CNG BOC FSM
Maintenance Manual
Preface

To reduce the chance of personal injury and/or property damage, the following must be carefully observed:

Proper installation, service, and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use replacement parts of lesser quality.

The procedures recommended and described in this Maintenance Manual are effective methods of performing a proper maintenance of the fuel storage module (FSM).

Accordingly, anyone who intends to use a replacement part, procedure, or tool which is not recommended in this manual, must first determine neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, procedure, or tool selected.

It is important to note that this manual contains “Cautions” and “Notices” that must be carefully observed in order to reduce the risk of personal injury during maintenance, or the possibility that improper maintenance may damage the vehicle or render it unsafe. It is also important to understand that these “Cautions” and “Notices” are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

The system must only be maintained by trained personnel who have read and understood this manual. Individual operator training is the responsibility of the company, firm, or organization placing the system in service.

If you need further information or have any questions, please contact:
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Lake Forest, CA 92630
USA
Tel: 949.930.3400
Fax: 949.930.3401
How to Use This Manual

This supplement contains information specific to CNG Back Of Cab fuel storage module (FSM). It does not explain everything you need to know about servicing your equipment. You must use this maintenance manual along with the service manual for the other installed components. Only then will you be able to properly operate and maintain your equipment.

This manual contains information for the CNG Back Of Cab Fuel Storage Modules.
Ordering Parts
To purchase repair or replacement parts for the CNG Back Of Cab fuel storage modules, use the online Parts Request Form. Retail parts pricing and the Parts Request Form are accessible at [www.qtww.com/service](http://www.qtww.com/service).

Technical Assistance
For questions regarding the installation, maintenance, and service for the Generation 1 or 2 CNG Fuel Storage Module, contact Quantum Technical Assistance at 800.816.8691.

This manual is for use only for the following Back Of Cab Generation 1 FSM Part Numbers:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>FEATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN 115696 123 DGE FSM</td>
<td>STANDARD</td>
</tr>
<tr>
<td>PN 116353 123 DGE FSM</td>
<td>STANDARD</td>
</tr>
<tr>
<td>PN 116785 123 DGE FSM</td>
<td>SLAVE</td>
</tr>
</tbody>
</table>

This manual is for use only for the following Back Of Cab Generation 2 FSM Part Numbers:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>FEATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN 116944 41 DGE FSM</td>
<td>SLAVE</td>
</tr>
<tr>
<td>PN 116074 123 DGE FSM</td>
<td>STANDARD</td>
</tr>
<tr>
<td>PN 117345 160 DGE FSM</td>
<td>STANDARD</td>
</tr>
<tr>
<td>PN 117155 180 DGE FSM</td>
<td>STANDARD</td>
</tr>
</tbody>
</table>
Module Identification

Generation 1

- 115696 – Fill Panel
- 116353 – Fill Panel
- 116785 – No Fill Panel (Slave)

All of the generation 1 BOC FSMs will have two exposed lift hooks (1) located at the top front of the module.

There are two additional lift hooks located under the rear cover. The FSM has been designed with 4 lift points to safely lift and maneuver the module for service, maintenance, and / or inspection as needed.

Generation 1 models with a fill panel (2) can be visually identified with a configuration as shown in the illustration to the right.

The slave model will not have any fill panel.

The part identification label (3) will be located in two separate locations depending on whether the FSM is equipped with a fill panel or if the FSM is a slave module.

If the FSM is equipped with a fill panel, then the part identification label is located on the inner left portion of the fill panel assembly.

If the FSM is a slave module, then the part identification label can be located inside the cylinder access panel on the frame.
Generation 2

- 116944 – 41 DGE (Slave)
- 116074 – 123 DGE
- 117345 – 160 DGE
- 117155 – 180 DGE

All of the generation 2 BOC FSMs will have two lift hook mounting locations (1) located at the top of the module.

The FSM has been designed with 2 lift points to safely lift and maneuver the module for service, maintenance, and / or inspection as needed.

Generation 2 models with a fill panel (2) can be visually identified with a configuration as shown in the illustration to the right.

Slave models will not have a fill panel.

The part identification label (3) will be located in two separate locations depending on whether the FSM is equipped with a fill panel or if the FSM is a slave module.

If the FSM is equipped with a fill panel, then the part identification label is located on the inner left portion of the fill panel assembly.

If the FSM is a slave module, then the part identification label can be located inside the cylinder access panel on the bottom cover.
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Introduction

The Back Of Cab (BOC) fuel storage module (FSM) is designed to store Compressed Natural Gas (CNG). The FSM holds 1 or 3 cylinders which are contained within a vertical structure and protected with a lightweight, fiberglass housing. Each cylinder is configured with an individual PRD manifold assembly and thermal relief valves. The FSM features both standard fill and fast fill valves (except slave models). The FSM covers are equipped with rear load lighting and a fill box light. The operating temperature for the fuel storage module has a range between −40°C to 65°C.

This manual provides information for the CNG Back Of Cab fuel storage modules.

About Compressed Natural Gas

Natural gas is a by–product of oil drilling and coal mining, but it can also be harvested independently from natural gas fields. It can be used as a motor fuel in two forms, Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG).

Natural gas is lighter than air. If a leak were to develop, the gas would rise and disperse through the atmosphere giving little chance for ignition. Compare that to gasoline and diesel fuel, both of which are dense liquids that tend to pool and are easily ignitable. When CNG is burned in the engine, it produces low emissions. This means less smog, less air pollution and cleaner air. This makes CNG a promising motor fuel for the future.

Raw natural gas is odorless, so a distinctive odorant that smells very much like strong sulfur is added prior to distribution. This strong odor makes the presence of a leak very easy to detect. If an odor is detected, which has been added for your safety, please inspect the vehicle for the source of the concern, and repair as needed.

Natural gas itself is a safer fuel than either gasoline or diesel fuel. It has a limited range of flammability, meaning it requires the correct mixture of air and fuel to burn—somewhere in the 5 to 15 percent range, and an ignition temperature of approximately 1100°F. Compare that to gasoline and diesel fuel which both have lower concentrations of flammability and lower temperatures of ignition.
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Safety

Important Safety Information

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

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

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

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

NOTICE is used to address practices not related to personal injury.

CAUTION, without the safety alert symbol, is used to address practices not related to personal injuries.

WARNING

Read this manual’s safety precautions before servicing this system. Failure to do so may result in death or serious injury.
Safety (Continued)

⚠️ DANGER ⚠️

The maintenance of the fuel storage module must be completed in compliance with all federal, state, and local regulations. It is the responsibility of the servicing facility to confirm that all regulations have been met. Failure to maintain the fuel storage module in accordance with applicable regulations will result in death or serious injury.

⚠️ WARNING ⚠️

CNG is extremely flammable. If something ignites it, you may be severely burned.
- Keep sparks, flames and ignition sources a minimum of 5 meters from CNG.
- Ensure work area is well ventilated.
- Always wear proper eye and hearing protection when working with pressurized gas.
- Use explosion proof drop lights when working on gaseous fueled systems.

Failure to follow these basic safety guidelines may result in serious death or personal injury.

⚠️ CAUTION ⚠️

CNG is stored at pressures up to 3,600 psi (25 MPa). Verify all pressure is properly vented from any fuel cylinder or fuel line before proceeding with disassembly. Failure to properly vent fuel system components may result in serious injury.

⚠️ CAUTION ⚠️

When filling your vehicle, keep sparks, flames and ignition sources a minimum of 5 meters from the refueling area which may result in minor or moderate injury including the risk for severe burns.
- Do not smoke near CNG or while refueling a system.
- Turn the system’s electrical system OFF while refueling.
- Refuel CNG fuel cylinders in a well–ventilated area.
- Keep mobile phones at a distance from the refueling area.

Failure to do so may result in minor to moderate injury.

⚠️ CAUTION ⚠️

Do not fill the fuel storage module with CNG if the cylinder pressure is less than 363 psi (2.5 MPa) AND the cylinder temperature is less than –31°F (–35°C).
Allow the fuel storage module temperature to rise above –31°F (–35°C) before filling.
Refueling under these conditions may cause personal injury and equipment or system damage.
Failure to refuel under these conditions may result in minor or moderate injury.

⚠️ CAUTION ⚠️

Using common automotive or plumbing O–rings as a replacement part may cause a leak while operating the system on CNG. Use only O–rings approved for use with CNG from an authorized source. Failure to use an O–ring approved for use with CNG may result in minor or moderate injury.
Safety Features
The CNG Back Of Cab fuel storage module has been engineered to the highest standard to ensure occupant safety in any circumstance.

The system utilizes:
- Stainless steel fuel lines and fittings
- Type 4 (composite) fuel cylinders
- Over temperature protection
- Manual lock off valves
- Electronic lock off valve within the regulator assembly (if equipped)

In the Event of Equipment Fire
If a fire should occur in the vicinity of the cylinder system, the thermal relief devices located in the module may be activated. If any of the relief devices activate, a very rapid venting of gas may occur. If a fire caused the activation and the cylinder is full of a flammable gas, it is likely that the gas exiting the pressure relief line will ignite which may be very dangerous. Even if the gas does not ignite, debris blown about by the gas jet may be dangerous and the loud noise caused by the rapid venting may cause hearing damage.

If any of the relief devices activate, then evacuate the area immediately and call the appropriate authorities. Once any of the relief devices have activated, the FSM or all of the cylinders must be decommissioned or returned to Quantum Technologies for inspection, disposition, and service.
System Overview

The CNG Back Of Cab fuel storage module has been designed to be installed on the Class 7 and 8 heavy duty trucks with a maximum frame width as defined in the General System Specifications section of this manual. The maintenance of this CNG fuel storage module may require minor adjustments or alterations of the vehicle to ensure a durable and safe operation.

The primary components of the CNG fuel storage module are:
- CNG Fuel Storage Cylinders (Type 4)
- Manual Fuel Tank Shut–off Valves
- Standard CNG Fill Valve
- High Flow CNG Fill Valve
- High Pressure Regulator (If Equipped)
- Fuel Gauge Module (If Equipped)

System Design and Operation

The fuel storage module contains fuel storage cylinders, thermal relief devices, fiberglass housing, and Type 4 cylinder mounting brackets.

The CNG fuel storage cylinders used in this fuel storage module are Type 4 cylinders which are wrapped in carbon fiber. The cylinder is shipped empty and must be properly pressurized and purged prior to service. Refer to the Cylinder Purge section of this manual for more information.

Operating Temperature Ranges

**NOTICE**

Operating temperature range of the CNG system is –40°F to 149°F (–40°C to 65°C). Operating the system in ambient temperatures outside of this range may damage the fuel system components.

Do not operate in the system in ambient temperatures outside the range of –40°F to 149°F (–40°C to 65°C). Exposure to excessive cold or heat will expose the system to conditions that may cause damage to system components.
General Vehicle Requirements

**Electrical Requirements (Except Slave Models)**
- Voltage Range: 12–16 VDC
- Nominal Current Draw: 2.0 A
- Peak Current Draw: 3.5 A
- BOC Electrical Connector: Deutsch HDP30–18–14 PN

**Coolant (Except Slave Models)**
- Minimum Coolant Flow: 0.5 Gal/Min
- Coolant Type: Glycol / Phosphate Based Coolant
- Fitting Type / Connection: (2x) 5/8” Hose Barb
- Coolant Concentration: Not to Exceed 60/40 Concentration

**Fuel**
- Fuel Outlet Connection: 3/4” 37° Flare
- CNG Fuel Quality: SAE J1616 CNG Fuel
General System Specifications

Generation 1

116785 – 123 DGE (Slave)

General Specifications

Designed Location ................................................................. Back Of Cab (BOC)
Gasoline Gallon Equivalency (IA) .................................................. 139.8 GGE
Gasoline Gallon Equivalency (NIST) ............................................. 119.1 GGE
Diesel Gallon Equivalency (IA) .................................................... 123.0 DGE
Diesel Gallon Equivalency (NIST) ................................................. 104.7 DGE
Module Weight (Empty) ............................................................ 1691 lbs (767 Kg)
Module Weight (Full) ............................................................... 2491 lbs (1130 Kg)
Internal Volume ......................................................................... 423 ±8 Gallons (1601 ±30L)
Fill Panel Location .................................................................. N/A
Cylinder Certifications ............................................................... Refer to Data Sheet 114093
Service Pressure ........................................................................ 3,600 psi (24.8 MPa) @ 70°F (21°C)
Minimum Working Pressure ...................................................... 290 psi (2 MPa)
Module Temperature Range ...................................................... −40°F (−40°C) to 149°F (65°C)
Fill Flow Rate (Standard Fill Receptacle with Filter)* .................. Average 3.0 DGE/min, up to 10 DGE/min
Fill Flow Rate (Standard Fill Receptacle without Filter)* .......... Average 4.5 DGE/min, up to 15 DGE/min
Fill Flow Rate (High Flow Fill Receptacle with Filter)* .............. Average 11.0 DGE/min, up to 30 DGE/min
Fill Flow Rate (High Flow Fill Receptacle without Filter)* ......... Average 16.0 DGE/min, up to 35 DGE/min

* System fill rates will vary based on ambient temperatures, station pressures, and fuel quality.

115696 / 116353 – 123 DGE (Standard)

General Specifications

Designed Location ................................................................. Back Of Cab (BOC)
Gasoline Gallon Equivalency (IA) .................................................. 139.8 GGE
Gasoline Gallon Equivalency (NIST) ............................................. 119.1 GGE
Diesel Gallon Equivalency (IA) .................................................... 123.0 DGE
Diesel Gallon Equivalency (NIST) ................................................. 104.7 DGE
Module Weight (Empty) ............................................................ 1700 lbs (771 Kg)
Module Weight (Full) ............................................................... 2500 lbs (1134 Kg)
Internal Volume ......................................................................... 423 ±8 Gallons (1601 ±30L)
Fill Panel Location .................................................................. Driver’s Side (See Yellow Box in Illustration)
Cylinder Certifications ............................................................... Refer to Data Sheet 114093
Service Pressure ........................................................................ 3,600 psi (24.8 MPa) @ 70°F (21°C)
Minimum Working Pressure ...................................................... 290 psi (2 MPa)
Module Temperature Range ...................................................... −40°F (−40°C) to 149°F (65°C)
Fill Flow Rate (Standard Fill Receptacle with Filter)* .................. Average 3.0 DGE/min, up to 10 DGE/min
Fill Flow Rate (Standard Fill Receptacle without Filter)* .......... Average 4.5 DGE/min, up to 15 DGE/min
Fill Flow Rate (High Flow Fill Receptacle with Filter)* .............. Average 11.0 DGE/min, up to 30 DGE/min
Fill Flow Rate (High Flow Fill Receptacle without Filter)* ......... Average 16.0 DGE/min, up to 35 DGE/min

* System fill rates will vary based on ambient temperatures, station pressures, and fuel quality.
**116944 – 41 DGE (Slave)**

**General Specifications**

- **Designed Location**: Back Of Cab (BOC)
- **Gasoline Gallon Equivalency (IA)**: 46.6 GGE
- **Gasoline Gallon Equivalency (NIST)**: 39.7 GGE
- **Diesel Gallon Equivalency (IA)**: 41.0 DGE
- **Diesel Gallon Equivalency (NIST)**: 34.9 DGE
- **Module Weight (Empty)**: 580 lbs (263 Kg)
- **Module Weight (Full)**: 804 lbs (365 Kg)
- **Total Internal Cylinder Volume**: 141 ±2 Gallons (534 ±8L)
- **Fill Panel Location**: N/A
- **Cylinder Certifications**: Refer to Data Sheet 114093
- **Service Pressure**: 3,600 psi (24.8 MPa) @ 70°F (21°C)
- **Minimum Working Pressure**: 290 psi (2 MPa)
- **Module Temperature Range**: –40°F (–40°C) to 149°F (65°C)
- **Fill Flow Rate (Standard Fill Receptacle with Filter)**: Average 3.0 DGE/min, up to 10 DGE/min
- **Fill Flow Rate (Standard Fill Receptacle without Filter)**: Average 4.5 DGE/min, up to 15 DGE/min
- **Fill Flow Rate (High Flow Fill Receptacle with Filter)**: Average 11.0 DGE/min, up to 30 DGE/min
- **Fill Flow Rate (High Flow Fill Receptacle without Filter)**: Average 16.0 DGE/min, up to 35 DGE/min

* *System fill rates will vary based on ambient temperatures, station pressures, and fuel quality.*

**116074 – 123 DGE (Standard)**

**General Specifications**

- **Designed Location**: Back Of Cab (BOC)
- **Gasoline Gallon Equivalency (IA)**: 139.8 GGE
- **Gasoline Gallon Equivalency (NIST)**: 119.1 GGE
- **Diesel Gallon Equivalency (IA)**: 123.0 DGE
- **Diesel Gallon Equivalency (NIST)**: 104.7 DGE
- **Module Weight (Empty)**: 1759 lbs (798 Kg)
- **Module Weight (Full)**: 2432 lbs (1103 Kg)
- **Total Internal Cylinder Volume**: 423 ±6 Gallons (1602 ±24L)
- **Fill Panel Location**: Driver’s Side
- **Cylinder Certifications**: Refer to Data Sheet 114093
- **Service Pressure**: 3600 psi (24.8 kPa) @ 70°F (21°C)
- **Minimum Working Pressure**: 290 psi (2 MPa)
- **Module Temperature Range**: –40°F (–40°C) to 149°F (65°C)
- **Fill Flow Rate (Standard Fill Receptacle with Filter)**: Average 3.0 DGE/min, up to 10 DGE/min
- **Fill Flow Rate (Standard Fill Receptacle without Filter)**: Average 4.5 DGE/min, up to 15 DGE/min
- **Fill Flow Rate (High Flow Fill Receptacle with Filter)**: Average 11.0 DGE/min, up to 30 DGE/min
- **Fill Flow Rate (High Flow Fill Receptacle without Filter)**: Average 16.0 DGE/min, up to 35 DGE/min

* *System fill rates will vary based on ambient temperatures, station pressures, and fuel quality.*
General System Specifications (Continued)

Generation 2

117345 – 160 DGE (Standard)

General Specifications
Designed Location ................................................................. Back Of Cab (BOC)
Gasoline Gallon Equivalency (IA) ............................................................... 181.9 GGE
Gasoline Gallon Equivalency (NIST) ............................................................ 154.9 GGE
Diesel Gallon Equivalency (IA) ................................................................. 163.4 DGE
Diesel Gallon Equivalency (NIST) ............................................................ 138.7 DGE
Module Weight (Empty) ............................................................... 2180 lbs (989 Kg)
Module Weight (Full) ................................................................. 3067 lbs (1391 Kg)
Total Internal Cylinder Volume .................................................. 563 ±6 Gallons (2130 ±24L)
Fill Panel Location ................................................................. Driver’s Side
Cylinder Certifications ................................................................. Refer to Data Sheet 114093
Service Pressure ................................................................. 3600 psi (24.8 kPa) @ 70°F (21°C)
Minimum Working Pressure .......................................................... 290 psi (2 MPa)
Module Temperature Range .................................................. –40°F (–40°C) to 149°F (65°C)
Fill Flow Rate (Standard Fill Receptacle with Filter)* .................. Average 3.0 DGE/min, up to 10 DGE/min
Fill Flow Rate (Standard Fill Receptacle without Filter)* .................. Average 4.5 DGE/min, up to 15 DGE/min
Fill Flow Rate (High Flow Fill Receptacle with Filter)* .................. Average 11.0 DGE/min, up to 30 DGE/min
Fill Flow Rate (High Flow Fill Receptacle without Filter)* .................. Average 16.0 DGE/min, up to 35 DGE/min

* System fill rates will vary based on ambient temperatures, station pressures, and fuel quality.

117155 – 180 DGE (Standard)

General Specifications
Designed Location ................................................................. Back Of Cab (BOC)
Gasoline Gallon Equivalency (IA) ............................................................... 204.6 GGE
Gasoline Gallon Equivalency (NIST) ............................................................ 174.3 GGE
Diesel Gallon Equivalency (IA) ................................................................. 183.6 DGE
Diesel Gallon Equivalency (NIST) ............................................................ 155.7 DGE
Module Weight (Empty) ............................................................... 2314 lbs (1050 Kg)
Module Weight (Full) ................................................................. 3307 lbs (1500 Kg)
Total Internal Cylinder Volume .................................................. 633 ±6 Gallons (2396 ±24L)
Fill Panel Location ................................................................. Driver’s Side
Cylinder Certifications ................................................................. Refer to Data Sheet 116892
Service Pressure ................................................................. 3600 psi (24.8 kPa) @ 70°F (21°C)
Minimum Working Pressure .......................................................... 290 psi (2 MPa)
Module Temperature Range .................................................. –40°F (–40°C) to 149°F (65°C)
Fill Flow Rate (Standard Fill Receptacle with Filter)* .................. Average 3.0 DGE/min, up to 10 DGE/min
Fill Flow Rate (Standard Fill Receptacle without Filter)* .................. Average 4.5 DGE/min, up to 15 DGE/min
Fill Flow Rate (High Flow Fill Receptacle with Filter)* .................. Average 11.0 DGE/min, up to 30 DGE/min
Fill Flow Rate (High Flow Fill Receptacle without Filter)* .................. Average 16.0 DGE/min, up to 35 DGE/min

* System fill rates will vary based on ambient temperatures, station pressures, and fuel quality.
Components Locator
Generation 1

Covers

1. Access Cover
2. Front Cover
3. Right–Side Cover
4. Left–Side Cover
5. Rear Cover
Component Locator (Continued)
Generation 1

1. FSM Front Cover
2. PRD Vent Lines
3. CNG Cylinder Valve (Qty 3)
4. CNG Cylinder (Qty 3)
5. Fill Panel
Component Locator (Continued)

Generation 1

Fill Panel
1. CNG Pressure Gauge
2. 1/4–Turn Manual Shut Off Valve
3. Standard NGV1 CNG Fill Valve
4. High Flow, ISO 14469–2, CNG Fill Valve

Fuel Gauge Module
1. Electrical Connector / Interface
2. Fuel Gauge Module

Service Components
1. Coalescing Filter
2. System Vent Valve
Component Locator (Continued)
Generation 2

Access Door / Access Panel

(1) Cylinder Access Door
(2) Access Panel
(3) Fuel Outlet Pipe (3/4" Connection, 37° Flare)
(4) High Pressure Fuel Inlet/Outlet Pipe* (3/8" ORFS 8–6–6 Connection)*
(5) High Pressure Fuel Inlet/Outlet Pipe* (3/8" ORFS 8–6–6 Connection)*
(6) System Vent Valve
(7) System Vent Cap

*For frame mounted cylinder connection
Component Locator (Continued)

Generation 2

**Cylinder Access Door**
2. High–Pressure Coalescing Filter
3. PRD Outlet Ports

**Electrical Interface**
1. Electrical Connector

**Fill Panel**
1. Manual Shut–Off Valve
2. Standard CNG Fill Valve (to 3600 psi)
3. CNG Pressure Gauge (0–5000 psi)
4. High Flow CNG Fill Valve, ISO 14469–2
Component Locator (Continued)
Generation 2

Covers

116074, 116944
1. Fill Panel Door (Not Available on Slave Model)
2. Cylinder Access Door
3. Left–Side Cover
4. Front Cover
5. Right–Side Cover
6. Rear Cover
7. Access Panel

117155, 117345
1. Fill Panel Door
2. Cylinder Access Door
3. Left–Side Rear Cover
4. Left–Side Front Cover
5. Right–Side Front Cover
6. Right–Side Rear Cover
7. Access Panel
Label Locator

Generation 1

The following labels are required by MVSS 303, NFPA 52, and ISO 3864–2. Always replace any labels that are damaged or missing.

1. PN 116137

2. PN 116140
   The Cylinder Inspection Label must be replaced at each inspection.

3. PN 114270

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CNG BOC FSM Maintenance Manual
Label Locator (Continued)
Generation 1

When calling for parts, use the part number and serial number indicated on this label.
Label Locator (Continued)

Generation 2

The following labels are required by MVSS 303, NFPA 52, and ISO 3864–2. Always replace any labels that are damaged or missing.

1. PN 116140
   The Cylinder Inspection Label must be replaced at each inspection.

2. PN 116770
   When calling for parts, use the part number and serial number indicated on this label.

3. PN 116552

4. PN 114254
Label Locator (Continued)

Generation 2

5

PN 114270

6

PN 116335
**Service and Maintenance**

**Generation 1 – Maintenance Schedule**

The following maintenance items are specific to the CNG fuel system on your vehicle. These items are required in addition to the maintenance items listed for your other equipment used to ensure safe and reliable operation.

The services shown in this schedule should be performed after 100,000 miles (160,000 km) at the same intervals.

<table>
<thead>
<tr>
<th>Check At Each Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Inspect the fill receptacle O–Ring(s). Refer to the Fill Receptacle O–Ring Inspection section in this manual.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check Every 6,000 miles / 10,000 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Drain the coalescing filter. ¹ Refer to the Coalescing Filter Drain section in this manual.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check Every 18,000 miles / 30,000 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Replace the coalescing filter (Or replace after 4 successful drains). ¹ Refer to the Coalescing Filter Service section in this manual.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check Every 36 months or 36,000 miles / 60,000 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Perform 18,000 mile procedure.</td>
</tr>
<tr>
<td>- Visually inspect the cover assembly. Refer to the Fuel Storage Module Cover Inspection section in this manual.</td>
</tr>
<tr>
<td>- Visually inspect the cylinder brackets and isolators. ² Refer to the Cylinder Bracket and Isolator Inspection section in this manual.</td>
</tr>
<tr>
<td>- Perform a leak check. Refer to the Leak Checking the System section in this manual.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check Every 12 months or 100,000 miles / 160,000 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Perform 36,000 mile procedures.</td>
</tr>
<tr>
<td>- Inspect the CNG fuel cylinders. Refer to the Cylinder Inspection section in this manual.</td>
</tr>
</tbody>
</table>

¹ Drain and filter cartridge replacement intervals may vary depending on fuel quality.
² The FSM covers may remain on the module for this inspection unless a concern is observed.
³ Record the inspection information in the vehicle’s permanent file. Refer to the CNG Cylinder – Installation and Maintenance Manual for more information at www.qtww.com. A copy of the Cylinder Inspection Form is located at the back of this manual in Appendix D.
Service and Maintenance (Continued)

Generation 2 – Maintenance Schedule
The following maintenance items are specific to the CNG fuel system on your vehicle. These items are required in addition to the maintenance items listed for your other equipment used to ensure safe and reliable operation.

The services shown in this schedule should be performed after 100,000 miles (160,000 km) at the same intervals.

Check At Each Fill
- Inspect the fill receptacle O–Ring(s).
  Refer to Fill Receptacle O–Ring Inspection section in this manual.

Check Every 10,000 miles / 16,000 km
- Drain the coalescing filter. ¹
  Refer to Coalescing Filter Drain section in this manual.

Check Every 36 months or 36,000 miles / 60,000 km
- Perform 10,000 mile procedure.
- Replace the coalescing filter (Or replace after 4 successful drains). ¹
  Refer to Coalescing Filter Service section in this manual.
- Visually inspect the cover assembly.
  Refer to Fuel Storage Module Cover Inspection section in this manual.
- Visually inspect the cylinder brackets and isolators. ²
  Refer to Cylinder Bracket and Isolator Inspection section in this manual.
- Perform a leak check.
  Refer to Leak Checking the System section in this manual.

Check Every 12 months or 100,000 miles / 160,000 km
- Perform 36,000 mile procedures.
- Inspect the CNG fuel cylinders.
  Refer to Cylinder Inspection in this manual.
- Visually inspect the fuel storage module (covers removed). ³

¹ Drain and filter cartridge replacement intervals may vary depending on fuel quality.
² The FSM covers may remain on the module for this inspection unless a concern is observed.
³ Record the inspection information in the vehicle’s permanent file. Refer to the CNG Cylinder – Installation and Maintenance Manual for more information at www.qtww.com. A copy of the Cylinder Inspection Form is located at the back of this manual in Appendix D.
### Maintenance Parts

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Quantum PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNG Coalescing Filter Element Kit (Generation 1)</td>
<td>116323</td>
</tr>
<tr>
<td>CNG Coalescing Filter Element Kit (Generation 2)</td>
<td>117018</td>
</tr>
<tr>
<td>Load Lamp</td>
<td>116162</td>
</tr>
<tr>
<td>Fill Panel Lamp</td>
<td>115598</td>
</tr>
<tr>
<td>O–Ring – 3/8&quot; ORFS</td>
<td>S3–20503–008</td>
</tr>
<tr>
<td>O–Ring – 1/2&quot; ORFS</td>
<td>S3–20503–023</td>
</tr>
<tr>
<td>O–Ring – SAE–8</td>
<td>S3–20503–010</td>
</tr>
<tr>
<td>O–Ring – Drain Plug, Coalescing Filter (Generation 1)</td>
<td>S3–20503–011</td>
</tr>
<tr>
<td>O–Ring – Drain Plug, Coalescing Filter (Generation 2)</td>
<td>S3–20503–010</td>
</tr>
<tr>
<td>O–Ring – Standard Fill Receptacle, TN1</td>
<td>S3–20503–003</td>
</tr>
<tr>
<td>O–Ring – ORFS–6 to Fill Manifold (Generation 2)</td>
<td>116702–012</td>
</tr>
<tr>
<td>O–Ring – ORFS–8 to Fill Manifold (Generation 2)</td>
<td>116702–014</td>
</tr>
<tr>
<td>O–Ring – SAE–4 to Fill Manifold (Generation 2)</td>
<td>116702–904</td>
</tr>
<tr>
<td>O–Ring – SAE–6 to Fill Manifold (Generation 2)</td>
<td>116702–906</td>
</tr>
<tr>
<td>O–Ring – SAE–8 to Fill Manifold (Generation 2)</td>
<td>116702–908</td>
</tr>
<tr>
<td>O–Ring – SAE–10 to Fill Manifold (Generation 2)</td>
<td>116702–910</td>
</tr>
<tr>
<td>Dust Cap – Fill Receptacle Standard (Generation 1)</td>
<td>116620</td>
</tr>
<tr>
<td>Dust Cap – Fill Receptacle High Flow (Generation 1)</td>
<td>116621</td>
</tr>
<tr>
<td>Dust Cap – Fill Receptacle Standard (Generation 2)</td>
<td>117668</td>
</tr>
<tr>
<td>Dust Cap – Fill Receptacle High Flow (Generation 2)</td>
<td>117667</td>
</tr>
<tr>
<td>Fill Receptacle – Standard without Filter (Generation 1)</td>
<td>114928</td>
</tr>
<tr>
<td>Fill Receptacle – Standard with Filter (Generation 1)</td>
<td>115516</td>
</tr>
<tr>
<td>Fill Receptacle – High Flow with Filter (Generation 1)</td>
<td>114444</td>
</tr>
<tr>
<td>Fill Receptacle – Standard without Filter (Generation 2)</td>
<td>116694</td>
</tr>
<tr>
<td>Fill Receptacle – Standard with Filter (Generation 2)</td>
<td>116680</td>
</tr>
<tr>
<td>Fill Receptacle – High Flow without Filter (Generation 2)</td>
<td>116685</td>
</tr>
<tr>
<td>Fill Receptacle – High Flow with Filter (Generation 2)</td>
<td>116679</td>
</tr>
</tbody>
</table>
Torque Specifications

Fuel Line

<table>
<thead>
<tr>
<th>Description</th>
<th>Torque Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” 37° Flare (To Fuel Line)</td>
<td>89 lb ft. (120 N.m)</td>
</tr>
<tr>
<td>3/4–16 SAE (To Regulator)</td>
<td>30 lb ft. (40 N.m)</td>
</tr>
<tr>
<td>3/8” ORFS</td>
<td>30 lb ft. (40 N.m)</td>
</tr>
<tr>
<td>1/2” ORFS</td>
<td>40 lb ft. (54 N.m)</td>
</tr>
<tr>
<td>9/16–18 SAE (VTI PRD)</td>
<td>22 lb ft. (30 N.m)</td>
</tr>
</tbody>
</table>

Hex Flange

<table>
<thead>
<tr>
<th>Description</th>
<th>Torque Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6–1.0 (FSM Covers – Generation 1)</td>
<td>62 lb in. (7 N.m)</td>
</tr>
<tr>
<td>M8–1.25 (FSM Covers – Generation 1)</td>
<td>62 lb in. (7 N.m)</td>
</tr>
<tr>
<td>M8–1.25 (FSM Covers – Generation 2)</td>
<td>71 lb in. (8 N.m)</td>
</tr>
<tr>
<td>M8–1.25 (FSM Access Panel – Generation 2)</td>
<td>14 lb ft. (19 N.m)</td>
</tr>
<tr>
<td>M14 Fasteners</td>
<td>125 lb ft. (170 N.m)</td>
</tr>
<tr>
<td>M16 Fasteners</td>
<td>199 lb ft. (270 N.m)</td>
</tr>
</tbody>
</table>

*All torque values are dry threads unless otherwise noted.

Miscellaneous

<table>
<thead>
<tr>
<th>Description</th>
<th>Torque Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder Strap Nuts</td>
<td>See Spring Height Inspection in this manual</td>
</tr>
<tr>
<td>Coalescent Filter Drain Plug (Generation 1)</td>
<td>21 lb ft. (28 N.m)</td>
</tr>
<tr>
<td>Coalescent Filter Drain Plug (Generation 2)</td>
<td>11 lb ft. (15 N.m)</td>
</tr>
<tr>
<td>Coalescent Filter Housing (Generation 1)</td>
<td>40 lb ft. (54 N.m)</td>
</tr>
<tr>
<td>Coalescent Filter Housing (Generation 2)</td>
<td>25 lb ft. (33 N.m)</td>
</tr>
<tr>
<td>Fill Receptacle – Standard (Generation 1)</td>
<td>48 lb ft. (65 N.m)</td>
</tr>
<tr>
<td>Fill Receptacle – High Flow (Generation 1)</td>
<td>85 lb ft. (115 N.m)</td>
</tr>
<tr>
<td>Fill Receptacle (Generation 2)</td>
<td>58 lb ft. (79 N.m)</td>
</tr>
<tr>
<td>System Vent Valve Cap</td>
<td>24 lb ft. (32 N.m)</td>
</tr>
</tbody>
</table>
Service Procedures

Fill Receptacle O–Ring Inspection
Inspect the fill receptacle O–ring. Make sure the O–ring is in place and properly seated in the groove. Replace the O–Ring if it is missing or damaged.

To replace the fill receptacle O–ring follow these steps:

1. Remove the O–ring (1) from the fill receptacle. You can use a small screwdriver, a ball point pen or a paper clip.

   **CAUTION**
   
   Using common automotive or plumbing O–rings as a replacement part may cause a leak while operating the system on CNG. Use only O–rings approved for use with CNG from an authorized source. Failure to use an O–ring approved for use with CNG may result in minor or moderate injury.

2. Install the new O–ring in the fill receptacle. Make sure the O–ring is properly seated in the groove.
Coalescing Filter Drain

Generation 1

The fuel system is equipped with a coalescing filter assembly. It is expected that the element of this filter assembly should not need to be replaced beyond the recommended service interval. However, it may accumulate oil and will need to be drained periodically. Depending on the quality of fuel being used, the service interval may need to be adjusted.

Use the procedure below to drain fluids from the filter assembly. If the filter element needs to be replaced, refer to the filter manufacturer documentation for filter element replacement procedures.

2. Vent the pressure from the fuel lines using the CNG system vent valve. Refer to System Venting in this manual.

**CAUTION**

Vent the fuel system pressure to atmospheric levels before servicing the filter assembly. Failure to relieve system pressure may result in serious personal injury and or system damage.

4. Slowly remove the drain from the bowl on the bottom of the filter assembly. Use caution as residual pressure may be present.
5. When the bowl has finished draining, clean the threads on the drain plug. Remove and discard the O–Ring on the drain plug. Install a new O–Ring on the drain plug and insert the drain plug back into the filter housing, then tighten to 21 lb ft. (28 N.m).
6. Close the system vent valve.
7. Replace the system vent valve cap and tighten to 24 lb ft (32 Nm).
8. Open the manual shut off valves on all fuel cylinders.
9. Pressurize the fuel fill lines. Check all disturbed connections for leaks.
Coalescing Filter Drain (Continued)

Generation 2

The fuel system is equipped with a coalescing filter assembly. It is expected that the element of this filter assembly should not need to be replaced beyond the recommended service interval. However, it may accumulate oil and will need to be drained periodically. Depending on the quality of fuel being used, the service interval may need to be adjusted.

Use the procedure below to drain fluids from the filter assembly. If the filter element needs to be replaced, refer to the filter manufacturer documentation for filter element replacement procedures.

2. Vent the fuel system pressure to atmospheric levels before servicing the filter assembly. Failure to relieve system pressure may result in serious personal injury and or system damage.
3. Vent the pressure from the fuel lines using the CNG system vent valve. Refer to System Venting in this manual.
4. Slowly remove the drain from the bowl on the bottom of the filter assembly. Use caution as residual pressure may be present.
5. When the bowl has finished draining, clean the threads on the drain plug. Remove and discard the O–Ring on the drain plug. Install a new O–Ring on the drain plug and insert the drain plug back into the filter housing, then tighten to 11 lb ft. (15 N.m).
6. Close the system vent valve.
7. Replace the system vent valve cap and tighten to 24 lb ft (32 N.m).
8. Open the manual shut off valves on all fuel cylinders.
9. Pressurize the fuel fill lines. Check all disturbed connections for leaks.
Coalescing Filter Service

**Generation 1**

The fuel system is equipped with a coalescing filter assembly. It is expected that the element of this filter assembly should not need to be replaced beyond the recommended service interval. However, it may accumulate oil and will need to be drained periodically. Depending on the quality of fuel being used, the service interval may need to be adjusted.

The fuel filters should not need to be serviced beyond the recommended interval unless poor quality fuel has been used. In the unlikely event the filter was to become clogged, you may notice decreased flow rates and or freezing of the filter assembly. Use the procedure below to drain fluids from the filter assembly. If the filter element needs to be replaced, refer to the filter manufacturer documentation for filter element replacement procedures.


**CAUTION**

Vent the fuel system pressure to atmospheric levels before servicing the filter assembly. Failure to relieve system pressure may result in serious personal injury and or system damage.

2. Vent the pressure from the fuel lines using the CNG system vent valve. Refer to *System Venting* in this manual.
3. Slowly remove the drain plug from the bowl on the bottom of the filter assembly.
4. When the bowl has finished draining, clean the threads on the drain plug. Remove and discard the O–Ring on the drain plug. Install a new O–Ring on the drain plug and insert the drain plug back into the filter housing, then tighten to 21 lb ft. (28 N.m).
5. Remove the filter housing assembly. Remove and discard the O–Ring on the filter housing.
6. Remove the filter. Remove and discard the O–Ring on the filter.
7. Install the filter with the new O–Ring.
8. Install the filter housing with the new O–Ring and tighten to 40 lb ft. (54 N.m)
9. Close the system vent valve.
10. Replace the system vent valve cap and tighten to 24 lb ft (32 N.m).
11. Open the manual shut off valves on all fuel cylinders to pressurize the fuel lines.
12. Check all disturbed connections for leaks.
Coalescing Filter Service (Continued)

Generation 2
The fuel system is equipped with a coalescing filter assembly. It is expected that the element of this filter assembly should not need to be replaced beyond the recommended service interval. However, it may accumulate oil and will need to be drained periodically. Depending on the quality of fuel being used, the service interval may need to be adjusted.

The fuel filters should not need to be serviced beyond the recommended interval unless poor quality fuel has been used. In the unlikely event the filter was to become clogged, you may notice decreased flow rates and or freezing of the filter assembly. Refer to the manufacturer documentation for filter element replacement procedures.


**CAUTION**

Vent the fuel system pressure to atmospheric levels before servicing the filter assembly. Failure to relieve system pressure may result in serious personal injury and or system damage.

2. Vent the pressure from the fuel lines using the CNG system vent valve. Refer to System Venting in this manual.
3. Slowly remove the drain plug from the bowl on the bottom of the filter assembly.
4. When the bowl has finished draining, clean the threads on the drain plug. Remove and discard the O–Ring on the drain plug. Install a new O–Ring on the drain plug and insert the drain plug back into the filter housing, then tighten to 11 lb ft. (15 N.m).
5. Remove the filter housing assembly. Remove and discard the O–Ring on the filter housing. Clean the inside of the filter housing with a lint–free cloth.
6. Remove and retain the knurled fastener at the base of the filter element. Remove and discard the filter element.
7. Install the new filter element with the metal disc positioned at the top. Install the knurled fastener at the base of the filter element.
8. Install and lubricate the new O–Ring onto the filter housing assembly. Install the filter housing assembly and tighten to 25 lb ft. (33 N.m).
9. Close the system vent valve.
10. Replace the system vent valve cap and tighten to 24 lb ft (32 N.m).
11. Open the manual shut off valves on all fuel cylinders to pressurize the fuel lines.
12. Check all disturbed connections for leaks.
Fuel Storage Module Cover Inspection

**NOTICE**

*Perform a system inspection if the covers are damaged.*

The fuel storage module covers must be inspected as specified in the Maintenance Schedule. Inspecting the FSM covers is necessary for the structural integrity of the FSM as well as for the protection of the cylinder.

The fuel storage module covers should be inspected to verify that:
- All hardware is installed and torqued to specification
- All dents, dings, and/or damage are documented and remediated accordingly
- All heat sources and/or related components are within a safe distance from the fuel storage module as defined in the Installation Manual

**Cover Removal and Replacement**

**Generation 1 – Cover Removal**

**NOTICE**

*The fuel storage module covers are painted and are categorized as Class A finish. Use care when working with Class A finishes.*

1. Open the cylinder access door, remove and retain the 4 fasteners that hold the end cap to the cage.
2. Remove and retain the fasteners that hold the end caps.
3. Remove and retain the end caps. Store in a protected area.
4. Remove and retain the hardware for the hose support bar and grab handles.
5. Remove and retain the hose support bar and grab handles.
Cover Removal and Replacement (Continued)

**Generation 1 – Cover Removal**

6. Remove and retain the fasteners that secure the center of the rear cover.

   **Note:** These fasteners are unique and have Vibra–Tite applied to prevent fastener loosening.

7. Disconnect the load light connector pigtail located at the base of the rear cover.

8. Remove and retain the fasteners securing the rear cover to the cage. Remove the rear cover and store in a protected area.
Cover Removal and Replacement (Continued)

Generation 1 – Cover Removal
If the FSM is mounted on a vehicle, skip steps 9–10.

9. Remove and retain the fasteners that secure the center of the front cover.

   Note: These fasteners are unique and have Vibra–Tite applied to prevent fastener loosening.

10. Remove and retain the fasteners securing the front cover to the cage.
Cover Removal and Replacement (Continued)

Generation 1 – Cover Replacement

NOTICE

The fuel storage module covers are painted and are categorized as Class A finish. Use care when working with Class A finishes.

1. If removed, loose fit the fasteners securing the front cover to the cage. Inspect all fasteners during installation, replace as needed.

2. Apply Vibra–Tite to the fasteners. Loose fit the fasteners that secure the center of the front cover.

   Vibra–Tite is good for multiple cycles. Only reapply as needed only on the 7 center bolts.

3. Loose fit the fasteners that secure the rear cover to the cage and front cover.

   Verify the spacers are still in place.
Cover Removal and Replacement (Continued)

**Generation 1 – Cover Replacement**

4. Connect the load light connector pigtail located at the base of the rear panel.

5. Apply Vibra–Tite to the fasteners. Loose fit the fasteners that secure the center of the rear cover.

Vibra–Tite is good for multiple cycles. Only reapply as needed only on the 11 center bolts.

6. Install the hose support bar and fasteners, then tighten to 14 lb ft (19 N.m).

7. Install the grab handles and fasteners, then tighten to 14 lb ft (19 N.m).

8. Tighten the fasteners that secure the center of both the front and rear covers to 6 lb ft (8 N.m).

9. Tighten the fasteners that secure both the front and rear covers to 6 lb ft (8 N.m).
Cover Removal and Replacement (Continued)

**Generation 1 – Cover Replacement**

10. Install the end caps and fasteners, then tighten to 6 lb ft (8 N.m).

11. Open the cylinder access door and tighten the 4 fasteners to 6 lb ft (8 N.m).
Cover Removal and Replacement (Continued)

**Generation 2 – Cover Removal**

*160 DGE & 180 DGE Shown. 41 DGE & 123 DGE Similar.*

**NOTICE**

> The fuel storage module covers are painted and are categorized as Class A finish. Use care when working with Class A finishes.

1. Remove and retain the hardware for the hose support bar and grab handles.
2. Remove and retain the hose support bar and grab handles.

3. Remove and retain the fasteners for the rear access panel.
   Not applicable for 41 DGE FSMs, proceed to step 7.
4. Remove and retain the rear access panel.

5. Disconnect the load lamp connector.
   Cover the connector ends to prevent damage.
Cover Removal and Replacement (Continued)

**Generation 2 – Cover Removal**

6. Remove and retain the fasteners securing the rear left cover. Remove and retain the cover. Store the cover in a protected area.

7. Remove and retain the fasteners securing the rear right cover. Remove and retain the cover. Store the cover in a protected area.

If the FSM is mounted on a vehicle, skip steps 8–9.

8. Remove and retain the fasteners securing the front left cover. Remove and retain the cover. Store the cover in a protected area.
Cover Removal and Replacement (Continued)

Generation 2 – Cover Removal

9. Remove and retain the fasteners securing the front right cover to the cage. Remove and retain the cover. Store the cover in a protected area.
Cover Removal and Replacement (Continued)

Generation 2 – Cover Replacement

160 DGE & 180 DGE Shown. 41 DGE & 123 DGE Similar.

NOTICE

The fuel storage module covers are painted and are categorized as Class A finish. Use care when working with Class A finishes.

1. If removed, loose fit the fasteners securing the front right. Inspect all fasteners during installation, replace as needed.

2. If removed, loose fit the fasteners that secure the front left cover.

3. Loose fit the fasteners that secure the rear right cover.
Generation 2 – Cover Replacement

4. Loose fit the fasteners that secure the rear left cover.
   
   Tighten all cover fasteners to 6 lb ft (8 N.m).

5. Connect the load light connector located to the left of the regulator. Not applicable for 41 DGE FSMs, proceed to step 7.

6. Install the rear access panel and tighten to 14 lb ft (19 N.m)
Cover Removal and Replacement (Continued)

Generation 2 – Cover Replacement

7. Install the hose support bar and fasteners, then tighten to 14 lb ft (19 N.m).

8. Install the grab handles and fasteners, then tighten to 14 lb ft (19 N.m).
Cylinder Cleaning

**NOTICE**

Do not pressure wash the fuel storage module or cylinders. Use of a pressure washer may damage the cylinder(s) and/or regulatory labels.

Cylinder cleaning is necessary to properly inspect for any cylinder damage that may have occurred since the last inspection. In general, it would be safe to assume that anything that you would use to wash the painted surface of your vehicle should be safe for the cylinder if used in the same concentrations.

The exterior of the cylinder can be cleaned using water alone or water and a mild detergent such as Simple Green®. If a detergent is used, rinse the cylinder thoroughly with clean water. DO NOT use a pressure washer or steam cleaner as the label or dome on the cylinder may be damaged.

Cylinder Inspection

**DANGER**

In order for a complete and through cylinder inspection to be completed, any accessible covers must be removed and the cylinders must be properly cleaned prior to inspection. Failure to properly inspect and detect any cylinder damaged will result in severe injury or death.

Periodic inspection of the FSM cylinders is required to ensure the safe and reliable operation of the fuel storage module. There are a number of documents commonly used in the industry as guidelines to ensure that a complete and through cylinder and fuel storage module inspection is performed. Quantum recommends that any technician responsible for performing cylinder inspections follow these guidelines. At a minimum, the documents listed below should be used and followed when performing cylinder inspections along with the *Quantum CNG Type 4 Cylinder Installation and Maintenance Manual*.

- CGA C–6.4 *Methods for External Visual Inspection of Natural Gas Vehicle*
- ISO 19078 *Inspection of the cylinder installation, and requalification of high pressure cylinders for the on–board storage of natural gas as a fuel for automotive vehicles*
- ISO 11623 *Gas Cylinders– Composite Construction– Periodic inspection and testing*

Any recommendations from Quantum that exceed the requirements outlined in the CGA or ISO documents should be followed and are considered to supersede those requirements. If there is a case where any Federal, State, or Local regulation is found to contradict or are more stringent than the inspection or maintenance requirements set forth by Quantum, then the Federal, State, or Local regulations should be followed without exception.

Inspections must follow CGA C–6.4 & ISO 19078 standards. The inspection should include thorough examinations of the fuel storage module structure, brackets, and cylinder(s).

Any observations regarding damaged and/or replaced fuel and vent lines or loose fittings must be recorded.

In order to ensure that the cylinders are fit for continued safe use, the inspection shall be carried out by persons who have the appropriate experience and or training needed to perform a thorough cylinder inspection. The inspector shall have available and within easy access during the inspection, the equipment and the documentation needed to properly complete the inspection.

The vehicle to be inspected shall be positioned in such a way that the inspector has unimpeded access to the surface of the cylinder.

If specific inspection criteria are required and cannot be found in this document, reference the *Quantum CNG Type 4 Cylinder Installation and Maintenance Manual* or ISO 19078 in that order. In the event a conflict exists between the Quantum documents and ISO 19078, the inspection criteria defined in the Quantum documents should take precedent.

For detailed information about fuel cylinder inspection and maintenance refer to the *Quantum CNG Cylinder Installation and Maintenance Manual* at [www.gtww.com/service](http://www.gtww.com/service).
Cylinder Bracket and Isolator Inspection

Inspect the fuel storage module brackets and isolators at the intervals stated in the maintenance schedule.

The following items must be inspected:
- Cylinder mounting brackets
- Cylinder strap spring heights
- Rubber isolators
- Anti–rotation blocks
- Lateral movement blocks

Visually inspect the rubber isolators to confirm they have not slipped out of position. In the picture to the right, the isolator has slipped off the cylinder bracket. This can create a hazardous condition since the cylinder may receive damage from directly contacting the bracket.

Verify that the rubber isolator is properly seated on the cylinder brackets and straps. Inspect the rubber isolator for cracks, deterioration, or other damage. Replace the rubber isolators whenever the cylinder straps are removed or loosened.

Inspect the cylinder brackets, straps, mounting frame, and mounting hardware for cracks, corrosion, deformation, or other damage.

Replace any parts that are suspect or found to be damaged or defective.
Cylinder Bracket and Isolator Inspection (Continued)

Visually inspect the valve and confirm it is straight up and down (0°) as shown in the illustration to the right. A valve that has rotated may indicate cylinder movement.

Use an angle indicator on one of the frame pieces of the fuel storage module to gauge the angle of the entire fuel storage module. The reading from the frame will need to be subtracted from the reading taken from the cylinder valves.

Use an angle indicator tool on the valve to determine the valve angle. If the cylinder has rotated more than ±5°, then the cylinder will need to be repositioned in the cylinder support brackets.

\[ \text{Valve Angle} - \text{Frame Angle} = \text{Actual Valve Angle} \]

Visually inspect the cylinder for lateral movement. In multiple cylinder configurations, it may be noticeable to see one valve either protruding or recessed more than the other cylinders. In this photo, the cylinder has moved laterally to the LH side of the unit.

Open the cylinder access door and place a straight edge against the outer frame. Use a tape measure and measure the distance between the straight edge and the cylinder valve boss. The cylinder must be within 2.7”–3.5” (68–88mm). Check all three (3) valves. If the cylinder is outside of range, then the cylinder will need to be repositioned in the cylinder support brackets.
Spring Height Inspection

**NOTICE**

*If constant spring height adjustments are necessary, inspect the isolators and bracketry for wear or damage.*

**NOTICE**

*A composite cylinder will expand and contract as the internal pressure increases and decreases. In order to compensate for expansion and contraction the cylinder strap rubber isolator is designed to deform slightly. The rubber isolators may settle which may result in causing the cylinder strap spring height to vary from factory installed torque.*

**Generation 1**

Check the spring height between the spring saddle and the bottom of the washer.

<table>
<thead>
<tr>
<th>Cylinder Pressure (psi)</th>
<th>Spring Height in (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 – 599</td>
<td>1.22” (31)</td>
</tr>
<tr>
<td>600 – 1499</td>
<td>1.18” (30)</td>
</tr>
<tr>
<td>1500 – 2399</td>
<td>1.14” (29)</td>
</tr>
<tr>
<td>2400 – 2999</td>
<td>1.10” (28)</td>
</tr>
<tr>
<td>3000 – 3600</td>
<td>1.06” (27)</td>
</tr>
</tbody>
</table>

**Generation 2**

Check the spring height from the base of the spring up to the flange of the nut.

<table>
<thead>
<tr>
<th>Cylinder Pressure (psi)</th>
<th>Spring Height in (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 – 1199</td>
<td>2.83” (72)</td>
</tr>
<tr>
<td>1200 – 1799</td>
<td>2.80” (71)</td>
</tr>
<tr>
<td>1800 – 2399</td>
<td>2.76” (70)</td>
</tr>
<tr>
<td>2400 – 2999</td>
<td>2.72” (69)</td>
</tr>
<tr>
<td>3000 – 3599</td>
<td>2.68” (68)</td>
</tr>
<tr>
<td>3600</td>
<td>2.64” (67)</td>
</tr>
</tbody>
</table>
Leak Checking the System

Use this procedure if a CNG fuel system leak is suspected. Leaks may be noticed with ice forming on the lines or fittings, oil stains, or a smell detected from the CNG odorant chemical in the fuel.

The system can be checked for leaks after initial power–up, at idle or while the system is operating. Always leak check the fuel system after any service that disturbs fuel carrying components has been performed.

CNG gas is lighter than air and will rise. When using a hand held detector, always check above lines and fittings for best results.

1. Start the system to ensure all fuel lines are pressurized.

   **IMPORTANT:** When leak checking a system is it strongly recommended that the high pressure side is checked at several pressure points (i.e. 500 psi, 1500 psi, 3000 psi, 3600 psi) as leaks may be present at lower pressures and not at higher pressures.

2. Check the fuel system for leaks by using a CNG gas detector, ultrasonic leak detector, or Snoop®. If using a gas detector, run the detector’s probe along the top of all lines, joints, and fittings. Any leaks detected should be repaired before the unit is returned to service.
Module Fuel Shut–Off

1. Locate the opening near the cylinder valve of each fuel storage module for each side of the vehicle.

2. Close the fuel cylinder manual shut off valve on each of the cylinders. To close, turn the shut off valve clockwise (approximately 4 turns) until fully seated.

3. If the system includes slave fuel storage modules, close the shut off valves clockwise prior to service.
**System Venting**

A high pressure vent valve has been installed that will allow venting of the high pressure CNG piping and cylinders for service.

If the CNG system requires service and the high pressure components must be removed or repaired, use the following procedure:

1. Close the manual shut off valves on all fuel storage cylinders. If equipped with slave fuel storage modules, confirm that the cylinder valves are closed. Refer to [Module Fuel Shut–Off](#) in this manual for more information.

2. Connect a vent hose to the vent port (JIC –6, 37° Flare) on the CNG system vent valve and tighten to 24 lb ft (32 N.m).

3. Slowly open the vent valve and allow the CNG to vent until the pressure has been exhausted.

4. If the CNG flow and or pressure do not appear to be decreasing after a reasonable period of time, close the CNG system vent valve.

5. Verify all CNG storage cylinder valves are fully closed.

6. Repeat steps 3 through 5 as required.

7. Verify the system is empty by checking the fuel pressure gauge and confirming that the system is no longer venting.

8. Close the system vent valve.

9. Remove the vent hose from the vent port.

10. Install the vent valve cap and tighten to 24 lb–ft (32 N.m).
Cylinder Venting

**WARNING**

This FSM is equipped with a system vent valve and orifice. If venting apart from the system vent valve, then an orifice must be used. Failure to use an orifice in the venting system may subject the fuel storage module to extremely low temperatures during venting resulting in severe damage to (or failure of) these components. Use the orifice specified by this procedure when venting the fuel storage module. Failure to follow this instruction may result in death or serious injury and damage components.

**CAUTION**

If proper procedures are not followed during fuel cylinder venting, serious injury or death may occur. Read and understand all safety information before proceeding with the release of pressurized gas. Refer to Important Safety Information in this manual. It is also strongly recommended that the local fire authority be consulted to ensure all local regulations are followed.

**NOTICE**

The system vent valve is equipped with an orifice, if this port is used, then no additional orifice is needed. If using other than the system vent valve, then the vent hose must be equipped with a 0.042” (1.06mm) orifice to prevent damage to the cylinder valve.

Venting systems must meet the requirements of applicable local codes or venting regulations.

Due to the design of Type 4 fuel cylinders there will always be low levels of permeation that may result in a fuel under the FSM covers.
Cylinder Venting (Continued)

**DANGER**

Operating the system with the system vent valve in the open position and with the end cap removed, will result in a fuel leak; verify the valve is in the closed position and the end cap is secure before filling or operating the system. Failure to follow this instruction will result in serious injury or death.


2. Open the 1/4 turn manual shut off valve.

   **Confirm the system vent valve (1) has been turned to the clockwise so that the handle is perpendicular to the line. This is the closed position.**

3. Remove the valve port end cap (2) on the outlet port.

**NOTICE**

*The system vent valve is equipped with an orifice, if this port is used, then no additional orifice is needed. If using other than the system vent valve, then the vent hose must be equipped with a 0.042” (1.06mm) orifice to prevent damage to the cylinder valve.*

4. Connect the vent line and tighten to 24 lb ft. (32 N.m).

5. Open the manual shut off valve on the fuel cylinder to be vented.

6. Slowly open the system vent valve by turning the valve handle counter–clockwise so that the handle is parallel with the vent line.

7. Drain the fuel cylinder to approximately 10 psig ± 5 psig (1.7 bar ±0.3 bar).

8. If the cylinder valve is to be serviced, purge the remaining CNG from the fuel cylinder. Refer to *Cylinder Purge* in this manual.

9. After the venting and purge procedures are complete, verify the manual shut off is closed by turning the valve clockwise until it stops.

10. Close the system vent valve (1) so that it is perpendicular to the line as shown.

11. Remove the vent line.

12. Reinstall the valve port end cap (2) and tighten to 24 lb ft (32 N.m).
System Purge

Generation 1 Purge Instructions
The following procedure should be used whenever the CNG fuel system will be disassembled and left or there is a concern of trapped fuel remaining in the high pressure portion of the fuel delivery system.

This procedure will only purge flammable gases from the high pressure portion of the fuel storage system. The fuel storage cylinder and low pressure portion of the fuel delivery system may still contain flammable gas under pressure.
Fuel System Purge (Continued)

Generation 1 Purge Instructions

The purge process dilutes the contents of the system to a level that significantly limits or eliminates the potential flammability range of any gases present in the portion of the system being purged.

**WARNING**

Do not use compressed air to purge the fuel delivery system. Introduction of oxygen will create a flammable mixture. Failure to follow this instruction may result in severe injury or death.

**NOTICE**

Quantum recommends the use of clean, dry, inert gas (Nitrogen, >99.5% purity) for this procedure.

1. Close the cylinder manual shut off valve on any cylinder connected to the system being serviced.

2. Open the system manual shut off valve on the fill panel.
Fuel System Purge (Continued)

3. Remove and retain the system vent valve cap.
   Using the system vent valve, vent the CNG from the fuel delivery system.
   Close the system vent valve.

4. Using a pressure regulator and fill hose connected to the CNG fill receptacle, pressurize the fuel system with a dry inert gas (nitrogen, argon, etc.) to at least 1500 psi (103 bar).

5. Vent and disconnect the fill nozzle.

6. Using the system vent valve, vent the inert gas from the fuel delivery system.
   Confirm the valve is in the closed position.

7. Reinstall the system vent valve port cap and tighten to 24 lb ft (32 Nm).

8. You may now service the fuel delivery system safely.
Fuel System Purge (Continued)

Generation 2 Purge Instructions

The following procedure should be used whenever the CNG fuel system will be disassembled and left or there is a concern of trapped fuel remaining in the high pressure portion of the fuel delivery system.

This procedure will only purge flammable gases from the high pressure portion of the fuel storage system. The fuel storage cylinder and low pressure portion of the fuel delivery system may still contain flammable gas under pressure.
Fuel System Purge (Continued)

Generation 2 Purge Instructions
The purge process dilutes the contents of the system to a level that significantly limits or eliminates the potential flammability range of any gases present in the portion of the system being purged.

⚠️ WARNING ⚠️
Do not use compressed air to purge the fuel delivery system. Introduction of oxygen will create a flammable mixture. Failure to follow this instruction may result in severe injury or death.

 NOTIFY
Quantum recommends the use of clean, dry, inert gas (Nitrogen, >99.5% purity) for this procedure.

1. Close the cylinder manual shut off valve on any cylinder connected to the system being serviced.

2. Open the system manual shut off valve on the fill panel.
Fuel System Purge (Continued)

3. Remove and retain the system vent valve cap.
   Using the system vent valve, vent the CNG from the fuel delivery system.
   Close the system vent valve.

4. Using a pressure regulator and fill hose connected to the CNG fill receptacle, pressurize the fuel system with a dry inert gas (nitrogen, argon, etc.) to at least 1500 psi (103 bar).

5. Vent and disconnect the fill nozzle.

6. Using the system vent valve, vent the inert gas from the fuel delivery system.
   Confirm the valve is in the closed position.

7. Reinstall the system vent valve port cap and torque to 24 lb ft (32 Nm).

8. You may now service the fuel delivery system safely.
Cylinder Purge

The purge process dilutes the contents of the cylinder to a level that significantly limits the potential flammability range of any gases present in the cylinder.

Purging the CNG cylinder is an important step that should be performed before a cylinder is filled with CNG and or any time the cylinder has been open to atmosphere. Cylinder purging should also be performed to dilute the CNG concentrations within the cylinder any time a cylinder has been drained and will require service or shipping.

WARNING

Do not allow atmosphere to enter the fuel storage cylinder during purging. The fuel storage cylinder pressure should remain higher than atmospheric pressure during the purging process. Introduction of atmosphere (oxygen) in the cylinder may create a combustible mixture that if ignited, may result in serious injury or death.

NOTICE

Quantum recommends the use of clean, dry, inert gas (Nitrogen, >99.5% purity) for this procedure. If it is necessary to use flammable gas, this procedure should be performed after the CNG cylinder vehicle installation is completed.

Prior to the initial fill with CNG, or any service, the cylinder should be purged.

Only perform the purge process when the ambient temperature is above 0°F (−18°C). If cylinder was stored at temperatures below 0°F (−18°C) allow cylinder to warm up to room temperature >60°F (15°C) before proceeding.

A recommended purge procedure can be found in the CNG Cylinder Installation and Maintenance Manual available at www.qtww.com/service.

To vent the purge gas from the fuel storage module, refer to the Cylinder Venting procedure in this manual.
Fitting Service

**WARNING**
Vent the fuel system pressure to atmospheric levels before servicing.
- Do not bleed system by loosening fitting nut or fitting plug.
- Do not tighten fittings when system is pressurized.

Follow the [System Venting](#) section in this manual for more information. Failure to relieve system pressure may result in serious personal injury and or system damage.

**WARNING**
Always use a lubricant approved for use with CNG when servicing o–rings. Failure to use a CNG safe o–ring lubricant may result in serious personal injury and or system damage.

**WARNING**
Always use a new O–Ring when servicing fittings requiring an O–Ring. Always inspect the sealing surfaces in the fitting for damage and foreign debris before use. Failure to replace an O–Ring may result in serious personal injury and or system damage.
Fitting Service (Continued)

O–Ring Face Seal (ORFS)

Always use a new o–ring when reusing a fitting.

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign matter.

2. If the o–ring or seal is not pre–installed to fitting male port end, then install the proper sized o–ring or seal.

3. Inspect the flange surface for burrs, nicks, scratches, or any foreign matter.

4. Lubricate the o–ring.
Fitting Service (Continued)

5. Place the tube assembly against the fitting body so that the flat face of the flange comes in full contact with the o-ring. Thread the nut onto the fitting body by hand. Use a back-up wrench and tighten to the specifications listed in the Torque Specifications section within this manual.
Fitting Service (Continued)

SAE (J1926)– Straight Thread
Non–Adjustable Port End Fitting

Always use a new o–ring when reusing a fitting.

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign matter.
2. If the o–ring or seal is not pre–installed to fitting male port end, then install the proper sized o–ring or seal.
3. Lubricate the o–ring.
4. Screw fitting into port and tighten to proper torque.

Adjustable Port End Fitting

Always use a new o–ring when reusing a fitting.

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign matter.
2. If the o–ring or seal is not pre–installed to fitting male port end, then install the proper sized o–ring or seal.
3. Back off lock nut until 1 thread is showing. Make sure the back–up washer is not lose and is pushed up as far as possible.
4. Lubricate the o–ring.
5. Screw fitting into port until the back-up washer or the retaining ring contacts the face of the port. Light wrench application may be necessary. **Over tightening may damage the washer.**

![Image of fitting being screwed into port]

6. To align the tube end of the fitting to accept incoming tube or hose assembly, unscrew the fitting by the required amount, but not more than one full turn.

![Image of fitting unscrewed]

7. Using two wrenches, hold fitting in desired position and tighten locknut to the proper torque value.

8. Inspect to ensure that o–ring is not pinched and that the washer is seated flat on the face of the port.

![Image of locknut being tightened with torque wrench]
Fitting Service (Continued)

**CAUTION**

Do not use the Swagelok gap inspection gauge with reassembled fittings. Using the gauge on reassembled fittings may damage the fitting and result in serious personal injury or system damage.

Swagelok Tube Adaptors

1. Install the end opposite the tube adapter end.

2. Insert the tube adapter into the Swagelok tube fitting. Make sure that the tube adapter rests firmly on the shoulder of the tube fitting body and that the nut is finger–tight.

3. Mark the nut at the 6 o’clock position.

4. Use a back–up wrench and tighten the nut one and one–quarter turns to the 9 o’clock position.

For reassembly of tube fittings, refer to the **Swagelok Tube Fittings (Reassembly)** section in this manual.
Fitting Service (Continued)

Swagelok Tube Fittings (New)

1. Fully insert the tube into the fitting and against the shoulder; rotate the nut finger–tight. **High–pressure applications and high safety–factor systems:** Further tighten the nut until the tube will not turn by hand or move axially in the fitting.

2. Mark the nut at the 6 o’clock position.

3. Use a back–up wrench and tighten the nut one and one–quarter turns to the 9 o’clock position.
Fitting Service (Continued)

Swagelok Tube Fittings (Reassembly)

When serviced properly, Swagelok tube fittings can be disassembled and reassembled many times.

1. Mark the tube at the back of the nut; mark a line along the nut and fitting body flats. Use these marks to ensure that you return the nut to the previously pulled-up position.

2. Insert the tube with preswaged ferrules into the fitting until the front ferrule seats against the fitting body.

3. Secure the fitting body steady with a back-up wrench.
   
   Rotate the nut with a wrench to the previously pulled-up position, as indicated by the marks on the tube and flats. At this point, you will feel a significant increase in resistance.
   
   Tighten the nut slightly.
Fitting Service (Continued)

Swagelok Port Connectors

When serviced properly, Swagelok tube fittings can be disassembled and reassembled many times. Make subsequent connections by slightly tightening with a wrench after snugging the nut by hand.

Connect the machined ferrule end **before** connecting the tube adapter end.

**Machined Ferrule End**

1. Slip the nut over the machined ferrule end of the port connector.

2. Insert the port connector into the end connection and finger–tighten the nut.

3. While holding fitting body steady, tighten the nut one–quarter turn.
Module Initial Pressurization

⚠️ WARNING ⚠️
If a leak is detected, immediately stop filling the system. Failure to follow this instruction may result in serious injury or death.

⚠️ CAUTION ⚠️
Compressed Natural Gas (CNG) is extremely flammable. If something accidentally ignites it, you may be badly burned. Keep sparks, flames, and smoking materials away from natural gas. Do not smoke if you are near natural gas or refueling your vehicle. Failure to do so may result in minor to moderate injury.

⚠️ CAUTION ⚠️
Compressed Natural Gas (CNG) is stored in the fuel cylinder at pressures up to 3,600 psi (24.8 MPa) at 70°F (21°C). To prevent personal injury:

- Never fill to a pressure greater than 3,600 psi (24.8 MPa) at 70°F (21°C).
- Never fill a leaking or damaged cylinder.

Failure to do so may result in minor to moderate injury.

⚠️ CAUTION ⚠️
Failure to follow the initial pressurization instructions may irreversibly damage the fuel storage cylinder, leading to CNG leakage. Fuel leakage may result in minor to moderate injury or damage to the vehicle.

⚠️ CAUTION ⚠️
Performing this procedure when the CNG cylinder temperature is less than 0°F (–18°C) may result in damage to the cylinder. Allow the CNG cylinder to warm to room temperature >60°F (13°C) for a minimum of 12 hours before pressurizing. If ambient conditions where test is performed are less than 0°F (–18°C), complete the procedure within ½ hour after removing cylinder from room temperature environment. Failure to follow this requirement may result in minor to moderate injury.

⚠️ NOTICE ⚠️
When a cylinder is pressurized from empty, a small quantity of AIR (not fuel) is compressed out from between the liner and composite shell. This may cause bubbling around the surface of the shell and/or the end bosses during leak tests. This is a normal condition known as “permeation” and the bubbling should subside typically within 30 minutes. If there is any doubt leave the cylinder pressurized overnight. If the pressure is unchanged and the bubbling has subsided, this is considered normal permeation of entrapped air.

You may also observe some cracking or popping sounds coming from the cylinder during the initial pressurization. If the liner has settled away from the shell during shipping, some cracking or popping noises may be heard during the initial fill; you may also be hearing the shell of the cylinder settling as it is pressurized. If there is no damage to the cylinder, and no fuel leakage is detected, there should be no concern pressurizing the cylinder.
Module Initial Pressurization (Continued)

If while filling the vehicle a leak is detected in the system, the fill process should be stopped immediately. The system should not be filled until the leak or leaking component has been repaired or replaced.

The recommended steps for this procedure are outlined in order below:

1. Ensure that the fuel storage module is properly installed in a vehicle or retained in an appropriate test fixture before proceeding.

2. Open the Manual Shut Off Valve and cylinder valves.

3. Connect the gas supply to the system fill valve.

4. Slowly fill to 30 bar (430 psig) while listening for gross leakage. Re–test and repair any leaks discovered. When leak test is successfully passed, vent the system through the vent circuit. These steps validate the equipment setup and operation for testing the CNG cylinder valve/PRD interface. Test all connections and interfaces in the circuit with a liquid leak test fluid. Observe all connections and interfaces for bubble formation over a two minute period. If no bubbles are present, continue with procedure. If bubbles are found, close the supply valve and vent the system by opening the vent circuit ¼ turn valve and repair any leak(s) before proceeding.

5. Increase the cylinder pressure to 100 bar (1450 psig). Re–test and repair any leaks discovered. When leak test is successfully passed, vent the system through the vent circuit. These steps validate the equipment setup and operation for testing the CNG cylinder valve/PRD interface. Test all connections and interfaces in the circuit with a liquid leak test fluid.

6. If inert gas was used for this procedure, then vent the cylinder following the Cylinder Venting procedure in this manual.

Air may escape between the liner and the carbon fiber overwrap when leak checking the cylinder.
Module Initial Pressurization (Continued)

The area between the liner and the overwrap will trap air when the cylinder has been vented. Pressurizing the cylinder causes the liner to expand causing the liner to squeeze the air out of the space between the liner and the carbon fiber overwrap.

The area between the valve boss and the carbon fiber overwrap is highlighted in the image to the right. Air escaping from this area is normal as the liner expands within the cylinder.

Air may be noticed for up to 5 days.

Use a CNG leak detector to sample the air. No CNG should be present. If CNG is detected, then move the vehicle outdoors to a safe location and contact Quantum Technical Support immediately 800/816–8691.

Air escaping between the valve boss, valve boss adaptor, and/or the valve must be tested for the presence of CNG. If CNG is detected, then move the vehicle outdoors to a safe location and contact Quantum Technical Support immediately 800/816–8691.
Collision Repairs

NOTICE

If the vehicle containing this system is involved in a collision where the fuel storage system was directly impacted or air bag deployment occurred, the vehicle should be removed from service. The system must not be operated until it has been thoroughly inspected by a qualified CNG technician.

If the system has been involved in an accident the fuel storage system and all fuel carrying components must be inspected for damage.

Do not expose the fuel storage module to high ambient temperatures. Exposing the fuel storage module to temperatures greater than 149°F (65°C) may result in an unexpected discharge of fuel.

It is strongly recommended that paint ovens not be used to accelerate the paint curing process on equipment with CNG storage systems.

If paint repairs are required, the system cannot be subjected to temperatures over 149°F (65°C) or the fuel cylinder liner may be damaged. The fuel storage system is also equipped with over relief devices. Heating the fuel will cause an increase in system pressure. If the fuel storage system is full when subjected to extreme temperatures, the relief devices may be activated.
Storage Guidelines

Anytime the fuel storage module or fuel cylinders are not in the system, store it in a dry and safe location that prevents damage from systems or other shop equipment. Protect all open ports and fittings with the appropriate plugs or caps in place. Do not store the fuel cylinders in direct sunlight or in close proximity to a heat source or open flame.

Following a few simple safety precautions will prevent injuries resulting from the use of a damaged fuel storage module.

Do:
- Protect the fuel storage module and cylinders from damage when it is not installed in the system.
- Examine the fuel storage module and cylinders for damage after any system crash or grounding.
- Examine the cylinders and brackets for damage anytime there is evidence that the stone shield or covers have been struck by a solid object.
- Perform regular leak inspections on high-pressure lines (every 6 months).

Do Not:
- Drill holes in the cylinder or any of the components.
- Drop the fuel cylinder or fuel cylinder assembly.
- Block off or plug the thermal PRD vents except with the Quantum technologies supplied dust caps.

Failure to follow these instructions may cause irreparable damage to the cylinder assembly resulting in possible system damage, severe personal injury or death.

If a fuel cylinder is to be stored for an extended period of time outside of the system, the fuel pressure must be vented from the fuel cylinder and the cylinder should be purged with an inert gas. Refer to Cylinder Purge in this manual.

Long Term System Storage Procedure

If the CNG system is going to be unused or stored for an extended period (longer than 4 weeks) the following precautions should be followed:

1. Ensure the storage area is well ventilated.
3. Close the fuel storage module 1/4 turn manual shut off valve.
Removing Cylinders From Service

⚠️ **WARNING**
Failure to remove traces of flammable vapor or gas may lead to dangerous explosions of disposed cylinders. Cylinders must be purged of flammable vapors before disposal. Failure to do so may result in serious injury or death.

⚠️ **WARNING**
Cylinders that have been damaged, or exceed the lifespan indicated on the cylinder label, may be at risk of gas leakage. These cylinders must be removed from service and disposed of according to applicable laws and regulations. Failure to do so may result in serious injury or death.

**Decommissioning Procedure**
The CNG fuel cylinder has a predetermined service life from the date of manufacture. The fuel cylinder “DO NOT USE AFTER DATE” appears on a label on the cylinder. The fuel cylinder expiration date is also located on the fill area label.

Any fuel cylinder in service beyond the date indicated on the cylinder label or that exhibits level 3 damage or greater, must be removed from service with the following procedure:

1. Vent and purge the cylinder. Refer to [Cylinder Purge](#) in this manual.
2. Clearly mark the cylinder as "CONDEMNED".
3. Disconnect the vent hose.
4. Remove the cylinder from the vehicle. Refer to the latest service procedures.
5. Place the cylinder outside in a well ventilated area.
6. Allow the cylinder to stand for 24 hours with the cylinder valve manually held open.
7. With a non–electric drill and with the cylinder valve removed, drill a ½” diameter or greater hole completely through the cylinder wall and inner liner at the end of the cylinder serial number. Do not drill through and destroy the serial number.
8. Dispose of the cylinder in a safe and approved manner. A properly decommissioned cylinder is considered solid waste by most authorities. If in doubt, contact your local disposal regulatory agency for disposal requirements.
Filling Your Fuel Storage Module

To ensure proper system operation, it is recommended that the CNG system is filled with CNG that meets SAE J1616 specifications.

⚠️ CAUTION ⚠️

Compressed Natural Gas (CNG) is extremely flammable. If something accidentally ignites it, you may be badly burned. Keep sparks, flames and smoking materials away from natural gas. Do not smoke if you are near natural gas or refueling your vehicle.

⚠️ CAUTION ⚠️

Compressed Natural Gas (CNG) is stored in the fuel cylinder at pressures up to 3,600 psi (24.8 MPa) at 70°F (21°C). To prevent personal injury:
- Never fill to a pressure greater than 3,600 psi (24.8 MPa) at 70°F (21°C).
- Never fill a leaking or damaged cylinder.

The fill valve panel is located on the fuel storage module end panel assembly.

The fuel system is equipped with two fill valves; a standard NGV 1 compliant 3600 psi fill valve (1) and a high flow, 3600 psi, ISO 14469–2 compliant fill valve (2). Either fill valve may be used with no additional actions required by the system operator.
Filling Your Fuel Storage Module (Continued)

**WARNING**

If a leak is detected, immediately stop filling the system. Failure to follow this instruction may result in serious injury or death.

If while filling the vehicle a leak is detected through the fill valve that is not currently being used, or anywhere else in the system, the fill process should be stopped immediately. They system should not be filled until the leak or leaking component has been repaired or replaced.

Because CNG is a gas, the amount stored in the CNG fuel cylinder depends on pressure and temperature. The CNG fuel system uses a service pressure of 3,600 psi (24.8 MPa) at 70°F (21°C).

Many CNG fuel stations in the United States presently operate at this pressure. However, some stations in the United States and all stations in Canada presently operate at 3,000 psi (20.7 MPa). This lower refueling pressure will reduce the capacity of your fuel storage system by about 15%.

Also a “fast fill” station heats and expands the natural gas during refueling. A fast fill can reduce the capacity of your fuel storage system by about 15%. A system refueled using a “slow fill” overnight dispenser is not subject to this condition and should receive a full fill.

Fast filling using the high flow fill receptacle may also result in a decreased fuel capacity due to the additional heat generated in the cylinder by the faster filling times.

Some fast fill CNG fuel stations provide temperature compensated refueling. This means that the fuel station will automatically adjust refueling pressure if the outside temperature is very hot or very cold. For example, on a very hot day (100°F (38°C)), the fuel station may provide a refueling pressure of about 4,000 psi (27.6 MPa). This is normal and does not indicate a problem.

To fill your vehicle with CNG fuel, do the following:

1. Turn off the engine and set the parking brake.
2. Turn off all equipment that may produce heat, sparks or flame.
3. Remove the fill valve cap and any debris from the fill valve.
4. Inspect the fill valve O–ring. Make sure the O–ring is seated in the groove. Never connect the fill nozzle to the valve if the O–ring is missing or damaged. Refer to Fill Receptacle O–Ring Inspection in this manual.

**CAUTION**

Attempting to fill a Compressed Natural Gas (CNG) fuel system that has a missing or damaged O–ring is dangerous. Natural gas can leak. If the natural gas is accidentally ignited, you or others may be injured. Replace the O–ring before filling the cylinder.

5. Connect the CNG fill nozzle to the fill valve and follow the instructions displayed on the fuel dispenser.
6. When finished fueling, disconnect the fill nozzle, return it to the dispenser, and put the fill valve cap back on the fill valve.
Low Ambient Temperature Vehicle Refueling

**WARNING**

Never pressurize a CNG cylinder that is not restrained by approved brackets properly mounted or otherwise acceptably restrained to prevent movement while under pressure. Failure to observe this warning may result in death or serious injury.

**CAUTION**

Performing this procedure when the fuel storage module is less than \(0^\circ F\) (\(-18^\circ C\)) may result in damage to the components within the FSM. Allow the FSM to warm to room temperature >60\(^\circ\) F (13\(^\circ\) C) for a minimum of 12 hours before pressurizing. Failure to follow this requirement may result in minor or moderate injury as well as damage to components.

Fueling in low ambient temperatures may cause freezing concerns and potential flow restrictions within the fuel storage module. Fueling in low ambient temperatures may result in potential flow restrictions as ice begins to form inside the fuel lines and components. In some cases, the fuel flow may be restricted or entirely blocked due to ice build–up. If the lines are blocked with ice, the ice must thaw before flow resumes.

Cold ambient temperatures may have an effect on system components causing them to temporarily change size and shape. Quantum fuel storage modules are designed to operate at temperatures as low as \(-40^\circ F\) (\(-40^\circ C\)). Both the rate of fueling and cold ambient temperatures may drop the temperature within the FSM below \(-40^\circ F\) (\(-40^\circ C\)). When this happens, the soft parts that seal the system may lose their ability to seal against metallic components which may have changed size and shape. The CNG within the system may escape past the seals and out to atmosphere. Gas escaping past the seals will create a dangerous condition and may damage the fuel storage module components.

Filling at a slower rate in cold ambient temperatures will make it less likely for components to change size and shape. Faster fill rates will create a larger pressure drop which will significantly lower the temperature of the fuel as it passes through the system. Faster fill rates may result in dropping the temperature beyond the \(-40^\circ F\) (\(-40^\circ C\)) limit.

Also, the quality of fuel has an effect on line freezing. Quantum builds all fuel storage modules to be compatible with SAE J1616 quality CNG.

**SAE J1616 1.0** – Water content and other corrosion precursors, heavier hydrocarbons which may condense within the fuel container, particulate matter, oil and energy content need to be controlled in order to minimize corrosion and provide satisfactory low–temperature vehicle operation, performance, and emissions levels.
Refueling Problems

If the system cannot be refueled, check for the following:

- The refueling system is not operating properly
  - Refer to the refueling system operating instructions.

- Refueling nozzle not properly engaged on the fill receptacle.
  - Verify nozzle is fully engaged.

- Cylinders already full.
  - Verify CNG level in the cylinders using the pressure gauge.

- The cylinders have higher pressure than the refueling system.
  - Check the system pressure available from the refueling system and check it against the CNG pressure in the cylinders.

If the items above have been checked and the system still will not take fuel, the system may require service.
Appendix A – System Mechanization (Continued)
Appendix B – Wiring Diagrams (Continued)

Generation 1
Appendix B – Wiring Diagrams (Continued)

Generation 1
Appendix B – Wiring Diagrams (Continued)
Generation 2
Appendix B – Wiring Diagrams (Continued)

Generation 2
Appendix B – Wiring Diagrams (Continued)

Generation 2
Appendix B – Wiring Diagrams (Continued)
Generation 2
Appendix B – Wiring Diagrams (Continued)

Generation 2
Appendix C – Fuel Gauge Driver Module Output Voltages

How to use this graph:
1. Obtain a reading from the fuel pressure gauge located on the fill panel of the fuel storage module. (See Example 1 = 2100 psi)
2. Trace the value to the fuel pressure line, then follow the value down to determine the fuel level in %. (See Example 2 = 46%)
3. Trace the value up to the appropriate vehicle output gauge application, then follow the value to the left to determine the gauge output voltage. (See Example 3 = 1.9 volts)
<table>
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<th>Inspection Interval (Mileage or Years)</th>
<th>Inspection Date</th>
<th>Inspector</th>
<th>Inspector Initials</th>
<th>Type of Repair*</th>
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* Record the type of repair as None, Level 1, Level 2, or Exchanged. See “Cylinder Inspection” in the CNG Cylinder – Installation and Maintenance Manual applicable to your cylinder (available at www.qtww.com) for the inspection criteria.
Revision History:

Revision X1: Draft release.
Revision X2: Preliminary release.
Revision X3: Review updates.
Revision A: Initial Release.

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