehicle Traffic Incident Fatal Injury Severity	General Public	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 13	22. Price

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TRANSPORTATION RESEARCH CENTER
ON-SITE COMPRESSED NATURAL GAS VEHICLE EXPLOSION INVESTIGATION

FOR THE OFFICE OF DEFECTS INVESTIGATION (ODI)
CASE NUMBER - [redacted]
LOCATION - WISCONSIN
VEHICLE - 2014 FREIGHTLINER M2 112
CRASH DATE - April 2014

BACKGROUND

This on-site investigation focused on the Compressed Natural Gas (CNG) fuel system of a 2014 Freightliner M2 112 (**Figure 1**). One of the five CNG fuel cylinders was punctured by the left fork of an unsecured Yale Type E forklift located in the cargo box of the Freightliner resulting in a explosion of the fuel cylinder. There was no fire. This investigation was initiated by the National Highway Traffic Safety Administration (NHTSA) on April 15, 2014 through the Office of Defects Investigation (ODI), which was responding to an on-line news article. This investigation was assigned on April 17, 2014 when cooperation to inspect the Freightliner was finalized with the vehicle's owner. The incident involved the Freightliner and the Yale Type E forklift located within the cargo box of the vehicle. This incident occurred in April 2014 at 1335 hours, in Wisconsin and was investigated by a local police agency. The Freightliner and incident scene were inspected on April 22, 2014. Interviews with the front right passenger of the Freightliner, the owner of the Freightliner, and the city public safety director were also conducted on April 22, 2014.

Figure 1: On-scene police photograph of the damaged 2014 Freightliner M2 112

This incident occurred on a two-lane roadway in an industrial park. The Freightliner was a two-door straight truck equipped with a CNG fuel system, consisting of five CNG fuel cylinders oriented horizontally and stacked vertically within an aluminum cabinet located between the truck cab and cargo box. The cylinders had been filled the previous evening and the truck was used in the morning on the day of the incident. The fill level of the CNG tanks could not be determined. A restrained [redacted]-year-old male driver and a restrained [redacted]-year-old male front right passenger occupied the vehicle. The Freightliner was traveling east and was transporting an unsecured Yale Type E forklift. The Freightliner's driver was braking to initiate a right turn into a driveway when the forklift was displaced forward as a result of the deceleration and the forks impacted and pierced the front panel of the cargo box. The left fork then impacted and ruptured the lowest of the five CNG fuel cylinders resulting in a explosion. There was no fire. The driver sustained fatal injuries and expired at the scene. The front right passenger sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where he was admitted for one day.

Incident Site: This incident occurred during daytime hours on a two-lane roadway in an industrial park. The weather conditions were clear with 10 mile visibility, northeasterly winds at 27 km/h (17 mph), a temperature of 0.6° C (33° F), and dew point of -2° C (28° F), according to local weather reports. The bituminous roadway traversed in an east-west direction and had one through lane in each direction that were bordered by gravel shoulders approximately 2 m (6.5 ft) in width. The eastbound lane was 3.5 m (11.5 ft) wide and the westbound lane was 4 m (13.1 ft) wide. The roadway pavement markings consisted of a broken yellow center line. The roadway was level and the speed limit was 56 km/h (35 mph). The Incident Diagram is included on page 13 of this report.

Pre-Incident: The forklift was driven into the Freightliner's cargo box at a factory loading dock by the driver of the Freightliner, and the forks were lowered to the floor of the cargo box. It was reported in the police reconstruction report that the forklift's shift lever was placed in neutral and the parking brake was set. The forklift was not secured with straps nor were the wheels blocked. It was also reported in the police reconstruction report that, based on information from representatives of a local Yale forklift dealer, the parking brake was designed only to hold the forklift in place on a ≤15% grade. It was not designed to prevent the forklift from rolling during transport. The forklift's specific location within the cargo box is unknown, since only the driver of the Freightliner was involved in loading it onto the truck and he sustained fatal injuries during the incident. The driver of the Freightliner intended to travel from the loading dock to the street, turn right, and travel to a second building located approximately 500 m (1,640 ft) from the loading dock where the driver and right passenger would deliver the forklift and pick up a table. The Freightliner was traveling east in the right lane approaching the driveway to the second building (**Figure 2**) at a travel speed, estimated by the right passenger, of 40 km/h (25 mph). The passenger stated during the SCI interview that he and the driver were conversing, and it was necessary for him to alert the driver that they were approaching the driveway to their destination. He further stated the driver then pumped the brakes to reduce the Freightliner's speed.

Figure 2: Freightliner's eastbound approach to the driveway (on right) and area of explosion

Incident: The unsecured forklift traveled forward in the cargo box as the driver braked. The front forks pierced the front panel of the cargo box and the left fork impacted the lowest of five CNG fuel cylinders that were oriented horizontally and stacked vertically within an aluminum cabinet located between the truck cab and cargo box. The impact site on the CNG cylinder was located 65 cm (25.6 in) left of the right cylinder end. This impact resulted in a rupture and explosion of the cylinder. There was no fire. The Freightliner's air lines were severed and the wheels locked, leaving police-reported skid marks that ranged from 4.3 - 7.44 m (14.1 - 24.4 ft) in length as the vehicle skidded to final rest, heading southeast. A speed to skid to a stop calculation based on the longest skid mark length and a deceleration value range[1] of 0.41 - 0.56 g yielded a speed range at the onset of the skid

[1] Traffic Accident Reconstruction, Volume 2 of The Traffic Accident Investigation Manual by Lynn B. Fricke, Northwestern University Traffic Institute, 1990

of 27.8 km/h (17.3 mph) - 32.5 km/h (20.2 mph). The force of the explosion resulted in severe damage to the frame, undercarriage, cargo box, fuel cabinet, CNG cylinders, and cab of the Freightliner.

Post-Incident: The police were notified of the incident at 1336 hours and arrived on scene at 1342 hours. Fire, rescue, and medical personnel responded to the incident. The front right passenger of the Freightliner stated during the interview that he checked on the driver and attempted to awake him from unconsciousness but was unsuccessful. He noticed the smell of natural gas and climbed out of the right front window which had disintegrated from the explosion. The driver of the Freightliner sustained fatal injuries and expired at the scene. The front right passenger sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where he was admitted for two days. The Freightliner was towed from the incident scene due to damage.

2014 FREIGHTLINER M2 112

DESCRIPTION

The Freightliner was a rear wheel drive, 6 x 4, two-passenger, straight truck (VIN: 1FVHC5DX9EHxxxxxx) that was manufactured in August 2013 and was equipped with an 8.9-liter I-6 engine powered by compressed natural gas, a ten-speed automatic transmission, four-wheel anti-lock brakes, and a 6.1 m (20 ft) long cargo box. The windshield glazing was AS1 laminated and the left, right, and backlight glazings were AS2 tempered. The glazing for all non-fixed windows were closed at the time of the incident. The specified wheelbase was 472 cm (186 in).

The vehicle manufacturer's recommended tire size was 295/75R22.5 The vehicle was equipped with tires sized 295/75R22.5 and 275/80R22.5 on the front and rear wheels, respectively. The manufacturer's recommended cold tire pressure for the front and rear tires was 758 kPa (110 psi).

The vehicle was equipped with driver and right passenger cloth-covered, box-mount bucket seats with integral head restraints.

EXTERIOR DAMAGE

Frame and Undercarriage: The explosion deformed the truck frame directly below the fuel cylinder cabinet (**Figure 3**). Both frame rails were bent, as were the frame cross members fore and aft of the cylinder cabinet. The center section of the drive shaft was fractured and separated from the transmission. The air brake lines were severed and the air brake tank was also slightly displaced. The rear engine mounts were undamaged.

Figure 3: Freightliner's undercarriage damage directly under fuel cabinet

Passenger Cab: The cab of the truck was heavily damaged from the explosion (**Figure 4**). The most

severe damage occurred below and behind the driver's seat . The entire cab was displaced upward and forward approximately 40 cm (15.7 in) and the back panel of the cab was torn vertically, intruding into the passenger area. Shards of carbon fiber wrap and fiberglass from the ruptured cylinder were found throughout the inside of the cab and the windshield was holed from the force of the explosion.

Figure 4: Police on-scene photograph of damage to cab of the Freightliner

Cargo Box: The truck's cargo box (**Figure 5**) was also heavily damaged from the explosion. The front panel was largely displaced from the main structure. The roof and rear door panels completely detached and the left side panel was partially detached. There was slight damage to the floor and right side panel.

Figure 5: Police on-scene photograph of damage to the Freightliner's cargo box

Cargo: The only cargo was a Yale Type E battery powered forklift, Model ERP040TFN03739W. The forklift (**Figure 6**) measured 306 cm (120.5 in) from back to fork tips and weighed 4,035 kg (8,896 lb). Each fork was 106 cm (41.7 in) in length and 10 cm (3.9 in) in width. The forks were 1.5 cm (0.5 in) thick at the tips and 4 cm (1.6 in) at the base and were set 49 cm (19.3 in) apart from each other. A parking brake was located on the left side of the instrument panel and was engaged at the time of the incident.

Figure 6: Yale Type E forklift (in cargo box at time of incident)

CNG Cylinder Cabinet Damage

The cabinet for the CNG cylinders was manufactured by Agility Fuel Systems and was located between the cab and cargo box. The cabinet included an aluminum support structure that measured 217 cm (85.4 in) in height and 53 cm (20.9 in) in width, which was encased by aluminum sheeting. There was no protective barrier between the CNG cabinet and the cargo box. The rack allowed for five CNG cylinders to be mounted by the neck, horizontally onto cross members. The cylinders were stacked vertically in the cabinet. The cabinet sustained severe damage as a result of the explosion (**Figure 7**). The sheet metal encasing the cabinet was mostly displaced from the vehicle, with only the forward panel remaining attached. The left rear vertical frame member fractured and separated 88 cm (34.6 in) from the bottom support and the front vertical frame member

was rotated 90 degrees to the left. All cross members, on both sides, were either fractured, displaced, or bent (**Figure 8**).

Figure 7: Left side damage to fuel cabinet

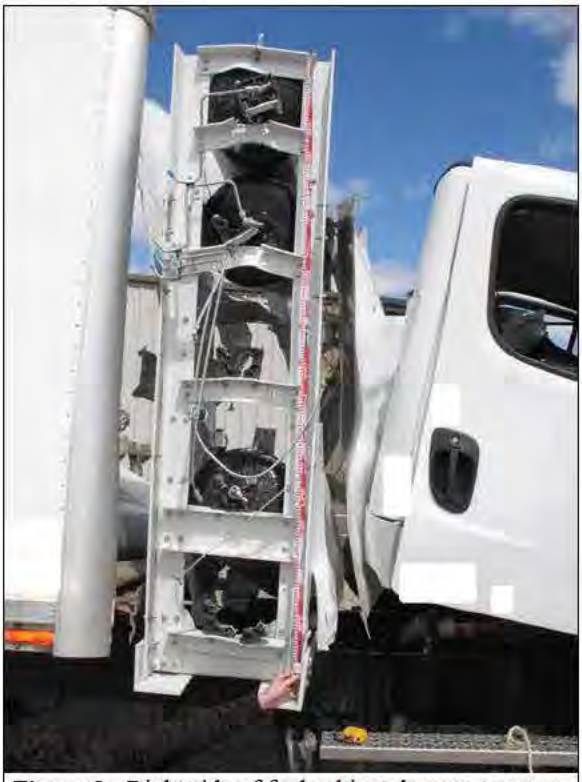


Figure 8: Right side of fuel cabinet damage to cross members

CNG Cylinders and Damage

The five CNG cylinders were Type 4 design (polymer liner with carbon fiber and fiberglass overwrap), manufactured by Hexagon Lincoln, Model number RH36A16-07601. Each cylinder measured 205 cm (80.6 in) in length, 41 cm (16 in) in diameter, and were certified with ANSI NGV2 and FMVSS 304. Each cylinder was equipped with a Pressure Relief Device (PRD) at each end, which was designed to pipe discharge away to the top of the cabinet in the event of a breach of the system. Each cylinder had a manual valve without an excess flow device that was manufactured by OMB. The bottom cylinder (cylinder 1) was impacted by the left fork of the forklift and ruptured (**Figure 9**), with the damage starting 65 cm (25.6 in) left of the right end of the cylinder. A 66 cm (26 in) section of the left end of the cylinder (**Figure 10**) separated and was displaced into the street (**Figure 11**). Both valves separated from the bottom cylinder. Cylinder 2 remained intact, but the left side dropped from its mount. The left side valve was detached and part of the right side valve remained in place. Cylinder 3 was propelled out of the cabinet and landed in the street, according

Figure 9: Ruptured CNG cylinder

to incident documents. At least one valve remained attached to the cylinder. Cylinders 4 and 5, at the top of the cabinet, remained in their positions and all valves remained attached.

Figure 10: Displaced section of ruptured CNG cylinder

Figure 11: Police on-scene photograph showing location of displaced section of bottom CNG cylinder (arrow)

Figure 12: Exterior view of intrusion of back wall of Freightliner's cab

Interior Damage

The interior of the Freightliner sustained severe damage from the CNG cylinder explosion. There were a total of twelve intrusions to the passenger compartment. The most severe intrusions occurred in the driver's space and were to the back wall of the cab and the backlight header (**Figures 12** and **13**), which intruded longitudinally approximately 80 cm (31 in), and 30 cm (12 in), respectively, and the floor, which intruded vertically approximately 40 cm (16 in). The driver was projected forward by the explosion and he loaded the steering assembly (**Figure 13**), displacing it forward approximately 25 cm (10 in). Scuff marks were noted on the roof above the driver's seat, possibly from contact by the driver's head. The rearview mirror was also displaced from possible contact by the driver's right hand. Fragments of fiber glass from the ruptured CNG tank were also deposited throughout the cab. Some of the fragments cut the ceiling upholstery in the front right passenger's space, and fragments were embedded in the roof and damaged a plastic storage compartment in this area. Both doors were jammed shut and the left door was mechanically pried open by rescue personnel. The windshield was in place and holed due to explosion forces. The right and left glazings as well as the backlight all disintegrated due to the explosion. The only undamaged glazings were the small windows on each door.

Manual Restraint Systems

The front seating positions were equipped with lap and shoulder safety belts with fixed upper anchors.

The driver was restrained by the lap and shoulder safety belt based on the police-reported statement of a witness who was one of the first to arrive at the vehicle immediately following the

incident. The front right passenger stated during the interview that he was restrained by the lap and shoulder safety belt. He sustained a contusion across his chest consistent with safety belt usage. Inspection of both safety belt assemblies revealed evidence of historical usage, but no discernable evidence of loading was found.

Figure 13: Intrusion of the back wall of the Freightliner's cab and displacement of the steering column from driver contact

CNG Fuel System Inspection by Other Party

The Freightliner and its fuel system were inspected by the Director of Technology for the Clean Vehicle Education Foundation. A summary of findings from his preliminary report[2] relative to the CNG fuel system are as follows:

1. The neck mounts on all five cylinders were broken by the pressure wave and there were many fractures of the aluminum supporting structure.

2. The right front vertical member of the supporting structure was bent into a radius, apparently by the rupturing cylinder when it was propelled forward and to the right by the escaping gas.

3. All of the high-pressure CNG from the system escaped through the broken cylinder connections in about ten minutes following the arrival of the first responders. There was no ignition and no fire.

4. The composite fracture apparently progressed approximately in a longitudinal direction and then turned and ran circumferentially, separating one of the cylinder ends and ejecting it from the driver's side of the truck.

5. No existing reports of such low velocity, high momentum and concentrated impacts against fiber reinforced composite pressure vessels have been identified. This impact scenario is unlike either the blunt impacts imposed during the NGV2 drop tests or the high-velocity impact of the NGV2 penetration test (gunfire). The sharpness of the fork tip and its point of impact directly into the cylinder sidewall are also unlike the previous oblique severe impacts of roof-mounted cylinders against overhead obstruction. This is the first rupture incident apparently resulting from impact on a NGV2 cylinder made since the drop impact tests were strengthened in 1998.

6. The pressurized cylinder had enhanced sidewall rigidity because it was nearly full. This rigidity probably prevented general deflection in the sidewall (to an oval shape). This deflection is

[2] The report was obtained from the investigating police agency. There was no prohibition specified in the report regarding the dissemination of the preliminary findings.

considered favorable in reducing impact damage to an empty cylinder. A more compliant, less pressurized cylinder could have deflected and reduced damage at the point of impact.

7. The cylinder was possibly more rigidly attached to the massive truck chassis because it was the bottom cylinder in a framework rigid enough to carry a five-high stack of cylinders. The cylinder thus could not move away from the impact to reduce the damage at the point of impact.

8. The shape of the fork tip probably produced a cut perpendicular to the critical hoop direction reinforcing fibers. These fibers carry the greatest load in a pressure vessel and the orientation of the fork tip was such to maximize the number of hoop fibers that were damaged.

9. If the fork tip penetrated the sidewall of the cylinder it would have wedged the break open because the long taper of the fork. This could have inflicted greater damage than a simple penetration by a 2 mm x 60 mm point.

10. A low impact speed with high momentum may be more damaging to composites than a high velocity impact.

11. Information from tests and other accidents indicate that CNG cylinders resist rupture as a result of more blunt impacts. This may be a more likely damage scenario from general loose cargo. The occupant space in the cab could receive considerable protection from the cylinders and mounting structure.

2014 FREIGHTLINER M2 112 OCCUPANTS

DRIVER DEMOGRAPHICS

Age/Sex:	[redacted]
Height:	
Weight:	
Eyewear:	
Seat Type:	Pedestal
Seat Track Position:	Unknown
Manual Restraint Usage:	Lap and shoulder safety belt
Usage Source:	Witness statement
Air Bags	None
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Removed by emergency responders
Transport from Scene:	Transported from scene for autopsy
Medical Treatment:	None, deceased at scene

DRIVER INJURIES [redacted]

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1 2	Hemorrhage, subarachnoid over both cerebral hemispheres, not further specified	140693.2,1 140693.2,2	Steering wheel rim	Probable
3	Fracture right orbital plate, not further specified	251200.2,1	Steering wheel rim	Probable
4	Fracture nose with displacement (deformity), not further specified	251002.2,4	Steering wheel rim	Probable
5	Laceration pericardium with residual blood in sac	441602.2,4	Steering wheel hub and/or spokes	Certain
6	Laceration (tear) right and left atria, not further specified	441016.6,4	Steering wheel hub and/or spokes	Certain
7	Laceration (tear), multiple, thoracic aorta, not further specified	420206.4,4	Steering wheel hub and/or spokes	Certain
8	Laceration (rupture) left diaphragm with protrusion of stomach into left chest cavity	440610.4,2	Steering wheel hub and/or spokes	Certain
9	Fractured ribs, multiple, bilaterally, right greater than left	450203.3,3	Steering wheel hub and/or spokes and rim	Certain
10	Contusions bilateral pleural surfaces of lungs, not further specified	441420.3,3	Steering wheel hub and/or spokes	Probable
11	Lacerations bilateral pleural surfaces of lungs with extensive parenchymal hemorrhage	441450.4,3	Steering wheel hub and/or spokes	Certain
12	Hemothoraces, bilaterally, with residual blood in each pleural cavity, not further specified	442200.3,3	Steering wheel hub and/or spokes and rim	Certain
13	Laceration left kidney, not further specified	541620.2,2	Steering wheel rim	Certain
14	Lacerations, multiple, capsule of liver, with internal crush injury of parenchyma, not further specified	541826.4,1	Steering wheel hub and/or spokes and rim	Certain
15	Laceration capsule of spleen with fragmentation of spleen, not further specified	544226.4,2	Steering wheel hub and/or spokes and rim	Certain
16	Fracture, palpable, right shoulder, not further specified	751800.2,1	Seat back, driver's	Probable
17 18	Lacerations (cuts) right side of face from right periorbital area to right chin, not further specified	210602.1,1 210602.1,8	Noncontact injury: flying glass, back light	Probable
19	Lacerations (cuts) right side of neck, not further specified	310602.1,1	Noncontact injury: flying glass, back light	Probable

***Driver Injuries** (Continued)* [redacted]

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
20	Laceration, stellate tear, open wound, right lower quadrant of abdomen, not further specified	510602.1,1	Steering column and/or tilt adjustment lever	Probable
21	Abrasions, multiple, posterior right upper arm from shoulder to elbow	710202.1,1	Noncontact injury: flying glass, back light	Probable
22	Laceration (cut) posterior right arm near elbow	710602.1,1	Noncontact injury: flying glass, back light	Probable
23	Abrasions, multiple, dorsal (posterior) left wrist, not further specified	710202.1,2	Noncontact injury: flying glass, back light	Probable
24	Lacerations, multiple, dorsal (posterior) right hand	710602.1,1	Noncontact injury: flying glass, back light	Probable
25	Abrasions, multiple, on bilateral thighs, not further specified	810202.1,3	Steering wheel rim	Probable
26	Abrasions, multiple, on lower legs, not further specified	810202.1,3	Left lower instrument panel	Certain
27	Contusions, multiple, on proximal bilateral thighs, not further specified	810402.1,3	Steering wheel rim	Probable
28	Contusions, multiple, on lower legs, not further specified	810402.1,3	Left lower instrument panel	Certain
29	Laceration, open, just below and lateral to left knee with foreign material embedded	810602.1,2	Left lower instrument panel	Certain

Source: Autopsy Records.

DRIVER KINEMATICS

The driver was restrained by the lap and shoulder safety belt. He was displaced forward and upward as a result of explosion forces and intrusion of the back wall of the cab. His face and chest loaded the steering assembly causing a subarachnoid hemorrhage, fracture of the right orbital plate and nose, lacerations of the pericardium, right and left atria, thoracic aorta, and diaphragm. He also sustained bilateral fractures of multiple ribs, contusions and lacerations of the lungs, and lacerations of the left kidney, liver, and spleen from contacting the steering assembly. Contact with the seat back caused a fracture of the right shoulder, and he sustained multiple lacerations and abrasions from flying glass from the disintegrated backlight. He also sustained multiple abrasions and contusions to the lower extremities from contacting the lower left instrument panel and steering wheel rim, and an open laceration of the left lower leg, also from contacting the lower left instrument panel. The driver injuries were fatal and he was officially pronounced deceased at 1640 hours.

FRONT RIGHT OCCUPANT DEMOGRAPHICS

[redacted]

Age/Sex: [redacted]
Height:
Weight:
Eyewear:
Seat Type: Pedestal
Seat Track Position: Unknown
Manual Restraint Usage: Lap and shoulder safety belt
Usage Source: Passenger interview and injury data
Air Bags None
Alcohol/Drug Involvement: None
Egress from Vehicle: Exited without assistance through disintegrated right front window
Transport from Scene: Ambulance
Medical Treatment: Hospitalized one day

FRONT RIGHT OCCUPANT INJURIES

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Traumatic (closed) head injury, not further specified, with mild headache	110009.1,0	Noncontact injury: impact (blast) forces	Probable
2	Contusion, acute left lung, left upper lobe, secondary to explosion/blast	441420.3,2	Noncontact injury: impact (blast) forces	Certain
3	Contusion posterior scalp, not further specified	110402.1,6	Seat back, front right passenger's	Probable
4	Laceration, 1.3 cm (0.5 in) in length on right posterior scalp	110602.1,6	Other interior loose object: fiber glass debris	Probable
5	Avulsed (missing) gum tissue from upper right incisor area	243206.1,8	Right instrument panel	Probable
6 7	Abrasions, superficial, to right side of nose and lower lip	210202.1,4 210202.1,8	Right instrument panel	Probable
8	Abrasion across mid chest with bilateral tenderness, not further specified	410202.1,4	Torso portion of safety belt system	Certain
9	Penetrating (puncture) injury back of left shoulder, one near arm pit, one over scapula	716011.1,2	Other interior loose object: fiber glass debris	Certain
10	Laceration, 2.5 cm (1 in), vertically oriented, above right knee	810602.1,1	Right lower instrument panel	Probable
11	Laceration, 2.5 cm (1 in), horizontally oriented, below right knee	810602.1,1	Right lower instrument panel	Probable
12	Abrasion left lower leg, probably left knee, not further specified	810202.1,2	Right lower instrument panel	Probable

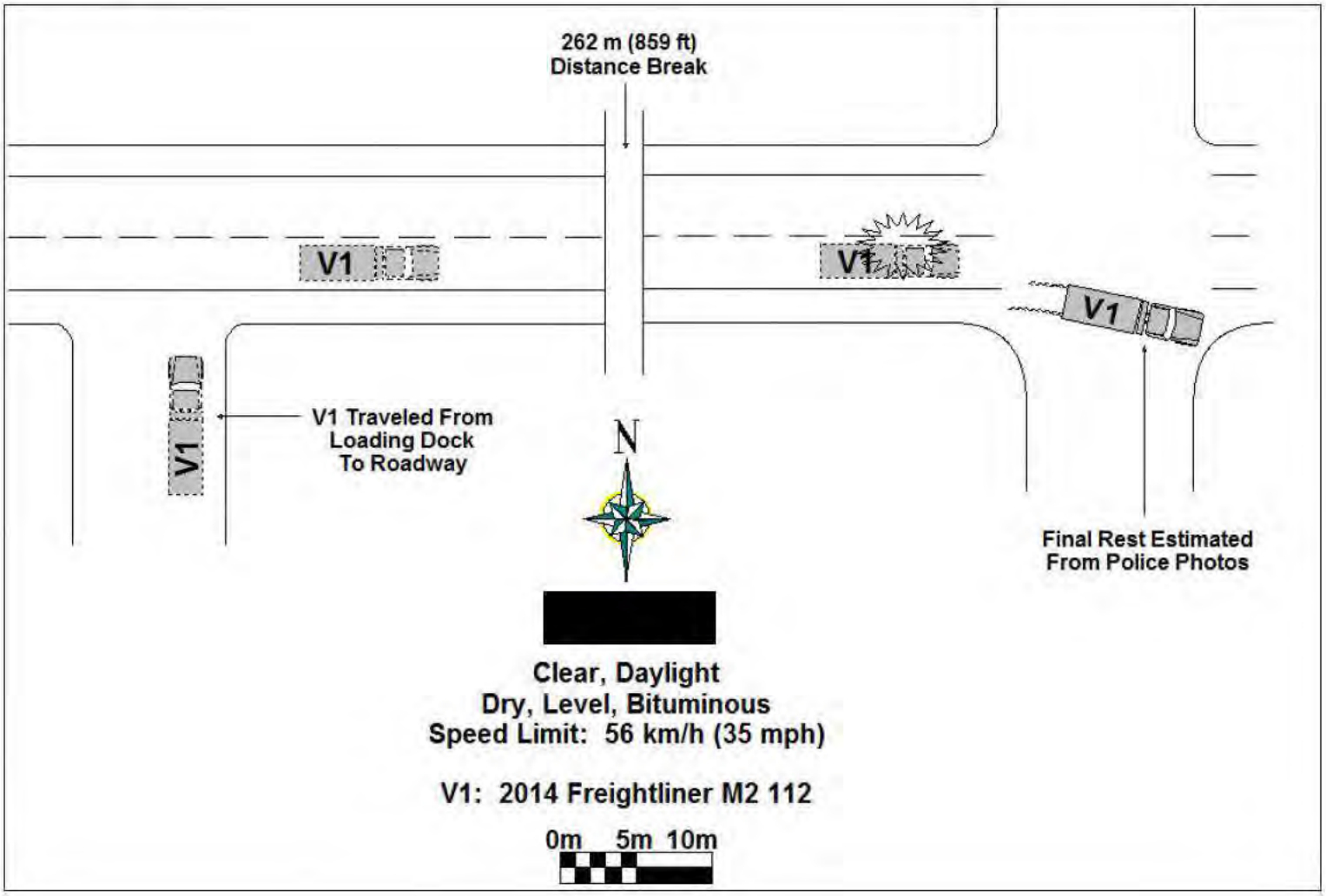
Front Right Occupant Injuries ***(Continued)*** [redacted]

Sources: Emergency Room Records, Hospitalization Records, and Interviewee Data–Same Person. Injury Numbers 4 and 9 through 11 came only from ***Interviewee Data****. Injury Numbers 3, 5, and 12 came only from* ***Emergency Room Records****. Injury Number 8 came only from* ***Hospitalization Records****. Injury Numbers 1 and 2 came from a combination of* ***Emergency Room*** *and* ***Hospitalization Records****. Injury Numbers 6 and 7 came from all three sources.*

FRONT RIGHT OCCUPANT KINEMATICS

The front right passenger was restrained by the lap and shoulder safety belt and was displaced forward as a result of explosion. The blast forces caused a closed head injury and left lung contusion. He loaded the safety belt causing an abrasion across his chest, and contacted his face on the right instrument panel causing an abrasion on the nose and lower lip, and an avulsion of the gum. His lower extremities contacted the right lower instrument panel causing a laceration above and below the right knee and an abrasion on the left knee. He rebounded back into his seat and contacted the back of his head on the seat causing a contusion to the posterior scalp. Flying fiber glass fragments from the exploded CNG cylinder caused two puncture injuries to the back of the left shoulder and a laceration to the back of the head. The front right passenger exited the vehicle without assistance through the disintegrated right side window glazing. He was transported by ambulance to a hospital where he was admitted for one day.

INCIDENT DIAGRAM [redacted]



PE14-020

11-4-2014

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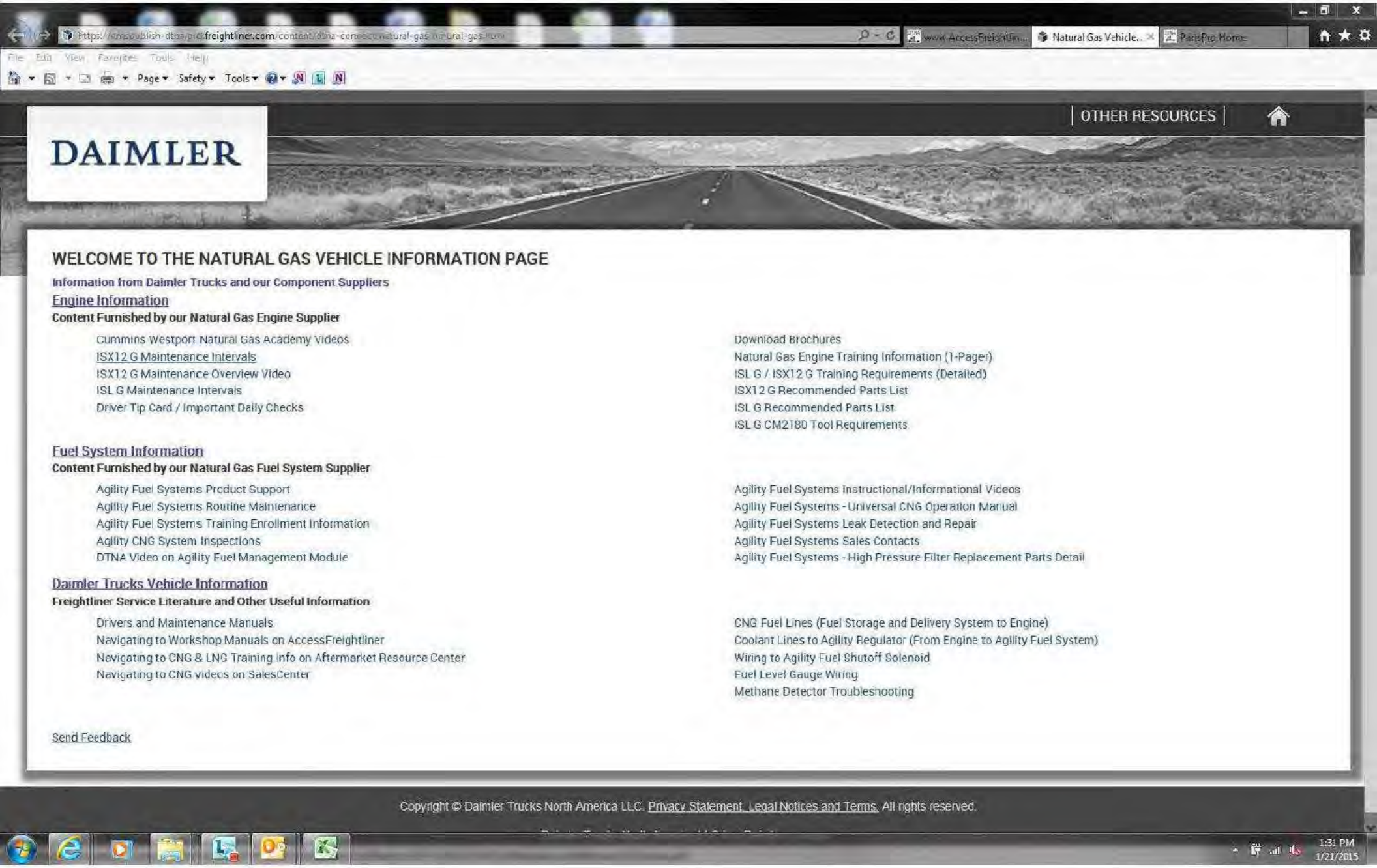
Natural Gas Information Page Image



WELCOME TO THE NATURAL GAS VEHICLE INFORMATION PAGE

Information from Daimler Trucks and our Component Suppliers

Engine Information

Content Furnished by our Natural Gas Engine Supplier

- Cummins Westport Natural Gas Academy Videos
- ISX12 G Maintenance Intervals
- ISX12 G Maintenance Overview Video
- ISL G Maintenance Intervals
- Driver Tip Card / Important Daily Checks
- Download Brochures
- Natural Gas Engine Training Information (1-Pager)
- ISL G / ISX12 G Training Requirements (Detailed)
- ISX12 G Recommended Parts List
- ISL G Recommended Parts List
- ISL G CM2180 Tool Requirements

Fuel System Information

Content Furnished by our Natural Gas Fuel System Supplier

- Agility Fuel Systems Product Support
- Agility Fuel Systems Routine Maintenance
- Agility Fuel Systems Training Enrollment Information
- Agility CNG System Inspections
- DTNA Video on Agility Fuel Management Module
- Agility Fuel Systems Instructional/Informational Videos
- Agility Fuel Systems - Universal CNG Operation Manual
- Agility Fuel Systems Leak Detection and Repair
- Agility Fuel Systems Sales Contacts
- Agility Fuel Systems - High Pressure Filter Replacement Parts Detail

Daimler Trucks Vehicle Information

Freightliner Service Literature and Other Useful Information

- Drivers and Maintenance Manuals
- Navigating to Workshop Manuals on AccessFreightliner
- Navigating to CNG & LNG Training Info on Aftermarket Resource Center
- Navigating to CNG videos on SalesCenter
- CNG Fuel Lines (Fuel Storage and Delivery System to Engine)
- Coolant Lines to Agility Regulator (From Engine to Agility Fuel System)
- Wiring to Agility Fuel Shutoff Solenoid
- Fuel Level Gauge Wiring
- Methane Detector Troubleshooting

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News Story Link

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NGVAMERICA
Natural Gas Vehicles for America

MEMBER NEWSLETTER

Advocating the increasing use of NGVs where they benefit most.
For the economy. For the environment. For health. For security. For America.

April 4, 2014
Volume 17 Edition 14

Man Dies in Natural Gas Truck Accident

On Thursday, an accident occurred in the Village of Howard, Wisconsin, outside of Green Bay, involving a natural gas truck in which the driver was killed and the passenger hospitalized. News and police reports indicate that the accident appeared to be the result of a heavy shifting load compromising the truck's fuel system. The load in this case was a forklift truck that slid forward as the vehicle slowed to turn, penetrating the back-of-cab-mounted CNG fuel system. *There was no detonation or a thermal event in this tragic accident.*

Below is a summary of information currently available to NGVAmerica:

- The Freightliner box-style truck was transporting a large forklift truck from one facility to another about 300 yards away.
- When the driver braked to pull into the driveway, the forklift rolled toward the front of the vehicle, forks forward, penetrating through the trailer wall and into the cylinder cabinet (which had been manufactured by Agility Fuel Systems).
- A view from the front shows a Type IV Hexagon Lincoln neck-mount cylinder.
- A picture of the truck taken from the driver's side-view appears to show that the fork carriage pushed the whole cylinder cabinet and truck cab forward.
- Two lower cylinders are missing from the cylinder cabinet. The bottom cylinder was impacted by a fork near the top of the sidewall and ruptured into two pieces
- The other cylinder was blown clear but did not rupture.
- The valve was broken off of the middle cylinder when it was forced out of the neck mount.
- The two top cylinders are still in their mounts.
- The escaping gas pushed the cab floor almost to the windshield. The driver was killed and the passenger was ejected through the windshield.
- The drive shaft was bent into a U and the engine blown off its mounts.
- Natural gas was still escaping from broken lines when the first responders arrived.
- One end of a cylinder is on the ground some distance from driver's side of the truck. It looks like a clean circumferential break indicating that the helical plies failed but not the hoop plies. White glass fibers are apparent at the break.

The industry, NGVAmerica and CVEF will continue to work with authorities to investigate the incident. We will keep our members informed as new information becomes available.

Senate Finance Committee Considers Tax Extenders

This week, the Senate Finance Committee considered and passed, on a bipartisan vote, the *Expiring Provisions Improvement Reform and Efficiency (EXPIRE) Act*, a "tax extenders" bill. The bill seeks to extend tax incentives that either expired on December 31, 2013 or are set to lapse at the end of 2014. Of importance to the NGV industry, the legislation includes two one-year extensions (from January 1, 2014 thru December 31, 2015) for the preexisting the 50 cent per gallon alternative transportation fuel tax credit and the alternative fuel vehicle refueling property tax credit. The passage of this legislation by the Senate Finance Committee is the first step by the Congress to address the expired tax provisions. These provisions must still be considered by the full Senate and the House of Representatives before it can be sent to the President. Legislative language, amendment text and related materials are all available on the website of the Senate Finance Committee

at: [redacted]. For more information, contact Paul Kerkhoven at 202.824.7363 or pkerkhoven@ngvamerica.org.

NGVAmerica Members, Clean City Stakeholders Visit Capitol Hill

On Tuesday, clean transportation leaders as well as numerous Clean Cities coordinators and stakeholders from across the nation were in Washington, D.C., to educate federal policymakers about the need to expand America's use of alternative fuels. On the following day, NGVAmerica members met with their Members of Congress to discuss the need for an extension of the fuel and infrastructure credits and the need to expand our use of natural gas as a transportation fuel. The meetings were especially timely as the Senate Finance committee was considering legislation to extend expired tax credits the following day (See previous article). NGVAmerica members were in town for their spring board meeting, while the Clean Cities coordinators and their stakeholders were in town to attend the Transportation Energy Partners-organized Energy Independence Summit. During the summit participants were given the opportunity to interact with top administration officials—including a keynote address by EPA Administrator Gina McCarthy and leaders from the federal Departments of Energy, Defense, and Transportation, as well as from numerous NGVAmerica sponsoring organizations. A combined total over 240 Congressional offices were visited about the need for an extension of the alternative fuel and infrastructure credits as well as the ongoing need for federal support for alternatives to petroleum-based fuels. NGVAmerica wishes to express its gratitude to all the participants for taking the time out of their busy schedules to visit with their Members of Congress. For more information, contact Paul Kerkhoven at 202.824.7363 or pkerkhoven@ngvamerica.org.

NRC Report on Next Phase of Fuel Economy and GHG Reductions

On Friday, the National Research Council (NRC) released a report that offers insight into ways that NHTSA and EPA can improve upon the current fuel economy and greenhouse gas (GHG) regulations for medium and heavy duty vehicles. The report, *Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two: First Report,* was published by the National Academy of Sciences. The report devotes a great deal of attention to the potential benefits of NGVs, and includes specific recommendations on the ways future regulations can better accommodate NGVs.

One recommendation is that the agencies should establish a separate standard for NGVs along the lines of the current ones for gasoline and diesel vehicles. Regulations in place today provide different levels of emissions control and sometimes different phase-in periods for gasoline and diesel fueled engines and vehicles. Under the EPA and NHTSA

regulations, NGVs can fall under the gasoline regulations or the diesel regulations depending on whether the natural gas engine was derived from a base gasoline or diesel engine. The latest regulations also provide some flexibility, allowing manufacturers of heavy duty natural gas engines to choose which designation to use but, once a category is established, the natural gas engine must meet all of the requirements set out for the particular engine-type, including meeting criteria pollutant emissions (e.g., NOx, PM) for that engine category. Requirements that are specific to gasoline or diesel engines may not in some cases be appropriate for natural gas. If NGVs were to be regulated separately, EPA and NHTSA could fashion rules based on what is technologically and economically feasible for natural gas.

A second recommendations specific to natural gas include modifying the Greenhouse Emissions Model (GEM) to specifically include examples of natural gas engine types. GEM is used by manufacturers to demonstrate compliance with the standards, but to date it does not include any inputs for natural gas. A third recommendation (this one made with respect to other fuels – not just natural gas) is to include an assessment of upstream emissions in order to ensure that any benefits provided by tailpipe emissions or fuel economy performance are not otherwise negated by upstream emissions.

The report recommends that the government and private entities should support technical improvements to natural gas engine efficiency as well as cost reductions to storage systems and emissions controls in order to better take advantage of the greenhouse gas and petroleum reduction potential of natural gas. There also is a recommendation that EPA and NHTSA evaluate the need for and potential benefits and costs of setting an in-use fuel specification for natural gas. The chapter on natural gas devotes much attention to discussing the economic benefits of natural gas, its lower greenhouse gas emissions potential, and the challenges facing the use of natural gas as a transportation fuel.

The report otherwise spends a lot of time talking about the shortcomings of the Greenhouse Emissions Model and the need for real-world data to help regulators establish baseline fuel economy and emissions in order to guide an assessment of progress that is being made.

The full report is available at: http://www.nas.edu. For more information, contact Jeff Clarke at 202.824.7364 or jclarke@NGVAmerica.org.

State Legislative Update: Another Busy Week for NGV Initiatives

This week, it was Nebraska, Mississippi and Washington making changes to the taxation of natural gas. In Nebraska, LB 867 changes the state excise tax so that it is now imposed

per GGE for CNG and per DGE for LNG. The change becomes effective January 1, 2015. LB 867 also exempts natural gas that is used to compress or liquefy natural gas for transportation from sales and use taxes. Further, the utility gross receipts taxes normally imposed on natural gas will not apply through Jan. 1, 2020 to natural gas that is sold for transportation purposes.

In Mississippi, HB 1590 amends the motor fuel tax so that LNG is now taxed on a DGE basis at a rate of 18 cents. LNG vehicles also will no longer be required to comply with the states decal program. The changes are effective starting in 2015. In Washington, SB 6440 amends the motor fuel tax so that it no longer covers CNG or LNG. Both fuels instead will be covered by the decal program. Washington's excise tax was not beneficial so this change may be a temporary improvement. Other changes impact utility taxes and limit the price that utilities may charge marine users of natural gas.

In Georgia, new incentives are included in HB 348, which was signed into law on April 4. The new law provides tax credits for medium and heavy duty alternative fuel vehicles. The tax credits are limited to dedicated NGVs and vehicles that use at least 90 percent natural gas. The maximum value of the credits is as follows: $12,000 for vehicles weighing 8,501–26,000 lbs. GVWR, and $20,000 for vehicles at 26,001 lbs. GVWR and up. The credits are capped at $2.5 million per fiscal year and there is a per company limit of $250,000 per year. The incentives are in place from July 1, 2015 to June 30, 2017.

Other important bills enacted:

- New York: AB 8559 extends the excise tax exemption for natural gas and other fuels until Sept. 30, 2016
- Utah: HB 61 includes new grant incentives for heavy duty on-road vehicles as well as non-road vehicles and equipment
- Utah: HB 74 expands tax credits currently available for new vehicles or conversions to include leased vehicles

For more information, please contact Jeff Clarke at 202.824.7364 or jclarke@ngvamerica.org.

NGV Market Engagement Encouraged at Illinois Municipal Utility Gathering

On Friday, NGVAmerica made the case for NGV market engagement at the Illinois Public Energy Agency (IPEA) Annual Conference in Effingham, Illinois. IPEA represents small- to medium-sized municipal gas distribution companies in the state. Stephe Yborra presented an NGV overview including market metrics, trends and

projections, and then presented the case for NGV adoption by fleets, suggesting ways IPEA members might work together to engage businesses that operate throughout the state. Following Stephe's mini-workshop, Argonne National Laboratory's Marcy Rood Werpy and St. Louis Clean Cities Coalition's Kevin Herdler briefly outlined grants, rebates and other assistance available through the Illinois EPA's Green Fleets Program and the state's Department of Commerce and Economic Opportunity's Alternative Fuel Research and Infrastructure Grant Program.

More information about IEPA's Green Fleets Program is available at www.illinoisgreenfleets.org, or you may contact Darwin Burkhart at 217.557.1441or darwin.burkhart@illinois.gov. More information about Illinois DCEO's Infrastructure grants program is available at http://www.illinois.gov/dceo/. Information about other states' grants and incentive programs is also available via the Policy Portal located on NGVAmerica's access-controlled Members Center using your membership password. For additional information about this and other NGVAmerica outreach activities, contact Stephe Yborra (syborra@ngvamerica.org or 301.829.2520) or Tom Sheehan (tsheehan@ngvamerica.org or 207.925.1136).

CVEF CNG Critical Issues Workshop Reminder

The Clean Vehicle Education Foundation's (CVEF) Technology Committee has announced a CNG Critical Issues Workshop to be held June 23-24, 2014 at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. The workshop will address a set of technology issues critical to the continued safe deployment of NGVs and associated infrastructure. A maximum of eight topics will be discussed on day one. The last half day will focus on developing action items and position papers as needed. A briefing document on each issue will be prepared prior to the meeting for review. Also participants will be asked to prepare short presentations in support of, in opposition to or stating alternative positions for their topic of interest.

Examples of the issues that may be included are:

- Ventilation of maintenance facilities—review of CVEF/Sandia report
- Unintended consequences from burst disc PRD use
- Proper placement and venting of PRDs
- Design changes for cylinder valves for safe removal
- Dispensing technology to prevent over pressure fills and achieve more effective filling in warm conditions
- Communication fills and on-board pressure management for vehicles
- Reliability/monitoring of solenoid and excess flow valves on containers
- The CNG cylinder/valve/PRD as a system vs. independent sourcing

CVEF is requesting the participants and other industry stakeholders suggest additional topics that may need to be considered in the workshop. Attendance for the one and one-half day workshop will be by invitation and limited to thirty participants. Depending on attendance by the Technology Committee members, an additional five to ten slots may be available. Interested parties should contact John Dimmick at jdimmick.cvef@gmail.com or Doug Horne at dbhorne1@comcast.net.

Wrightspeed Delivers Natural Gas Turbine-Electric Vehicles to FedEx

On Monday, Wrightspeed announced delivery of its turbine-electric medium duty Route system to its first customer, FedEx. The Route is a "repower" powertrain system that replaces a truck's diesel engine, transmission and differential. The Route's electric drive, which also can be plugged in, employs a turbine generator to charge batteries as needed on the road and can run on natural gas or traditional liquid fuels. FedEx has deployed both CNG and diesel versions of Wrightspeed's technology. Both versions significantly surpass California Air Resources Board's emissions standards. "We tend to think of pure battery electric vehicles as the cleanest vehicle technology available, and that used to be true," says Wrightspeed marketing manager, Maya Giannini. "However, our onboard generator burns cleaner per kWh than the average mix of U.S. electric power plants, making Wrightspeed's products cleaner than an EV."

Altech-Eco Receives EPA Cert. for 2015 Ford F-250/350 6.2L Engine

Altech-Eco has received EPA certification for its bi-fuel and dedicated system for 2015 Ford F-250 and F-350 6.2L Engine. Altech-Eco offers in-the-bed tank configurations in 13.6 GGE and 21.2 GGE sizes for the F-250 and F-350 models. As a Ford QVM, Altech-Eco's systems enjoy the same 80,000 Miles/8 Year Emissions Components Warranty. For more information, visit www.altecheco.com/pages/f250.html or contact Miles George at miles@transecoenergy.com.

Clean Energy Opens Three CNG Stations, Signs Fueling Agreements

On Tuesday, Clean Energy announced fueling has begun at its Amarillo, Texas, and Oklahoma City, Oklahoma, America's Natural Gas Highway (ANGH) stations to serve UPS' growing heavy duty LNG truck fleet. UPS deployed six heavy duty LNG-powered trucks that will fuel at the Oklahoma City station, and an addition four trucks will also begin fueling at this location in the coming weeks. These tractors are expected to consume approximately 300,000 DGE of LNG per year. Ten LNG trucks have begun fueling at the Amarillo station under its previously announced bulk fueling agreement.

Clean Energy also announced two fueling agreements with Dillon Transport, a Tennessee-based truckload carrier, and carrier EJ Madison, a Texas-based transportation and logistics company. EJ Madison deployed a fleet of 20 long-haul dual-fuel LNG trucks on routes spanning Clean Energy's ANGH network. EJ Madison intends to expand this fleet with an additional 30 dual-fuel LNG trucks in the coming months. The vehicle conversions are being done by Clean Fuel Technologies in El Paso, Texas. Once fully deployed, the fleet is expected to consume approximately 336,000 DGE of LNG per year. Dillon Transport, a long-time customer of Clean Energy, has deployed an additional eight CNG trucks and signed a fueling agreement to fuel at Clean Energy's Fair Oaks Dairy station in Indiana. The fleet will be hauling raw materials for Owens Corning and is expected to consume approximately 240,000 DGE of CNG per year.

Also this week, Clean Energy announced fueling has begun at its newest publically accessible CNG station located at JFK International Airport within the newly-opened JFK multi-fuel travel plaza. The new station will service a variety of fleet vehicles, including heavy and medium duty trucks as well as shuttles and taxis that service the airport. Ferrara Brothers Building Materials will fuel some of its ready-mix concrete mixers at the new station, as will the New York Department of Sanitation's municipal refuse fleet. The travel plaza is open 24/7 and accepts credit cards and fleet fuel cards. Other alternative fuels available include E-85, EV charging stations, as well as conventional gasoline and diesel. Clean Energy is now operating at every international airport in the Northeast and currently operates over thirty public stations in the Tri-State area.

In addition, Clean Energy announced this week that it has commenced production and sales of "Redeem" (biomethane) fuel at its Memphis biomethane plant. The facility is located at the Republic Services' North Shelby landfill outside of Memphis. The facility is forecasted to achieve an annual production rate of approximately 3.7 million GGE of Redeem once fully operational. For more information, contact Patric Rayburn at patric.rayburn@cleanenergyfuels.com or 949.437.1411.

Freedom CNG Opens Fueling Station in Houston

Freedom CNG, a provider of natural gas fueling infrastructure for high-volume users in the Houston Metropolitan Area, has celebrated the grand opening of a new public fast-fill CNG fueling station in Houston. The station features three dispensers, which will service both commercial and public vehicles. The canopy and other aspects of the station were built to accommodate heavy-duty fleet vehicles. The station was designed around two 250 horsepower compressors capable of delivering approximately 1,500 GGE per hour. "Freedom CNG's vision for the future is to provide enough truck friendly fast-fill CNG fueling stations in the Houston area for fleets to have the confidence to adopt CNG as

their fuel of choice," said Bill Winters. Freedom CNG plans to add an addition 10 fueling stations to the greater Houston area. For more information, visit www.freedom-cng.com or contact John Athon at 713.725.6353 or john@freedom-cng.com.

Chevy Dealership Opens CNG Station in Dallas

On Tuesday, Chevy dealership Classic Chevrolet opened a CNG fueling station Dallas, Texas. The Classic Clean Fuels station will serve both fleets and consumers. The station is located in the Thompson Group Commercial & Fleet building parking lot. The Thompson Group will serve as the anchor fleet for the station.

Freight Liner Starts Production of Cascadia Natural Gas Sleeper

Freightliner Trucks has started production of additional features for the Freightliner Cascadia natural gas-powered tractor. The Cascadia natural gas tractor is now available with a 48-inch sleeper cab, and factory-installed CNG fuel tanks. The Meritor WABCO OnGuard Collision Safety System is also now available on Cascadia natural gas-powered tractors spec'd with a manual transmission. The Cascadia is equipped with the Cummins Westport ISX12 G engine, and it features a variety of CNG fuel tank configurations and up to 190 DGE capacity with an anticipated fill-range of about 800 miles. The Cascadia natural gas sleeper has a roomy and comfortable cab with driver-friendly features, as well as the latest aerodynamic elements to further enhance overall performance. For more information, visit www.FreightlinerTrucks.com.

Chart Unveils Larger Capacity LNG Fuel System

Chart Industries has made available a new bonus capacity LNG vehicle system. The new system maximizes the volumetric efficiency of the LNG fuel tank by six percent for the 2015 model year. This bonus capacity option is available on 26 inch diameter horizontal vehicle tanks—the industry standard size. While the size of the external tank remains the same, the internal tank capacity has been increased to extend vehicle range.

Ryder's Natural Gas Fleet Surpasses 20 Million Miles

Ryder Systems has announced that its fleet of over 500 NGVs has now surpassed 20 million miles. The fleet consists of LNG and CNG tractors serving over 40 customer operations in California, New York, Texas, Arizona, Michigan, Utah, Georgia and Louisiana. Since deploying its NGV program in 2011, Ryder has replaced approximately 3.1 million gallons of diesel fuel. In 2013, Ryder opened its first natural gas fueling stations to serve both the general public and Ryder lease and rental customers. Ryder's LCNG stations are located at two maintenance and fueling facilities in Orange and

Fontana, California. In addition to making NGVs available for rent or lease, Ryder's "Flex-to-Green Lease" solution is designed to ease the transition to a greener fleet. Businesses that opt for Ryder's Flex-to-Green Lease start out with a diesel-powered vehicle and then have the option to convert to an NGV at any time following the first full year of the lease.

New Company Sparq to Promote the Use of CNG in Transportation

Three members of the former Chesapeake Energy Corp. CNG vehicle team have launched Sparq Natural Gas, LLC, a new initiative aimed at promoting the use of CNG as a vehicle fuel. Based in Oklahoma, Sparq will partner with existing convenience stores and will act as a consultant to companies considering entering or expanding into the CNG business. CEO Norman Herrera explained Sparq's team, including Chief Financial Officer Tristan Adler and Chief Operating Officer Sufyan Qarni, wanted to introduce an NGV business founded on the objective of regional infrastructure development supported by national consulting and advisory services.

New Report Highlights Benefits of LNG in Canada's Marine Sector

The Steering Committee of Canada's West Coast Marine LNG Joint Industry Project has released a report highlighting the benefits of using LNG for Canada's marine sector. According to the report, *Liquefied Natural Gas: A Marine Fuel for Canada's West Coast*, all of the technologies needed to use LNG as a marine fuel are proven and commercially available. "Allowing access for LNG in the marine sector is smart and strategic for Canada," said Alicia Milner, President of the Canadian Natural Gas Vehicle Alliance (CNGVA) and Chair of the project steering committee. "British Columbia is uniquely positioned to become a preferred North American destination for LNG bunkering." In the near-term, coastal vessel operators have the best opportunity to benefit from LNG. For six coastal vessels analyzed, fuel costs were reduced by more than 50 percent with five of the ships having a payback on initial investment of less than six years. New marine regulations taking effect in January 2015 require a 90 percent reduction in fuel sulfur content. Compared to traditional marine fuels, LNG use can reduce sulfur emissions by at least 90 percent, lower nitrogen oxide emissions by 35 percent or more, decrease particulate matter by at least 85 percent and reduce greenhouse gas emissions by up to 19 percent. Jointly funded by Transport Canada and a broad group of industry and other participants, the report recommends changes to Canada's marine regulatory framework to allow for the review and approval of new LNG projects. These changes would support new projects moving forward, including the use of three LNG ferries that BC Ferries plans to have in operation in 2017.

The NGVAmerica newsletter is an NGVAmerica member benefit and should only be distributed to members of NGVAmerica. Redistribution to nonmembers is strictly prohibited. For more information, contact Rich Kolodziej at 202.824.7366 or rkoodziej@ngvamerica.org.

For comments on the content of this newsletter or for mailing list changes, contact Rich Kolodziej at rkolodziej@NGVAmerica.org.

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PE14-020

11-4-2014

DATA TO ODI

NO LETTER

One_dead_after_natural_gas_truck_explodes_in_Howard (thenorthwestern.com)

[redacted]

One person was killed after the truck he was driving exploded Thursday on Pamperin Road in Howard. / H. Marc Larson/Press-Gazette Media

Zoom

One person was killed after the truck he was driving exploded Thursday on Pamperin Road in Howard. / H. Marc Larson/Press-Gazette Media

HOWARD — A truck driver was killed and another man was critically injured Thursday when a truck's fuel system exploded near an industrial park, officials said.

Ed Janke, public safety director of the village of Howard, said the explosion — reported around 1:30 p.m. — appears to be the result of a shifting load compromising the truck's fuel system.The Brown County Sheriff's Office said the truck had slowed for a turn when the its load of heavy equipment moved forward and penetrated the truck's compressed natural gas fuel system, causing it to explode."The truck slowed to turn into a driveway and the load shifted inside, apparently, and that compromised the compressed natural gas fuel system on the truck," Janke said. "The fuel system subsequently detonated."The male driver was pronounced dead at the scene and a male passenger was thrown from the cab and transported to a hospital with what are described as critical injuries, the Brown County Sheriff's Office said in a written statement.About an hour after the original report, the truck's cab sat cocked forward on its chassis near the corner of Pamperin and Cornell roads in the Howard Industrial Park. Crews remained on the scene into late afternoon.Several businesses in the area were evacuated as a precaution, but Janke said later that people have been allowed to return to work.The truck is owned by Ace Manufacturing Industries Inc., which is located on Pamperin Drive. It was operating between two Ace Manufacturing Industries Inc. facilities in the area, Janke said."This is the first time I have seen the catastrophic release of a compressed fuel system like that," Janke said. "We were very concerned about additional explosions. We weren't sure what caused the original explosion, so we created a safe area."Ace Manufacturing issued a statement from co-owners [redacted] and [redacted] regarding the incident:"First and foremost, our thoughts and prayers go out to the family of the truck driver who lost his life in this accident, as well as another worker who was injured. For privacy reasons, we are not releasing the names of those involved. We are a small and close-knit company and this has shaken and saddened all of us."A hazardous material team was called to the scene, evaluated the area for any danger and determined no threat remained. The Brown County Sheriff's Department is investigating the incident.A number of people at the scene talked about how they heard a loud boom

and followed the firefighters to see the source of the noise."I was just sitting watching a baseball game and I heard a big ka-boom," said [redacted], who lives about a mile from the scene. "I knew it wasn't thunder. I didn't know what the heck it was."It was a big boom. It was loud enough it made my heart shudder."Pamperin Road between Velp Avenue and Cornell Road was expected to stay closed for several hours on Thursday while the investigation continues, according to the sheriff's office.—nphelps@pressgazettemedia.com and follow him on Twitter@nathanphelpsPG

PE14-020

11-4-2014

DATA TO ODI

NO LETTER

 Signed Request for Confidentiality and Certificate

DAIMLER

Daimler Trucks North America

Andy Jones
Manager
Product Compliance and Regulatory Affairs

January 23, 2015

Mr. O. Kevin Vincent
Chief Counsel
National Highway Traffic Safety Administration
1200 New Jersey Avenue, S.E.
West Building W41-227
Washington D.C. 20590

Re: Request for Confidential Treatment
Office of Defects Investigation Information Request [redacted]

Dear Mr. Vincent:

Pursuant to 49 C.F.R Part 512 and Exemption 4 of the Freedom of Information Act, 5 U.S.C. § 552(b)(4), Daimler Trucks North America LLC ("DTNA") respectfully requests confidential treatment for the DTNA documents which contain confidential and proprietary DTNA information. If disclosed, the Confidential DTNA Material herein would cause irreversible competitive harm to DTNA as it has spent substantial time and resources to develop the information. Part 512 requirements are provided below.

49 C.F.R § 512.8(a) – Describe the information for which confidentiality is being requested

The documents for which confidentiality is being requested are portions of the [redacted] response and 5 different electronic files on 1 CD related to [redacted] (hereinafter referred to as "Confidential DTNA Material"). The specific files for which confidential treatment is requested are listed below. These materials are marked "Confidential Business Information" on each page, as required by 49 C.F.R. § 512.6. As described in detail below, the Confidential DTNA Material reveals detailed sales and marketing information, field reports, warranty information, and test information which competitors could use to improve their own processes, designs and market position.

49 C.F.R § 512.8(b) – Identify the confidentiality standard(s)

Under § 512.15(b), information is exempt from disclosure if its disclosure would cause substantial harm to the competitive position of the submitter. Exemption 4 of the Freedom of Information Act ("FOIA"), 5 U.S.C § 552(b)(4), protects the confidentiality of information that would be likely to cause substantial competitive harm to the submitter if disclosed. *See National Parks and Conservation Ass'n v. Morton*, 498 F.2d 765 (D.C. Cir. 1974) (confidential commercial information is protected from disclosure under FOIA if its release is likely to cause competitive harm). The materials described below are proprietary and confidential business information, the

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4747 N. Channel Avenue
Portland OR 97217-7699
503-745-5508 Phone
503-745-5544 Fax
Andy.Jones@Daimler.com

release of which is likely to cause competitive harm to DTNA, and therefore entitled to confidential treatment.

49 C.F.R § 512.8(c)(2) - What the harmful effects of disclosure would be and why the effects should be viewed as substantial

Disclosure of the Confidential DTNA Material would cause substantial competitive harm. The trucking industry is highly competitive. "Because competition in business turns on the relative costs and opportunities faced by members of the same industry, there is a potential windfall for the competitors to whom valuable information is released under FOIA. If those competitors are charged only minimal FOIA retrieval cost for the information, rather than the considerable costs of private reproduction, they may be getting quite a bargain. Such bargains could easily have competitive consequences not contemplated as part of FOIA's principal aim of promoting openness in government." *Worthington Compressors, Inc. v. Costle,* 662 F.2d 45, 51 (D.C. Cir. 1981). Substantial competitive harm may also result from disclosures that reveal a company's strengths and weaknesses to competitors.

The Confidential DTNA Material could allow a competitor to develop a product, improve a process, or create a marketing strategy that without the Confidential DTNA Material the competitor would not. These consequences have been recognized as competitively significant and have been deemed to constitute substantial competitive harm. DTNA's competitors would greatly benefit, at DTNA's expense, from disclosure of the Confidential DTNA Material. The disclosure of this information would cause substantial harm to DTNA's competitive position.

This request for confidentiality pertains to portions of the [redacted] response and information contained in 5 electronic files on 1 CD-ROM related to [redacted]

1. Entire spreadsheet titled "Confidential Business Information Production Data.xlsx"
2. Detail production information in the response to request number 1 and request number 2.
3. Entire spreadsheet titled "Confidential Business Information Incident Data.xlsx".
4. Detailed warranty claim information in the response to request number 6 and request number 7.
5. Detailed test and analysis information in the response to request number 11.
6. Test reports titled "Confidential Business Information [redacted] CNG Cabinet Hard vs Rubber Mtg Review.pdf", "Confidential Business Information [redacted] 4461TM CTM CNG cabinet final inspection minor issues.pdf", "Confidential Business Information PTG077 - CNG Box - FE Results.pdf".
7. Detailed production parts usage and aftermarket parts sales information in the response to request number 14.

Item #1 - Entire spreadsheet titled "Confidential Business Information Production Data.xlsx"

Request number 1 of the Office of Defects Investigation request [redacted] asks DTNA to provide information regarding the VIN and configuration for each vehicle with a CNG fuel system manufactured for sale or lease in the United States by DTNA for model year 2011 through 2015 vehicles hence forth known as "subject vehicles" and "other CNG vehicles". DTNA contends that specific information regarding sales numbers and patterns is proprietary

information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. While fuel system configuration offerings are published, the extent to which specific configurations are sold, the geographic sales patterns, and the customer to whom they are sold is not available outside of DTNA. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain. Competitors could also adjust their own market plans and undercut DTNA's market share and reduce competition, resulting in substantial competitive harm to DTNA. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The spreadsheet is marked "confidential business information" as required by 49 CFR 512.6.

Item #2 - Detail production information in the response to request number 1 and request number 2

Request number 1 and request number 2 of the Office of Defects Investigation request [redacted] ask DTNA to provide information regarding the model and fuel system configuration for each subject vehicle and model year 2011 through 2015 M2 vehicles with a diesel fuel system hence forth known as "peer vehicles". DTNA contends that specific information regarding sales numbers and patterns is proprietary information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. While fuel system configuration offerings are published, the extent to which specific configurations are sold is not available outside of DTNA. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain. Competitors could also adjust their own market plans and undercut DTNA's market share and reduce competition, resulting in substantial competitive harm to DTNA. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The information is contained in brackets as required by 49 CFR 512.6.

Item #3 - Entire spreadsheet titled "Confidential Business Information Incident Data.xlsx"

Request number 4 of the Office of Defects Investigation request [redacted] asks DTNA to provide detailed information on reports which relate to, or may relate to, Level 2 or Level 3 CNG fuel container damage hence forth known as "subject condition" in the subject vehicles and other CNG vehicles. DTNA contends that specific information regarding field reports is proprietary information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain and provide competitors a list of perceived "strengths" and "weaknesses" of DTNA products. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The spreadsheet is marked "confidential business information" as required by 49 CFR 512.6.

Item #4 - Detailed warranty claim information in the response to request number 6 and request number 7

Request number 6 and request number 7 of the Office of Defects Investigation request NVS-[redacted] asks DTNA to provide detailed warranty information which relate to, or may

relate to, the subject condition in the subject or other CNG vehicles and alleged, reported or observed diesel fuel container damage that requires repair or replacement hence forth known as "peer condition" in peer vehicles. DTNA contends that specific information regarding warranty information is proprietary information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain and provide competitors a list of perceived "weaknesses" of DTNA products. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The information is contained in brackets as required by 49 CFR 512.6.

Item #5 - Detailed test and analysis information in the response to request number 11

Request number 11 of the Office of Defects Investigation request [redacted] asks DTNA to describe all assessments, analysis, test, test result, studies, surveys simulations, investigations, inquires and/or evaluations that relate to, or may relate to, the subject condition in the subject vehicles. Tests, studies, investigations, and testing timelines are described within the response indicating DTNA's development process. DTNA contends that specific information number, type and test timing regarding analysis, test, test result, studies, surveys simulations, investigations, inquires and/or evaluations is proprietary information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain and provide competitors a list of perceived "strengths" and "weaknesses" of DTNA products. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The files are marked "confidential business information" as required by 49 CFR 512.6.

Item #6 - Test reports titled "Confidential Business Information E91855 CNG Cabinet Hard vs Rubber Mtg Review.pdf", "Confidential Business Information E91855 PTG077 4461TM CTM CNG cabinet final inspection minor issues.pdf", "Confidential Business Information PTG077 - CNG Box - FE Results.pdf".

Request number 11 of the Office of Defects Investigation request [redacted] asks DTNA to describe all assessments, analysis, test, test result, studies, surveys simulations, investigations, inquires and/or evaluations that relate to, or may relate to, the subject condition in the subject vehicles. DTNA contends that specific information regarding analysis, test, test result, studies, surveys simulations, investigations, inquires and/or evaluations is proprietary information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain and provide competitors a list of perceived "strengths" and "weaknesses" of DTNA products. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The files are marked "confidential business information" as required by 49 CFR 512.6.

Item #7 - Detailed production parts usage and aftermarket parts sales information in the reponse to request number 14

Request number 14 of the Office of Defects Investigation request [redacted]ask DTNA to provide detailed aftermarket parts sales information regarding diesel fuel containers that may be used as replacement equipment on peer vehicles. DTNA contends that specific information regarding aftermarket parts sales is proprietary information, a trade secret and would be likely to cause substantial harm to DTNA's competitive position if released. While high level aftermarket parts sales information may be published, the individual part number sales figures are not available outside of DTNA. Disclosure of this information would provide competitors with substantial market information they could not otherwise obtain and provide competitors a list of perceived "strengths" and "weaknesses" of DTNA products. Competitors could also adjust their own market plans and undercut DTNA's aftermarket parts share and reduce competition, resulting in substantial competitive harm to DTNA. DTNA requests this information be granted confidential treatment pursuant to 49 CFR 512.15(a)&(b) for an indefinite period. The information is contained in brackets as required by 49 CFR 512.6.

49 C.F.R § 512.8(d) - Indicate if any items of information fall within any of the class determinations
Item #1 and Item #3 above, the production and incident VINs, are subject to the class determination for vehicle identification number information. *See* 49 C.F.R. part 512, Appendix D.

49 C.F.R § 512.8(e) - Indicate the time period for which confidential treatment is sought
DTNA anticipates that this information will continue to have great competitive value for the foreseeable future. Accordingly, DTNA requests that the information be protected from disclosure permanently.

Please note that a copy of this request has been submitted to Bruce York in the Office of Defect Investigations.

Please contact me if you have any questions.

Sincerely yours,

Andy Jones

Enclosure

DAIMLER

Daimler Trucks North America

Andy Jones
Manager
Product Compliance and Regulatory Affairs

January 23, 2015

Re: Certificate in Support of Request for Confidentiality

I Andy Jones, pursuant to the provisions of 49 CFR part 512, state as follows:

(1) I am Andy Jones, Manager, Product Compliance and Regulatory Affairs and I am authorized by DTNA to execute this certificate on its behalf;

(2) I certify that the information contained in [redacted] request (1), (2), (4), (6), (7), (11), and (14) is confidential and proprietary data and is being submitted with the claim that it is entitled to confidential treatment under 5 U.S.C. 552(b)(4) (as incorporated by reference in and modified by the statute under which the information is being submitted);

(3) I hereby request that the information contained [redacted] request (1), (2), (4), (6), (7), (11), and (14), be protected for an indefinite period;

(4) This certification is based on the information provided by the responsible DTNA personnel who have authority in the normal course of business to release the information for which a claim of confidentiality has been made to ascertain whether such information has ever been released outside DTNA;

(5) Based upon that information, to the best of my knowledge, information and belief, the information for which DTNA has claimed confidential treatment has never been released or become available outside DTNA;

(6) I make no representations beyond those contained in this certificate and, in particular, I make no representations as to whether this information may become available outside DTNA because of unauthorized or inadvertent disclosure (except as stated in paragraph 5); and

(7) I certify under penalty of perjury that the foregoing is true and correct. Executed on this the 23rd day of January, 2015. (If executed outside of the United States of America: I certify under penalty of perjury under the laws of the United States of America that the foregoing is true and correct).

Andrew Jones

Andy Jones

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PE14-020

11-4-2014

DATA TO ODI

NO LETTER

INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

ON-SITE COMPRESSED NATURAL GAS VEHICLE EXPLOSION INVESTIGATION

FOR THE OFFICE OF DEFECTS INVESTIGATION (ODI)
CASE NUMBER - [redacted]
LOCATION - WISCONSIN
VEHICLE - 2014 FREIGHTLINER M2 112
INCIDENT DATE - April 2014

Contract Number: [redacted]

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

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On-site compressed natural gas vehicle explosion investigation involving a 2014 Freightliner M2 112.

16. Abstract

This on-site investigation focused on the Compressed Natural Gas (CNG) fuel system of a 2014 Freightliner M2 112. One of the vehicle's five CNG fuel cylinders was punctured by the left fork of an unsecured Yale Type E forklift located in the cargo box of the Freightliner, resulting in an explosion of the fuel cylinder. There was no fire. This incident occurred on a two-lane roadway in an industrial park. The Freightliner was a two-door straight truck equipped with a CNG fuel system, consisting of five CNG fuel cylinders stacked vertically and secured within an aluminum cabinet located between the truck cab and cargo box. The cylinders had been filled the previous evening and the truck was used in the morning on the day of the incident. While the specific fill level of the CNG tanks is not known, it was reported by an investigator from the Clean Vehicle Education Foundation that the CNG cylinders were nearly full at the time of the incident. A restrained [redacted]-year-old male driver and a restrained [redacted]-year-old male front right passenger occupied the vehicle. The Freightliner was traveling east and was transporting an unsecured Yale Type E forklift. The Freightliner's driver was braking to initiate a right turn into a driveway when the forklift was displaced forward as a result of the deceleration and the forks impacted and pierced the front panel of the cargo box. The left fork then impacted and ruptured the lowest of the five CNG fuel cylinders resulting in a explosion. The driver sustained fatal injuries and expired at the scene. The front right passenger sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where he was admitted for one day.

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FOR THE OFFICE OF DEFECTS INVESTIGATION (ODI)
CASE NUMBER - [redacted]
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VEHICLE - 2014 FREIGHTLINER M2 112
CRASH DATE - April 2014

BACKGROUND

This on-site investigation focused on the Compressed Natural Gas (CNG) fuel system of a 2014 Freightliner M2 112 (**Figure 1**). One of the five CNG fuel cylinders was punctured by the left fork of an unsecured Yale Type E forklift located in the cargo box of the Freightliner resulting in a explosion of the fuel cylinder. There was no fire. This investigation was initiated by the National Highway Traffic Safety Administration (NHTSA) on April 15, 2014 through the Office of Defects Investigation (ODI), which was responding to an on-line news article. This investigation was assigned on April 17, 2014 when cooperation to inspect the Freightliner was finalized with the vehicle's owner. The incident involved the Freightliner and the Yale Type E forklift located within the cargo box of the vehicle. This incident occurred in April 2014 at 1335 hours, in Wisconsin and was investigated by a local police agency. The Freightliner and incident scene were inspected on April 22, 2014. Interviews with the front right passenger of the Freightliner, the owner of the Freightliner, and the city public safety director were also conducted on April 22, 2014.

Figure 1: On-scene police photograph of the damaged 2014 Freightliner M2 112

This incident occurred on a two-lane roadway in an industrial park. The Freightliner was a two-door straight truck equipped with a CNG fuel system, consisting of five CNG fuel cylinders oriented horizontally and stacked vertically within an aluminum cabinet located between the truck cab and cargo box. The cylinders had been filled the previous evening and the truck was used in the morning on the day of the incident. The fill level of the CNG tanks could not be determined. A restrained [redacted]-year-old male driver and a restrained [redacted]-year-old male front right passenger occupied the vehicle. The Freightliner was traveling east and was transporting an unsecured Yale Type E forklift. The Freightliner's driver was braking to initiate a right turn into a driveway when the forklift was displaced forward as a result of the deceleration and the forks impacted and pierced the front panel of the cargo box. The left fork then impacted and ruptured the lowest of the five CNG fuel cylinders resulting in a explosion. There was no fire. The driver sustained fatal injuries and expired at the scene. The front right passenger sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where he was admitted for one day.

Incident Site: This incident occurred during daytime hours on a two-lane roadway in an industrial park. The weather conditions were clear with 10 mile visibility, northeasterly winds at 27 km/h (17 mph), a temperature of 0.6° C (33° F), and dew point of -2° C (28° F), according to local weather reports. The bituminous roadway traversed in an east-west direction and had one through lane in each direction that were bordered by gravel shoulders approximately 2 m (6.5 ft) in width. The eastbound lane was 3.5 m (11.5 ft) wide and the westbound lane was 4 m (13.1 ft) wide. The roadway pavement markings consisted of a broken yellow center line. The roadway was level and the speed limit was 56 km/h (35 mph). The Incident Diagram is included on page 13 of this report.

Pre-Incident: The forklift was driven into the Freightliner's cargo box at a factory loading dock by the driver of the Freightliner, and the forks were lowered to the floor of the cargo box. It was reported in the police reconstruction report that the forklift's shift lever was placed in neutral and the parking brake was set. The forklift was not secured with straps nor were the wheels blocked. It was also reported in the police reconstruction report that, based on information from representatives of a local Yale forklift dealer, the parking brake was designed only to hold the forklift in place on a ≤15% grade. It was not designed to prevent the forklift from rolling during transport. The forklift's specific location within the cargo box is unknown, since only the driver of the Freightliner was involved in loading it onto the truck and he sustained fatal injuries during the incident. The driver of the Freightliner intended to travel from the loading dock to the street, turn right, and travel to a second building located approximately 500 m (1,640 ft) from the loading dock where the driver and right passenger would deliver the forklift and pick up a table. The Freightliner was traveling east in the right lane approaching the driveway to the second building (**Figure 2**) at a travel speed, estimated by the right passenger, of 40 km/h (25 mph). The passenger stated during the SCI interview that he and the driver were conversing, and it was necessary for him to alert the driver that they were approaching the driveway to their destination. He further stated the driver then pumped the brakes to reduce the Freightliner's speed.

Figure 2: Freightliner's eastbound approach to the driveway (on right) and area of explosion

Incident: The unsecured forklift traveled forward in the cargo box as the driver braked. The front forks pierced the front panel of the cargo box and the left fork impacted the lowest of five CNG fuel cylinders that were oriented horizontally and stacked vertically within an aluminum cabinet located between the truck cab and cargo box. The impact site on the CNG cylinder was located 65 cm (25.6 in) left of the right cylinder end. This impact resulted in a rupture and explosion of the cylinder. There was no fire. The Freightliner's air lines were severed and the wheels locked, leaving police-reported skid marks that ranged from 4.3 - 7.44 m (14.1 - 24.4 ft) in length as the vehicle skidded to final rest, heading southeast. A speed to skid to a stop calculation based on the longest skid mark length and a deceleration value range[1] of 0.41 - 0.56 g yielded a speed range at the onset of the skid

[1] Traffic Accident Reconstruction, Volume 2 of The Traffic Accident Investigation Manual by Lynn B. Fricke, Northwestern University Traffic Institute, 1990

of 27.8 km/h (17.3 mph) - 32.5 km/h (20.2 mph). The force of the explosion resulted in severe damage to the frame, undercarriage, cargo box, fuel cabinet, CNG cylinders, and cab of the Freightliner.

Post-Incident: The police were notified of the incident at 1336 hours and arrived on scene at 1342 hours. Fire, rescue, and medical personnel responded to the incident. The front right passenger of the Freightliner stated during the interview that he checked on the driver and attempted to awake him from unconsciousness but was unsuccessful. He noticed the smell of natural gas and climbed out of the right front window which had disintegrated from the explosion. The driver of the Freightliner sustained fatal injuries and expired at the scene. The front right passenger sustained police reported "A" (incapacitating) injuries and was transported by ambulance to a hospital where he was admitted for two days. The Freightliner was towed from the incident scene due to damage.

2014 FREIGHTLINER M2 112

DESCRIPTION

The Freightliner was a rear wheel drive, 6 x 4, two-passenger, straight truck (VIN: 1FVHC5DX9EHxxxxxx) that was manufactured in August 2013 and was equipped with an 8.9-liter I-6 engine powered by compressed natural gas, a ten-speed automatic transmission, four-wheel anti-lock brakes, and a 6.1 m (20 ft) long cargo box. The windshield glazing was AS1 laminated and the left, right, and backlight glazings were AS2 tempered. The glazing for all non-fixed windows were closed at the time of the incident. The specified wheelbase was 472 cm (186 in).

The vehicle manufacturer's recommended tire size was 295/75R22.5 The vehicle was equipped with tires sized 295/75R22.5 and 275/80R22.5 on the front and rear wheels, respectively. The manufacturer's recommended cold tire pressure for the front and rear tires was 758 kPa (110 psi).

The vehicle was equipped with driver and right passenger cloth-covered, box-mount bucket seats with integral head restraints.

EXTERIOR DAMAGE

Frame and Undercarriage: The explosion deformed the truck frame directly below the fuel cylinder cabinet (**Figure 3**). Both frame rails were bent, as were the frame cross members fore and aft of the cylinder cabinet. The center section of the drive shaft was fractured and separated from the transmission. The air brake lines were severed and the air brake tank was also slightly displaced. The rear engine mounts were undamaged.

Figure 3: Freightliner's undercarriage damage directly under fuel cabinet

Passenger Cab: The cab of the truck was heavily damaged from the explosion (**Figure 4**). The most

severe damage occurred below and behind the driver's seat . The entire cab was displaced upward and forward approximately 40 cm (15.7 in) and the back panel of the cab was torn vertically, intruding into the passenger area. Shards of carbon fiber wrap and fiberglass from the ruptured cylinder were found throughout the inside of the cab and the windshield was holed from the force of the explosion.

Figure 4: Police on-scene photograph of damage to cab of the Freightliner

Cargo Box: The truck's cargo box (**Figure 5**) was also heavily damaged from the explosion. The front panel was largely displaced from the main structure. The roof and rear door panels completely detached and the left side panel was partially detached. There was slight damage to the floor and right side panel.

Figure 5: Police on-scene photograph of damage to the Freightliner's cargo box

Cargo: The only cargo was a Yale Type E battery powered forklift, Model ERP040TFN03739W. The forklift (**Figure 6**) measured 306 cm (120.5 in) from back to fork tips and weighed 4,035 kg (8,896 lb). Each fork was 106 cm (41.7 in) in length and 10 cm (3.9 in) in width. The forks were 1.5 cm (0.5 in) thick at the tips and 4 cm (1.6 in) at the base and were set 49 cm (19.3 in) apart from each other. A parking brake was located on the left side of the instrument panel and was engaged at the time of the incident.

Figure 6: Yale Type E forklift (in cargo box at time of incident)

CNG Cylinder Cabinet Damage

The cabinet for the CNG cylinders was manufactured by Agility Fuel Systems and was located between the cab and cargo box. The cabinet included an aluminum support structure that measured 217 cm (85.4 in) in height and 53 cm (20.9 in) in width, which was encased by aluminum sheeting. There was no protective barrier between the CNG cabinet and the cargo box. The rack allowed for five CNG cylinders to be mounted by the neck, horizontally onto cross members. The cylinders were stacked vertically in the cabinet. The cabinet sustained severe damage as a result of the explosion (**Figure 7**). The sheet metal encasing the cabinet was mostly displaced from the vehicle, with only the forward panel remaining attached. The left rear vertical frame member fractured and separated 88 cm (34.6 in) from the bottom support and the front vertical frame member

was rotated 90 degrees to the left. All cross members, on both sides, were either fractured, displaced, or bent (**Figure 8**).

Figure 7: Left side damage to fuel cabinet

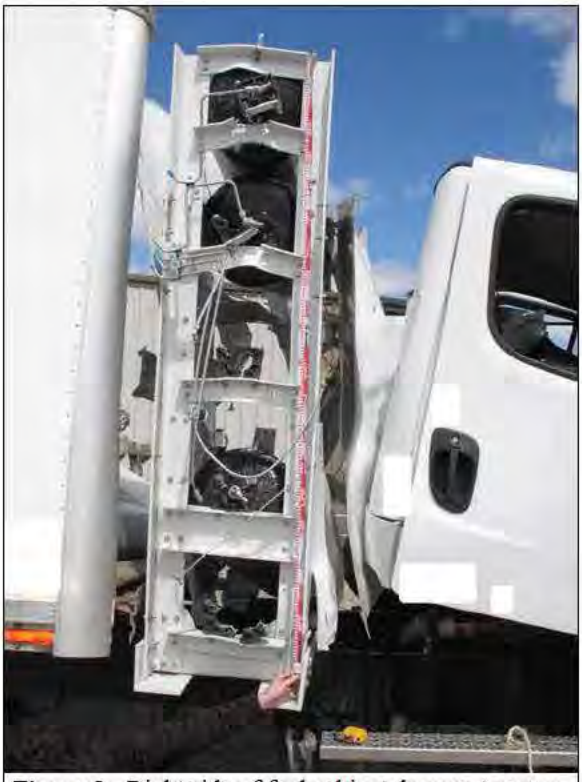


Figure 8: Right side of fuel cabinet damage to cross members

CNG Cylinders and Damage

The five CNG cylinders were Type 4 design (polymer liner with carbon fiber and fiberglass overwrap), manufactured by Hexagon Lincoln, Model number RH36A16-07601. Each cylinder measured 205 cm (80.6 in) in length, 41 cm (16 in) in diameter, and were certified with ANSI NGV2 and FMVSS 304. Each cylinder was equipped with a Pressure Relief Device (PRD) at each end, which was designed to pipe discharge away to the top of the cabinet in the event of a breach of the system. Each cylinder had a manual valve without an excess flow device that was manufactured by OMB. The bottom cylinder (cylinder 1) was impacted by the left fork of the forklift and ruptured (**Figure 9**), with the damage starting 65 cm (25.6 in) left of the right end of the cylinder. A 66 cm (26 in) section of the left end of the cylinder (**Figure 10**) separated and was displaced into the street (**Figure 11**). Both valves separated from the bottom cylinder. Cylinder 2 remained intact, but the left side dropped from its mount. The left side valve was detached and part of the right side valve remained in place. Cylinder 3 was propelled out of the cabinet and landed in the street, according

Figure 9: Ruptured CNG cylinder

to incident documents. At least one valve remained attached to the cylinder. Cylinders 4 and 5, at the top of the cabinet, remained in their positions and all valves remained attached.

Figure 10: Displaced section of ruptured CNG cylinder

Figure 11: Police on-scene photograph showing location of displaced section of bottom CNG cylinder (arrow)

Figure 12: Exterior view of intrusion of back wall of Freightliner's cab

Interior Damage

The interior of the Freightliner sustained severe damage from the CNG cylinder explosion. There were a total of twelve intrusions to the passenger compartment. The most severe intrusions occurred in the driver's space and were to the back wall of the cab and the backlight header (**Figures 12** and **13**), which intruded longitudinally approximately 80 cm (31 in), and 30 cm (12 in), respectively, and the floor, which intruded vertically approximately 40 cm (16 in). The driver was projected forward by the explosion and he loaded the steering assembly (**Figure 13**), displacing it forward approximately 25 cm (10 in). Scuff marks were noted on the roof above the driver's seat, possibly from contact by the driver's head. The rearview mirror was also displaced from possible contact by the driver's right hand. Fragments of fiber glass from the ruptured CNG tank were also deposited throughout the cab. Some of the fragments cut the ceiling upholstery in the front right passenger's space, and fragments were embedded in the roof and damaged a plastic storage compartment in this area. Both doors were jammed shut and the left door was mechanically pried open by rescue personnel. The windshield was in place and holed due to explosion forces. The right and left glazings as well as the backlight all disintegrated due to the explosion. The only undamaged glazings were the small windows on each door.

Manual Restraint Systems

The front seating positions were equipped with lap and shoulder safety belts with fixed upper anchors.

The driver was restrained by the lap and shoulder safety belt based on the police-reported statement of a witness who was one of the first to arrive at the vehicle immediately following the

incident. The front right passenger stated during the interview that he was restrained by the lap and shoulder safety belt. He sustained a contusion across his chest consistent with safety belt usage. Inspection of both safety belt assemblies revealed evidence of historical usage, but no discernable evidence of loading was found.

Figure 13: Intrusion of the back wall of the Freightliner's cab and displacement of the steering column from driver contact

CNG Fuel System Inspection by Other Party

The Freightliner and its fuel system were inspected by the Director of Technology for the Clean Vehicle Education Foundation. A summary of findings from his preliminary report[2] relative to the CNG fuel system are as follows:

1. The neck mounts on all five cylinders were broken by the pressure wave and there were many fractures of the aluminum supporting structure.

2. The right front vertical member of the supporting structure was bent into a radius, apparently by the rupturing cylinder when it was propelled forward and to the right by the escaping gas.

3. All of the high-pressure CNG from the system escaped through the broken cylinder connections in about ten minutes following the arrival of the first responders. There was no ignition and no fire.

4. The composite fracture apparently progressed approximately in a longitudinal direction and then turned and ran circumferentially, separating one of the cylinder ends and ejecting it from the driver's side of the truck.

5. No existing reports of such low velocity, high momentum and concentrated impacts against fiber reinforced composite pressure vessels have been identified. This impact scenario is unlike either the blunt impacts imposed during the NGV2 drop tests or the high-velocity impact of the NGV2 penetration test (gunfire). The sharpness of the fork tip and its point of impact directly into the cylinder sidewall are also unlike the previous oblique severe impacts of roof-mounted cylinders against overhead obstruction. This is the first rupture incident apparently resulting from impact on a NGV2 cylinder made since the drop impact tests were strengthened in 1998.

6. The pressurized cylinder had enhanced sidewall rigidity because it was nearly full. This rigidity probably prevented general deflection in the sidewall (to an oval shape). This deflection is

[2] The report was obtained from the investigating police agency. There was no prohibition specified in the report regarding the dissemination of the preliminary findings.

considered favorable in reducing impact damage to an empty cylinder. A more compliant, less pressurized cylinder could have deflected and reduced damage at the point of impact.

7. The cylinder was possibly more rigidly attached to the massive truck chassis because it was the bottom cylinder in a framework rigid enough to carry a five-high stack of cylinders. The cylinder thus could not move away from the impact to reduce the damage at the point of impact.

8. The shape of the fork tip probably produced a cut perpendicular to the critical hoop direction reinforcing fibers. These fibers carry the greatest load in a pressure vessel and the orientation of the fork tip was such to maximize the number of hoop fibers that were damaged.

9. If the fork tip penetrated the sidewall of the cylinder it would have wedged the break open because the long taper of the fork. This could have inflicted greater damage than a simple penetration by a 2 mm x 60 mm point.

10. A low impact speed with high momentum may be more damaging to composites than a high velocity impact.

11. Information from tests and other accidents indicate that CNG cylinders resist rupture as a result of more blunt impacts. This may be a more likely damage scenario from general loose cargo. The occupant space in the cab could receive considerable protection from the cylinders and mounting structure.

2014 FREIGHTLINER M2 112 OCCUPANTS

DRIVER DEMOGRAPHICS

Age/Sex:	[redacted]
Height:	
Weight:	
Eyewear:	
Seat Type:	Pedestal
Seat Track Position:	Unknown
Manual Restraint Usage:	Lap and shoulder safety belt
Usage Source:	Witness statement
Air Bags	None
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Removed by emergency responders
Transport from Scene:	Transported from scene for autopsy
Medical Treatment:	None, deceased at scene

DRIVER INJURIES [redacted]

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1 2	Hemorrhage, subarachnoid over both cerebral hemispheres, not further specified	140693.2,1 140693.2,2	Steering wheel rim	Probable
3	Fracture right orbital plate, not further specified	251200.2,1	Steering wheel rim	Probable
4	Fracture nose with displacement (deformity), not further specified	251002.2,4	Steering wheel rim	Probable
5	Laceration pericardium with residual blood in sac	441602.2,4	Steering wheel hub and/or spokes	Certain
6	Laceration (tear) right and left atria, not further specified	441016.6,4	Steering wheel hub and/or spokes	Certain
7	Laceration (tear), multiple, thoracic aorta, not further specified	420206.4,4	Steering wheel hub and/or spokes	Certain
8	Laceration (rupture) left diaphragm with protrusion of stomach into left chest cavity	440610.4,2	Steering wheel hub and/or spokes	Certain
9	Fractured ribs, multiple, bilaterally, right greater than left	450203.3,3	Steering wheel hub and/or spokes and rim	Certain
10	Contusions bilateral pleural surfaces of lungs, not further specified	441420.3,3	Steering wheel hub and/or spokes	Probable
11	Lacerations bilateral pleural surfaces of lungs with extensive parenchymal hemorrhage	441450.4,3	Steering wheel hub and/or spokes	Certain
12	Hemothoraces, bilaterally, with residual blood in each pleural cavity, not further specified	442200.3,3	Steering wheel hub and/or spokes and rim	Certain
13	Laceration left kidney, not further specified	541620.2,2	Steering wheel rim	Certain
14	Lacerations, multiple, capsule of liver, with internal crush injury of parenchyma, not further specified	541826.4,1	Steering wheel hub and/or spokes and rim	Certain
15	Laceration capsule of spleen with fragmentation of spleen, not further specified	544226.4,2	Steering wheel hub and/or spokes and rim	Certain
16	Fracture, palpable, right shoulder, not further specified	751800.2,1	Seat back, driver's	Probable
17 18	Lacerations (cuts) right side of face from right periorbital area to right chin, not further specified	210602.1,1 210602.1,8	Noncontact injury: flying glass, back light	Probable
19	Lacerations (cuts) right side of neck, not further specified	310602.1,1	Noncontact injury: flying glass, back light	Probable

***Driver Injuries** (Continued)* [redacted]

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
20	Laceration, stellate tear, open wound, right lower quadrant of abdomen, not further specified	510602.1,1	Steering column and/or tilt adjustment lever	Probable
21	Abrasions, multiple, posterior right upper arm from shoulder to elbow	710202.1,1	Noncontact injury: flying glass, back light	Probable
22	Laceration (cut) posterior right arm near elbow	710602.1,1	Noncontact injury: flying glass, back light	Probable
23	Abrasions, multiple, dorsal (posterior) left wrist, not further specified	710202.1,2	Noncontact injury: flying glass, back light	Probable
24	Lacerations, multiple, dorsal (posterior) right hand	710602.1,1	Noncontact injury: flying glass, back light	Probable
25	Abrasions, multiple, on bilateral thighs, not further specified	810202.1,3	Steering wheel rim	Probable
26	Abrasions, multiple, on lower legs, not further specified	810202.1,3	Left lower instrument panel	Certain
27	Contusions, multiple, on proximal bilateral thighs, not further specified	810402.1,3	Steering wheel rim	Probable
28	Contusions, multiple, on lower legs, not further specified	810402.1,3	Left lower instrument panel	Certain
29	Laceration, open, just below and lateral to left knee with foreign material embedded	810602.1,2	Left lower instrument panel	Certain

Source: Autopsy Records.

DRIVER KINEMATICS

The driver was restrained by the lap and shoulder safety belt. He was displaced forward and upward as a result of explosion forces and intrusion of the back wall of the cab. His face and chest loaded the steering assembly causing a subarachnoid hemorrhage, fracture of the right orbital plate and nose, lacerations of the pericardium, right and left atria, thoracic aorta, and diaphragm. He also sustained bilateral fractures of multiple ribs, contusions and lacerations of the lungs, and lacerations of the left kidney, liver, and spleen from contacting the steering assembly. Contact with the seat back caused a fracture of the right shoulder, and he sustained multiple lacerations and abrasions from flying glass from the disintegrated backlight. He also sustained multiple abrasions and contusions to the lower extremities from contacting the lower left instrument panel and steering wheel rim, and an open laceration of the left lower leg, also from contacting the lower left instrument panel. The driver injuries were fatal and he was officially pronounced deceased at 1640 hours.

FRONT RIGHT OCCUPANT DEMOGRAPHICS

[redacted]

Age/Sex:
Height:
Weight:
Eyewear:
Seat Type: Pedestal
Seat Track Position: Unknown
Manual Restraint Usage: Lap and shoulder safety belt
Usage Source: Passenger interview and injury data
Air Bags None
Alcohol/Drug Involvement: None
Egress from Vehicle: Exited without assistance through disintegrated right front window
Transport from Scene: Ambulance
Medical Treatment: Hospitalized one day

FRONT RIGHT OCCUPANT INJURIES

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Traumatic (closed) head injury, not further specified, with mild headache	110009.1,0	Noncontact injury: impact (blast) forces	Probable
2	Contusion, acute left lung, left upper lobe, secondary to explosion/blast	441420.3,2	Noncontact injury: impact (blast) forces	Certain
3	Contusion posterior scalp, not further specified	110402.1,6	Seat back, front right passenger's	Probable
4	Laceration, 1.3 cm (0.5 in) in length on right posterior scalp	110602.1,6	Other interior loose object: fiber glass debris	Probable
5	Avulsed (missing) gum tissue from upper right incisor area	243206.1,8	Right instrument panel	Probable
6 7	Abrasions, superficial, to right side of nose and lower lip	210202.1,4 210202.1,8	Right instrument panel	Probable
8	Abrasion across mid chest with bilateral tenderness, not further specified	410202.1,4	Torso portion of safety belt system	Certain
9	Penetrating (puncture) injury back of left shoulder, one near arm pit, one over scapula	716011.1,2	Other interior loose object: fiber glass debris	Certain
10	Laceration, 2.5 cm (1 in), vertically oriented, above right knee	810602.1,1	Right lower instrument panel	Probable
11	Laceration, 2.5 cm (1 in), horizontally oriented, below right knee	810602.1,1	Right lower instrument panel	Probable
12	Abrasion left lower leg, probably left knee, not further specified	810202.1,2	Right lower instrument panel	Probable

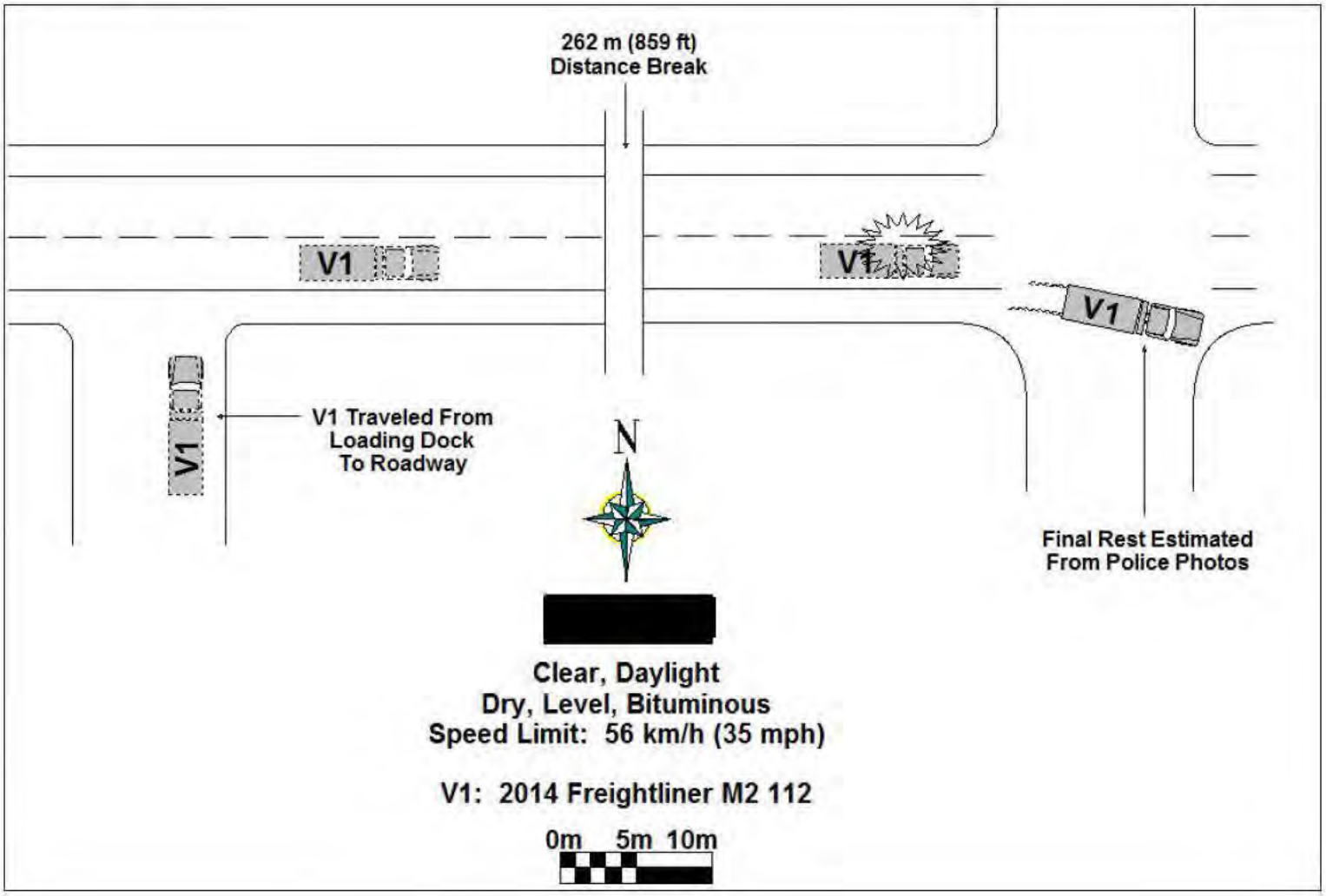
Front Right Occupant Injuries ***(Continued)*** [redacted]

Sources: Emergency Room Records, Hospitalization Records, and Interviewee Data–Same Person. Injury Numbers 4 and 9 through 11 came only from ***Interviewee Data****. Injury Numbers 3, 5, and 12 came only from* ***Emergency Room Records****. Injury Number 8 came only from* ***Hospitalization Records****. Injury Numbers 1 and 2 came from a combination of* ***Emergency Room*** *and* ***Hospitalization Records****. Injury Numbers 6 and 7 came from all three sources.*

FRONT RIGHT OCCUPANT KINEMATICS

The front right passenger was restrained by the lap and shoulder safety belt and was displaced forward as a result of explosion. The blast forces caused a closed head injury and left lung contusion. He loaded the safety belt causing an abrasion across his chest, and contacted his face on the right instrument panel causing an abrasion on the nose and lower lip, and an avulsion of the gum. His lower extremities contacted the right lower instrument panel causing a laceration above and below the right knee and an abrasion on the left knee. He rebounded back into his seat and contacted the back of his head on the seat causing a contusion to the posterior scalp. Flying fiber glass fragments from the exploded CNG cylinder caused two puncture injuries to the back of the left shoulder and a laceration to the back of the head. The front right passenger exited the vehicle without assistance through the disintegrated right side window glazing. He was transported by ambulance to a hospital where he was admitted for one day.

INCIDENT DIAGRAM [redacted]



PE14-020

11-4-2014

DATA TO ODI

NO LETTER

Update_names released deadly truck explosion (www.wearegreenbay.com)

[redacted]

48°F

[redacted]

04/03/2014 02:27 PM 04/04/2014 01:54 PM

[redacted]

UPDATE

HOWARD, Wis. [redacted] truck explosion in Howard this afternoon left one man dead and another critically injured. The blast happened within the Howard Industrial Park early this afternoon and was felt a half-mile away.

Brown County Sheriff says [redacted]-year-old [redacted] from Sobieski was driving the truck and was killed. The passenger, [redacted]-year-old [redacted] was transferred to a local hospital with non-life-threatening injuries.

These are images of the aftermath of that explosion, some sent into Local 5 News by our viewers. The box truck we are told was outfitted with a compressed natural gas fuel system and was carrying a load of heavy equipment.

According to police around 1:30 this afternoon, the truck was transporting products between two Ace warehouses located on Pamperin Road, when this happened.

"The truck slowed to turn into a driveway - the load shifted inside - and that compromised the natural gas system on the truck," according to Howard's Public Safety Director, Ed Janke. "The fuel system detonated and that resulted in one injury and one known fatality at this time."

Ace Manufacturing released this statement this afternoon saying, "Our thoughts and prayers go out to the family of the truck driver who lost his life in this accident, as well as another worker who was injured. We are a small and close-knit company and this has shaken and saddened all of us."

The Brown County Sheriff's Office has not yet released the names of these two men. For most of the afternoon Pamperin Road, between Velp Avenue and Cornell Road, was closed to traffic.

HOWARD, Wi[redacted]The Brown County Sheriff's office is investigating a deadly explosion which occurred in the 2200 block of Pamperin Rd. in the Village of Howard. The Sheriff's Department tells us that a box-style truck carrying heavy equipment was slowing to turn into a driveway, when the load shifted forward, piercing a fuel tank and causing the truck to explode.

Authorities tell us the male driver was pronounced dead at the scene. A male passenger was reportedly thrown from the truck and transported to an area hospital with critical injuries.

A number of businesses were either evacuated or asked to take cover in a safe area while rescue crews addressed leaking fuels and removed the injured passenger. Howard Fire and Brown County Hazmat Teams secured the area so a Reconstruction Team could start to document the scene.

Pamperin Rd. between Velp Ave. and Cornell Road will remain closed for several hours while the investigation continues.

Local 5 has a crew on the scene, we'll bring you the latest information as it becomes available.

Hazmat crews at scene of Howard explosion

Truck explosion in Howard

Truck involved in deadly explosion in Howard

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news

PE14-020

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DATA TO ODI

NO LETTER

Update_Victims of truck explosion identified (www.nbc15.com)

[redacted]

Posted: Fri 12:41 PM, Apr 04, 2014

UPDATED Friday, April 4, 2014 — 12:40 p.m.

HOWARD, Wis. (AP) – Brown County sheriff's authorities have identified the driver who was killed and the passenger who was injured when a box truck exploded in the Green Bay area.

[redacted] of the Oconto County community of Sobieski, died in the accident. [redacted] of Green Bay, is hospitalized with non-life threatening injuries.

The two were turning into a driveway in the village of Howard Thursday afternoon when the truck's load shifted forward and pierced the compressed natural gas fuel system, causing it to explode. The truck is leased to Ace Manufacturing, which is located near the scene of the accident.

Posted Thursday, April 3, 2014 — 5:13 p.m.

HOWARD, Wis. (AP) – One person is dead and another injured after a truck exploded near an industrial park in eastern Wisc

According to the Brown County Sheriff's Office, the box style truck slowed to turn into a driveway in the village of Howard at a pierced a fuel tank and caused the truck to explode.

In a news release, Lt. [redacted] said the male driver died at the scene. A male passenger was thrown from the vehicle

Some of the nearby businesses were evacuated or employees asked to take cover while rescue crews looked into leaking fu

PE14-020

11-4-2014

DATA TO ODI

NO LETTER

PE14-020

11-4-2014

DATA TO ODI

NO LETTER