CNG Gen 1 Frame Mount FSM
Installation Manual
Preface

To reduce the chance of personal injury and/or property damage, the following instructions 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 installed, operated, and 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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How to Use This Manual

This supplement contains information specific to the CNG Frame Mount 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 Gen 1 Frame Mount fuel storage module.
Ordering Parts
To purchase repair or replacement parts for the CNG Gen 1 Frame Mount Fuel Storage Module, contact your local Quantum sales representative.

Technical Assistance
For questions regarding the installation, maintenance, and service for the CNG Gen 1 Frame Mount Fuel Storage Module, contact Quantum Technical Assistance at 800.816.8691.

Price List
Published prices are accurate at the time of print and are subject to change without notice. For part pricing, contact your local Quantum sales representative.

This manual is for use only for the following FSM Part Numbers:

PN 114482 25X80" RH FSM, DUAL FUEL
PN 114233 25X90" RH FSM, DUAL FUEL
PN 116102 25X80" RH FSM, SLAVE
PN 114985 25X90" RH FSM, SLAVE
PN 115240 25X80" LH FSM, DUAL FUEL
PN 114790 25X90" LH FSM, DUAL FUEL
PN 115306 25X80" LH FSM, SLAVE
PN 115533 25X90" LH FSM, SLAVE
PN 116647 25X80" LH FSM, W/ REGULATOR
PN 116646 25X90" RH FSM, W/ REGULATOR
PN 117034 25X90" LH FSM, HIGH FLOW
Module Identification

Generation 1

- 114233, 114482, 114790, 115240 – Fill Panel (Dual Fuel)
- 114985, 115306, 115533, 116102 – No Fill Panel (Slave)
- 116646, 116647 – W/ Regulator
- 117034 – High Flow

All of the Generation 1 Frame Mount FSMs will have a lower cover that is not equipped with bolts that attach the lower cover to the cylinder mounting brackets. There will only be cover bolts along the perimeter of the lower cover.

The Generation 1 Frame Mount FSMs which are equipped with a regulator and fuel control module are identified with 6 bolts on the rear end cap. The 2 lower bolts on the end cap are used to mount the regulator. The 4 upper bolts on the end cap are used to mount the bracket for the fuel control module.

The Generation 1 Frame Mount FSMs that are built for high flow capacity can be identified with the check valve and mount attached to the inside of the rear end cap.
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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** is used to address practices not related to personal injuries.

**WARNING**

Read this manuals safety precautions before servicing this system. Failure to do so could result in serious injury or death.

CNG is extremely flammable. If something ignites it, you could 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 personal injury or death.

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.
Important Safety Information (Cont)

**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 could result in minor or moderate injury.

**CAUTION**

When filling your vehicle, keep sparks, flames and ignition sources a minimum of 5 meters from the refueling area which could 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

**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).

Refueling under these conditions may cause personal injury and equipment or system damage

Allow the fuel storage module temperature to rise above -31°F (-35°C) before filling.

**CAUTION**

Using a common automotive or plumbing O-ring as a replacement part could cause a leak while operating the system on CNG. If something ignites the leak, you could be burned. Use only CNG certified O-rings from an authorized source.

In the Event of Equipment Fire

If a fire should occur in the vicinity of the cylinder system, the pressure relief device located in the cylinder may be activated. If the pressure relief device activates, 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 and can be very dangerous. Even if the gas does not ignite, debris blown about by the gas jet could be dangerous and the loud noise caused by the rapid venting could cause hearing damage.

If the pressure relief device activates, evacuate the area immediately and call the appropriate authorities. Once the pressure relief device has been activated, the cylinder must be returned to Quantum Technologies for inspection, disposition and service.

Safety Features

The CNG fuel system has been engineered to 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 and over pressure protection.
System Overview

This CNG fuel storage module was designed as a generic fuel storage module to be used on multiple applications. The installation of this CNG fuel storage module may require minor adjustments or alterations of the vehicle to be installed as a durable and safe component.

This document outlines the procedure to install a CNG fuel storage module on a class 7 or class 8 heavy duty trucks.

The primary components of the CNG storage system are:
- CNG Fuel Storage Cylinder
- Standard CNG Fill Valve
- High Flow CNG Fill Valve

About 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.

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.

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 (593°C). Compare that to gasoline and diesel fuel which both have lower concentrations of flammability and lower temperatures of ignition.

Operating Temperature Ranges

**NOTICE**

*Operating temperature range of the CNG system is -40°F to 185°F (-40°C to 85°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 185°F (-40°C to 85°C). Exposure to excessive cold or heat will expose the system to conditions that may cause damage to system components.
System Block Diagram

- **F101** CNG Coalescent Filter Assembly
- **FC101** NGV1 Fill Valve
- **FC102** ISO 14469-2 Compliant High Flow Fill Valve
- **MV101** CNG Cylinder Manual Shut Off Valve
- **MV102** Fill Check Bypass Valve
- **MV103** Fuel Storage Module Manual Shut Off Valve
- **MV104** CNG System Vent Valve
- **PG102** Pressure Gauge
- **PR101** Pressure Relief Valve
General System Specifications

25" X 90" Fuel Storage Module
Overall Length (A) ................................................................. 101.1" (2568 mm)
Distance Between Cover End Cap Bolt Centers (B) ......................... 98.7" (2506 mm)
Recommended Mounting Area for Cylinder Straps (C) ......................... 13.5" (343 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D) 2 ........................................ 52.9" (1343 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D) 1 ........................................ 49.9" (1267 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D) 3 ........................................ 46.9" (1191 mm)
Approximate Fuel Storage Module Weight ...................................... 748 lb (339 kg)
Approximate Fuel Storage Module Weight (W/Fuel) .......................... 1003 lb (455 kg)

25" X 80" Fuel Storage Module
Overall Length (A) ................................................................. 91.1" (2314 mm)
Distance Between Cover End Cap Bolt Centers (B) ......................... 88.6" (2250 mm)
Recommended Mounting Area for Cylinder Straps (C) ......................... 12.0" (305 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D) 2 ........................................ 49.0" (1244 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D) 1 ........................................ 46.0" (1168 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D) 3 ........................................ 43.0" (1092 mm)
Approximate Fuel Storage Module Weight ...................................... 704 lb (319 kg)
Approximate Fuel Storage Module Weight (W/Fuel) .......................... 930 lb (422 kg)

* The cylinder straps may be mounted outside the recommended mounting area but the installation must be approved by a professional engineer.
1,2,3 Reference the centerline for the holes on the right side of the bracket as shown in the illustration above.
General System Specifications (Cont)

25" X 90" Fuel Storage Module - Slave
Overall Length (A) .......................................................... 95.7" (2431 mm)
Distance Between Cover End Cap Bolt Centers (B) ................................................. 93.3" (2369 mm)
Recommended Mounting Area for Cylinder Straps (C)* ...................................... 13.5" (343 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D)² ...... 48.9" (1241 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D)¹ ...... 45.9" (1165 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D)³ ...... 42.9" (1089 mm)
Approximate Fuel Storage Module Weight .............................................................. 720 lb (327 kg)
Approximate Fuel Storage Module Weight (W/Fuel) .............................................. 975 lb (442 kg)

25" X 80" Fuel Storage Module - Slave
Overall Length (A) .......................................................... 85.8" (2180 mm)
Distance Between Cover End Cap Bolt Centers (B) ................................................. 83.4" (2118 mm)
Recommended Mounting Area for Cylinder Straps (C)¹ ...................................... 12.0" (305 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D)² ...... 45.9" (1165 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D)¹ ...... 42.9" (1089 mm)
Distance Between Cover End Cap Bolt Center and Cover Support Bracket (D)³ ...... 39.9" (1013 mm)
Approximate Fuel Storage Module Weight .............................................................. 672 lb (305 kg)
Approximate Fuel Storage Module Weight (W/Fuel) .............................................. 898 lb (407 kg)

* The cylinder straps may be mounted outside the recommended mounting area but the installation must be approved by a professional engineer.
1,2,3 Reference the centerline for the holes on the right side of the bracket as shown in the illustration above.
General System Specifications (Cont)

25" X 60" Fuel Storage Module
Overall Length (A) ................................................................. 72.6" (1843 mm)
Distance Between Cover End Cap Bolt Centers (B) ................................. 70.3" (1779 mm)
Recommended Mounting Area for Cylinder Straps (C) ......................... 9.0" (229 mm)
Approximate Fuel Storage Module Weight ........................................ 570 lb (259 kg)
Approximate Fuel Storage Module Weight (W/Fuel) ....................... 736 lb (334 kg)

25" X 60" Fuel Storage Module – Slave
Overall Length (A) ................................................................. 67.1" (1705 mm)
Distance Between Cover End Cap Bolt Centers (B) ................................. 64.7" (1643 mm)
Recommended Mounting Area for Cylinder Straps (C) ......................... 9.0" (229 mm)
Approximate Fuel Storage Module Weight ........................................ 482 lb (219 kg)
Approximate Fuel Storage Module Weight (W/Fuel) ....................... 651 lb (295 kg)

* The cylinder straps may be mounted outside the recommended mounting area but the installation must be approved by a professional engineer.
Installer Qualifications

To successfully install a Quantum fuel storage module, the installer should meet or exceed the minimum requirements indicated below:

1. Must have the ability to read, understand, and follow the instructions contained in the CNG Fuel Storage Module Installation manual.
2. Must have knowledge of all local, state, and federal regulations and standards applicable for installing CNG systems.
3. Must have a basic understanding of CNG fuel system installations.

Tool Requirements

In addition to standard technician tools and safety equipment, the following tools and supplies are recommended to install the CNG fuel storage module:

Hand Tools

- Tape Measure
- 18" Socket Extension
- 11/16" Drill Bit with 1/2" Shank
- 3/8" Torque Wrench (lb/ft)
- 1/2" Torque Wrench (lb/ft)
- 11/16" Angle Open End Wrench
- 13/16" Angle Open End Wrench
- 13/16" Crowfoot
- 3/32" Hex Drive Socket
- 1/8" Hole Punch

Shop Equipment / Tools

- Drill with 1/2" Chuck
- 9" Digital Caliper
- Inert Gas Cylinder w/ Regulator, Lines, and CNG fill nozzle
- Transmission Jack
- Gantry / Engine Lift / A-Frame
- Metal Removal Cutting Tools (16 Gauge)
- Electronic Gas Detector
- Magnetic Drill Fixture (optional)
- Metal Cylinder Support Bracket Mounting Template
- Metal Cylinder Cover End Cap Mounting Template

Special Service Tools

- Kent-Moore® CNG Cylinder Sling for GM (J-45529)
- Cylinder Installation Support Fixture

Recommended Shop Supplies

- Snoop® Leak Detection Fluid
- Parker® O-Lube
- Zinc Rich Primer
- Fast Drying Enamel Paint
Packaging Contents and Assembly

The FSM will be shipped on a pallet as an unassembled set of components and fittings.

The contents of the delivery will include:
- Cylinder Bracket Assembly
- Cylinder Assembly
- PRD Assembly
- Rear End Cap Assembly
- Front End Cap Assembly
- Back Cover Assembly
- Upper Cover Assembly
- Lower cover Assembly
- Assembly Kit:
  - (1) Tank exp Label
  - (1) Bracket ASM, Upper Cover*
  - (2) Cylinder Strap
  - (12) Bolt – Hex Cap, 5/8-11, 1.75"*
  - (12) LockNut, Flanged 5/8-11*
  - (12) Washer, Flat 5/8-11*
  - (3) LockNut, Flanged 5/16"-18 ∆
  - (Varies) Bolt, Hex Head Conical Washer 5/16-18 ∞
  - (2) CNG Diamond Label

* Not included with 60" cylinder configurations
* Quantity 8 for 60" cylinder configurations
∆ Quantity 2 for 60" cylinder configurations
∞ Quantity varies per the size and type of the configuration
System Installation

This fuel storage module has been designed as a generic fuel storage module that can be installed on any number of applications. The installation instructions are intended to guide a knowledgeable and experienced CNG technician through the necessary steps to install this fuel storage system.

Compliance of the installation to all federal, state and local regulations is ultimately the responsibility of the installer.

Vehicle Installation Preparation

It is the responsibility of the installer to ensure the vehicle being equipped with this CNG fuel storage module is in good condition and that installation of this module will not create a hazard or cause damage to the vehicle.

**IMPORTANT:** Before you begin the installation process of the Quantum fuel storage module you should verify the installed assembly will meet all your customer requirements and regulatory requirements that may be applicable.

There are a number of considerations when determining where to place the mounting brackets on the vehicle frame:

- Will the height of the cover of the completed assembly fit the completed application?
- Will the step height be within the appropriate height range?
- Will the ground clearance of the completed assembly meet requirements?

Below are a few steps that will help you determine if the FSM can be successfully installed and meet all the Quantum, regulatory and customer requirements.

Step 1 Measure Width of Opening

Verify the overall length of the fuel storage module will fit in the allocated space and the area where the fuel storage module is to be installed is free of parts, brackets, bolts or components that may contact or damage the CNG cylinder. Verify the opening on the vehicle frame is large enough to accept the FSM with appropriate clearance.

The overall dimensions for the FSM are contained in this manual. Refer to **General System Specifications** in this manual for additional information.

Verify the FSM can be installed with at least 1.0” (25mm) of clearance on each end of the FSM.
Step 2 Calculate Ground Clearance

Verify the module will have adequate ground clearance.

This fuel storage module was designed with the intent that the top of the cover will be approximately level with the top of the vehicle frame rail. Due to the variations in vehicle ride heights and frame to ground heights, we cannot supply specific dimensions that will be appropriate for all installations.

Below are a few general guidelines from the common installation regulations.

National Fire Protection Association (NFPA) 52 states:

6.3.3.2 The fuel system, including containers, shall be installed with as much road clearance as practical.

6.3.3.3 This minimum clearance shall be measured from the road to the container, its housing, or its fittings, whichever is lowest, and shall not, with the vehicle loaded to its gross weight rating, allow any component to touch the road surface in the event of a flat tire or the removal of any tire.

Canadian Standards Association (CSA) B109 states:

6.4.1 Road Clearance Between Axles
The minimum clearance from the road to the lowest point of a fuel cylinder, its fittings and appurtenances, when installed below the frame and between the axles of a vehicle, and with the vehicle loaded to its gross weight rating, shall not be less than either:
(a) 175 mm (7 in) for a vehicle having a wheel base $\leq$ 3175 mm (125 in); or
(b) 225 mm (9 in) for a vehicle having a wheel base $>$ 3175 mm (125 in).

It is recommended that the fuel storage module be mounted as high as possible to maximize the ground clearance of the fuel cylinder and brackets.

The installer must first determine what the maximum installed height of the module can be to fit the application and leave adequate clearance to the vehicle components for service and assembly.

Begin by measuring the lowest portion of the vehicle body to the ground. If the vehicle is equipped with features that will affect the ride height of the body, the body MUST be adjusted to the lowest position for this measurement.

Next subtract the overall height of the FSM from the previous measurement. The fuel storage module is 27.6” (701 mm) tall from the lower cover to the upper cover.

Body Height – FSM Height = Ground Clearance

The remainder will be the ground clearance of the FSM after installation.

**CAUTION**

The regulations above indicate these measurements apply with the vehicle at its gross vehicle weight rating.

The installer must adjust the measurements to compensate for vehicle height changes that may occur after the vehicle is loaded.

Before proceeding, the installer should consult all federal, state and local regulations to ensure the installation will comply with all requirements.
Step 3 Inspect for Obstructions and Heat Sources

Due to the construction of the FSM and the location of the CNG cylinder pressure relief devices, Quantum has an additional requirement to add additional heat shielding if a heat source is within 4” (102 mm) of the CNG cylinder covers or to relocate the heat source. If the heat source is within 2” (51 mm) of the fuel storage module adjustments MUST be made in the installation to increase the distance between the heat source and the FSM.
If any of these conditions exist, an optional spacer kit is available that will move the FSM 2” (51 mm) away from the frame and any potential heat or abrasion sources.

- Verify the area of the vehicle where the fuel storage module will be installed is clear of any obstructions or components that may contact or damage the CNG cylinder.
- Check the area of the frame where the FSM will be mounted and note any obstructions or components that may impede cylinder bracket, end cap support bracket or cover installation.
- Inspect for any heat sources that may be closer that 2” (51 mm) from the FSM after installation. Provisions MUST be made to increase this clearance.
- Inspect for any heat sources that may be closer that 4” (102 mm) from the FSM after installation.
- Also inspect for any brackets or features on the frame rail that may interfere with the fuel storage module components and in particular the CNG cylinder.

CAUTION

If the FSM is installed with the optional spacer, the overall width of the vehicle with the completed FSM installed must NOT exceed 102” (2.6 m).
It is the responsibility of the installer to ensure the overall width of the vehicle meets all regulatory requirements.

23 CFR 658.15
Width.
(a) No State shall impose a width limitation of more or less than 102 inches, or its approximate metric equivalent, 2.6 meters (102.36 inches) on a vehicle operating on the National Network, except for the State of Hawaii, which is allowed to keep the State’s 108-inch width maximum by virtue of section 416(a) of the Surface Transportation Assistance Act of 1982 (STAA).

(b) The provisions of paragraph (a) of this section do not apply to special mobile equipment as defined in § 658.5.

§ 658.5. [49 FR 23315, June 5, 1984]
Safety Devices—Width Exclusion. Federally approved safety devices accorded width exclusion status include rearview mirrors, turn signal lamps, handholds for cab entry/egress and splash and spray suppressant devices. Although not normally considered a safety device, load-induced tire bulge is also excluded from consideration in determining vehicle width.

For more details on these exclusions, see 23 CFR 658.16 and appendix D to 23 CFR 658.
Step 4 Inspect Target Mounting Areas on Frame

Inspect the area of the frame where the cylinder support brackets and the end cap support brackets will be positioned. The frame must be undamaged and not show any evidence of excessive corrosion, damage, or fatigue. The installer must also be aware and not locate brackets where existing holes in the frame may inhibit drilling additional holes needed for the brackets. Refer to Frame Drilling Guidelines in this manual.

The area where the FSM brackets will be mounted must also be flat. The cylinder mounting bracket positions (C) may be adjusted to accommodate features or obstruction on the vehicle frame, but the end cap support bracket locations (B) cannot be changed or the FSM covers will not fit. The center support bracket can be positioned in 3 different locations, at 3” increments, to accommodate the best mounting position (D1,2,3). For the fuel storage module specifications. Refer to General System Specifications in this manual.
Step 5 Determine Bracket Mounting Height

In Step 2 you were asked to calculate the ground clearance of the FSM. The value from Step 2 will be used to calculate the position of the bottom hole for the CNG cylinder support brackets and the end cap cover supports.

In the example in Step 2 it was calculated that there was 12.4" of ground clearance.

The first step is to subtract 1" (25 mm) from this value for clearance between the lowest portion of the cab or vehicle structure and the FSM.

If this clearance was already considered when calculating the ground clearance in Step 2 do not perform this subtraction.

\[(C - 1") + 19" = D\]

Example: \((C – 1) = 12.4" – 1" = 11.4"\)

**IMPORTANT:** In the example above a 1" clearance was used, if the lowest point measured is a heat source then 2" minimum clearance is required.

Now that the adjusted ground clearance has been calculated, we can determine where the bottom hole of the CNG cylinder bracket would be positioned based on the previous measurements. The bottom hole of the CNG cylinder bracket is 19" (485 mm) from the bottom of the FSM.

Simply add 19" (485 mm) to the adjusted ground clearance and this should represent the position of the lower cylinder bracket mounting hole as measured from the ground.

If this measurement locates the lower bracket hole below the vehicle frame, the next hole center is 1.97" (50 mm) higher.

Example: \(11.4" + 19" = 30.4"\)

If this hole center is not properly positioned on the vehicle frame add 1.97" (50 mm). This new measurement would represent the distance from the ground to the second from the bottom CNG cylinder bracket mounting hole.

Example: \(11.4" + 19" = 30.4" + 1.97" = 32.4"\)

**CAUTION**

The distance from the ground to the lower cylinder bracket mounting bolt may NEVER exceed 36.35” (923 mm). If the CNG cylinder support brackets are mounted higher than this, the lower step on the FSM module will be higher than federal regulations allow. The step height on the completed assembly may not exceed 24” (609 mm).
Step 6 Select Which Mounting Holes to Use

It is necessary to ensure the holes being drilled for the FSM mountings comply with the vehicle manufacturer recommendations for drilling holes in the vehicle frame.

Refer to Frame Drilling Guidelines in this manual for general information and refer to the vehicle manufactures body building guide for additional information.

Next the installer must ensure that at least four (4) of the eight (8) possible mounting bolts can be used to secure each CNG bracket cylinder to the vehicle. It is recommended to have as large a bolt pattern as possible for your installation.

Depending on the installation height of the FSM different bolt hole configurations may be used. The bolt pattern must always be a square or rectangular bolt pattern. Never have more than 2 bolts in a vertical line on any of the FSM mountings. If you have questions regarding a specific bolt pattern usage contact Quantum Technologies for assistance.

A full size template of the CNG cylinder support brackets and the end cap support bracket mounting hole has been provided in Appendix A.
The illustration below is provided to help you visualize your installation and ensure all the mounting requirements can be met. This illustration summarizes all the steps you just completed to aid in the FSM positioning on the vehicle. Using the worksheet below this illustration may help determine the proper position of the Quantum FSM on your vehicle.

Distance from lowest portion of vehicle body to the ground? ________________________________

Body Height – FSM Height (27.6") = Ground Clearance: Record Ground Clearance ______________

Does the ground clearance meet customer and regulatory requirements? Circle One: YES NO

Determine CNG cylinder bracket mounting height _______________________________________________________________________

(Ground Clearance - 1") + 19" = Measurement to lower bracket bolt center.

Verify the lower bracket bolt hole center is not higher than 36.35" (923 mm). Circle One: OK NOT OK

Verify the locations of the holes to be drilled in the frame are appropriate. Circle One: OK NOT OK

Verify the actual size of the drill templates printed from the manual (if used) Circle One: OK NOT OK

Double check all other measurements to ensure the FSM will fit the target area. Circle One: OK NOT OK

Did you find that spacers were needed between the FSM and the vehicle frame? Circle One: NO 1” 2”
You will need the following information available to ensure the system, once installed, will be a safe and legal installation:

- Vehicle frame height (to top of frame).
- Maximum allowable height of fuel storage module.
- Minimum ground clearance requirement.
- Specifications for the fuel storage module. Refer to General System Specifications in this manual.

Once you have determined that the fuel storage module can be properly installed and meet all the necessary requirements, you can proceed with the installation.

Depending on your application the cylinder mounting brackets may need to move to accommodate a proper mounting surface on the vehicle frame.

The illustration below provides guidance for recommended bracket placement on the fuel cylinder.

![Diagram of recommended bracket placement](image)

The cylinder support brackets should be more than four inches (4") (102mm) from where the curve for the dome begins on the cylinder.

The cylinder support brackets should not be placed too close together or the cylinder may not be properly supported.

For the fuel storage module specifications, refer to General System Specifications in this manual.
Frame Drilling Guidelines

The drilling of the frame side member presents no unusual difficulty. Standard high speed steel drills of good quality will serve provided they are sharpened properly and not overheated during sharpening or use.

It is recommended to follow these guidelines when drilling holes in vehicle frames:

- Use existing holes whenever possible.
- Do not weld filler pieces into any unused holes of the chassis frame.
- Do not flame cut holes.
- Do not drill holes into the restricted areas of the frame rails.
- To prevent the forming of cracks from the drilled holes, the holes must always be deburred by 45° chamfering (on both sides) and subsequently treated with primer and paint.
- When measuring, verify there are no obstructions on the frame and ensure the area inside the frame is clear of components or lines that may be damaged during the drilling operation.

Hole Location Guidelines

The following recommendations should be considered when determining where to drill the holes in the frame members:

- Never drill holes in the flanges of the frame members.
- Never drill holes in the tapered end of the rear frame cutoff.
- The drilling of holes less than 2" (51mm) from a bend in the chassis frame is not recommended.
- Maintain a minimum distance of 2.8 times the diameter of the largest hole between holes.
- There should not be more than three holes located on a vertical line.
- Bolt holes should be no larger than is required for the size of bolts being used, in no instance larger than 11/16 (17.5 mm).
- If reinforcements are used, avoid drilling holes closer than 2.0 inches (51 mm) from the ends of the reinforcement.
Installation Instructions

1. Locate the forward cylinder end cap assembly on the vehicle frame, measure and mark the hole locations. The bolt pattern and template for the cylinder cover end cap which can be found in Appendix A. Refer to General System Specifications in this manual for the cylinder end cap assembly bolt centers.

**IMPORTANT:** When marking the holes to be drilled it is strongly recommended to use the widest bolt pattern spacing that can be used for your application.

**WARNING**

Do not use more than two (2) holes on either side of the cylinder bracket or end caps. Use of more than two holes may result in vehicle frame or bracket damage and loss of cylinder retention. Failure to follow this instruction may result in death or serious injury.

2. Locate the rear cylinder end cap assembly on the vehicle frame, measure and mark the hole locations. The bolt pattern and template for the cylinder cover end cap which can be found in Appendix A. Refer to General System Specifications in this manual for the cylinder end cap assembly bolt centers.

**CAUTION**

Verify the holes being marked for the rear cylinder support bracket are aligned with the holes for the front cylinder support bracket; misalignment of the brackets may cause damage to the CNG cylinder and or the CNG cylinder support brackets.

**IMPORTANT:** When marking the holes to be drilled it is strongly recommended to use the widest bolt pattern spacing that can be used for your application.

3. Locate the center support bracket on the vehicle frame. Measure and mark the hole locations. Only 2 bolt hole locations are needed. The bolt pattern and template for the center support bracket is the same as the cylinder support bracket which can be found at Appendix A. Refer to General System Specifications in this manual for the center support bracket bolt centers.

There are no restrictions regarding which bolt holes are used for the center support bracket.
**IMPORTANT:** The horizontal bolt center lines for the end caps must be aligned with the horizontal bolt centerlines that were used for the cylinder support brackets.

4. Locate the cylinder support bracket on the vehicle frame. Measure and mark the hole locations. The template for the cylinder support brackets can be found at Appendix A, then mark the locations for the cylinder support brackets.

5. Make sure that the holes are marked and aligned across all bolt holes for all brackets.

6. Confirm there are no obstructions on the frame and ensure the area inside the frame is clear of components or lines that may be damaged during the drilling operation.

7. Double-check the alignment of the holes for cylinder support and cover brackets. Measure again if needed.

8. Drill the marked holes for the cylinder support brackets, center support bracket, and end cap brackets. The holes should be drilled to 11/16" (17.5mm).

9. Clean any burrs from the holes and coat the holes with a zinc rich primer or equivalent anti corrosion coating.

10. Loose fit the end cap assemblies. Use the 5/8" hardware supplied with this kit. Each fastener must include a bolt, flat washer, and a flanged locking nut. The bolts should be installed from the frame side of the assembly with the nuts against the cylinder bracket. If spacers are to be used, install the spacers between the frame and the end caps.

**IMPORTANT:** the cylinder bracket mounting bolts must be lubricated with 10 wt oil prior to assembly.

11. Verify the vertical alignment of the end caps. Use a builder’s square to confirm they are perpendicular to the frame and parallel to each other.

12. Measure the distance between the holes that mount the front cover to the end caps. Use that measurement and adjust the end cap holes. After the distance has been adjusted, confirm that the end caps are still parallel with each other and perpendicular to the frame.
13. Loose fit the back cover onto the cylinder end cap mounting brackets using (6) 5/16-18 bolts.

14. Loose fit the center support bracket onto the frame. Install a spacer between the frame and the center support bracket if spacers are to be used for this application. Use the 5/8" hardware supplied with this kit. Each fastener must include a bolt, flat washer, and a flanged locking nut.

15. Loose fit the back cover support brackets and cylinder support brackets. Install a spacer between the frame and the back cover support brackets if spacers are to be used for this application. Use the 5/8" hardware supplied with this kit. Each fastener must include a bolt, flat washer, and a flanged locking nut. The bolts should be installed from the frame side of the assembly with the nuts against the cylinder bracket.

16. After the back cover support brackets, cylinder support brackets, center support bracket, and end cap assemblies have been mounted, tighten the 5/8" bolts to 180 lb ft ± 18 lb ft (244 Nm ±24 Nm) and tighten the back plate to the (6) back cover bolts to 25 lb-ft (34 Nm).

17. Confirm that the cylinder valve is parallel to the vehicle frame or at 0 (zero) degrees. The valve should have the knob at the top and it should be straight up and down ± 2 degrees. Adjust the CNG cylinder position as necessary.

18. Mark a vertical line on the vehicle frame 10.28" (261 mm) from the valve boss face of the cylinder to the outer face of the forward end cap.

If mounting a slave cylinder the measurement will be 5.1" (130 mm) from the valve boss face of the cylinder.

19. Confirm the distance between the valve boss face and the outer face of the forward end cap is 10.28" (261 mm). Adjust as needed maneuvering the loose fit parts.
The following steps instructing to install the CNG cylinder straps may be performed in any order to ease installation based on your application.

20. Place the cylinder strap in position and insert the lower cylinder strap bolt through the strap end and through the cylinder bracket. Install a flat washer and nut to the end of the bolt.

21. Tighten the lower strap retaining nut to 30 lb ft. ± 5 lb ft. (41 Nm ± 7 Nm).

22. Install one flat washer on the clevis pin; position the eye bolt in the cylinder bracket and secure in place using the clevis pin assembly.

23. Install a second flat washer over the clevis pin and then install the cotter pin through the hole in the clevis pin. Bend the one leg of the cotter pin 90 degrees to lock in place.

24. Place the strap tension lug through the cylinder strap. Make sure the flat side of the lug is facing away from the vehicle frame.

25. Move the cylinder strap into position while inserting the threaded end of the eye bolt through the strap tension lug.

26. Install the spring and the cylinder strap flanged locking nut to the threaded end of the eye bolt.
27. Verify the valve orientation is properly positioned parallel to the frame as shown. The valve should have the knob at the top and it should be parallel to the face of the cylinder bracket.

28. Verify the straps are properly aligned and positioned, verify the cylinder bracket and strap isolators are properly positioned and seated.

29. Once the cylinder valve angle has been confirmed, tighten the cylinder strap nuts until the installed height of the spring on the end of the cylinder strap is 1.23” ± 0.08” (31mm ± 2mm) with the cylinder pressure below 500 psi (34.5 bar).

30. Apply O-ring lube to the seal and install the fuel cylinder inlet/outlet fitting in the CNG cylinder valve.

   Tighten the fuel line fitting and the cylinder inlet/outlet fitting to 35 lb ft. ± 4 lb ft. (48 Nm ± 5Nm).
31. Apply O-ring lube to the seal and install the PRD outlet fitting in the CNG cylinder valve. 

Tighten the outlet adaptor fitting to the valve at 22 lb-ft. (30 Nm)

32. Tighten the Swagelok® fittings nuts to ¼ to ½ Turns From Finger Tight (TFFT).

33. Loose fit the back cover onto the end caps and back cover support brackets using the supplied cover bolts. Torque the back cover bolts to 25 lb-ft (34Nm)
34. Connect the PRD discharge pipe to the CNG cylinder valve. Do not tighten the fitting nut at this time.

35. Place a P-clamp on the PRD pipe assembly in three (3) places. Secure each P-Clamp to the back cover using a neoprene spacer, 3/8" bolt and nut as shown.  

Tighten the three (3) P-clamp bolts onto the back cover until the P-clamp is fully seated onto the spacer, then add 1-2 turns.

36. Secure the inlet adaptor fitting with a back wrench, tighten the PRD outlet fitting to the outlet adaptor fitting to 30 lb ft. (40 Nm).

37. Close the CNG cylinder manual shut off valve and verify the fuel outlet pipe is connected or plugged.

38. Using inert gas, pressurize the fuel storage module plumbing through the CNG fill valve.

**IMPORTANT:** When leak checking a system it is 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.

39. The fuel pipes, fittings, and valves highlighted in the illustration should be under pressure. Check the fuel system pipes for leaks by using an ultrasonic leak detector or Snoop®.
40. Disconnect the inert gas source and drain the pressure from the fuel storage module pipes using the CNG system vent valve. Refer to CNG System Vent Valve in this manual.

41. Open the CNG cylinder manual shut off valve.

42. Purge the CNG cylinder with inert gas. Refer to Purge Instructions in this manual for a recommended procedure.

43. Fill the CNG cylinder to approximately 500 psi (34 bar), follow the recommended initial fill procedures found in the Quantum CNG Cylinder Installation and Maintenance Manual available at www.qtww.com.

44. Perform a leak check on the PRD assembly and fittings 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.

45. Complete filling the CNG cylinder and leak check all the fuel storage module pipes and fittings including the PRD assembly and fittings.

**WARNING**

Verify the PRD valve discharge ports are aligned to the holes in the FSM lower cover. In the event of a PRD discharge, fuel will be trapped inside the FSM storage covers. Failure to align the PRD valve discharge ports to the holes in the cover may result in death or serious injury.

**NOTICE**

If the PRD manifold assembly must be modified during installation, then refer to the product datasheets for the latest PRD manifold construction specifications at www.qtww.com.

46. If the PRD manifold assembly has been modified, then drill holes as required in the lower cover that align to the PRD discharge ports.

47. Place the fuel storage module lower cover in position and secure with the cover bolts.

Tighten the cover bolts to 25 lb-ft (34 Nm).
48. The cylinder expiration date can be found on the CNG cylinder certification label.

Document the CNG cylinder serial number and cylinder expiration date on the vehicle work order.

49. Mark the cylinder expiration date on the cylinder expiration label using a 1/8 inch hole punch.

50. Mark the cylinder inspection date on the cylinder expiration label using a 1/8 inch hole punch.

The cylinder inspection date should be 36 months from the installation date of the CNG cylinder.

**Example** If the cylinder is installed in July of 2013 the next inspection would be due July of 2016.

51. Place the fuel storage module upper cover in position and secure the cover bolts. Tighten the cover bolts to 25 lb-ft (34 Nm).
52. Clean the bottom surface of the fill opening in the fuel storage module cover with denatured alcohol.

53. Apply the previously modified cylinder expiration label to the bottom surface of the fill opening in the fuel storage module cover.

For slave cylinder installations, install the label in a protected and visible location on the cover.
Proper stone and or heat shielding must be installed on your CNG fuel storage module. The installer must fabricate and install shielding as required to supplement the FSM covers in order adequately protect the FSM and fuel storage cylinder. Failure to install proper heat shielding may result in serious personal injury or death.

- Inspect the completed fuel storage module assembly and installation; look for any areas that may require additional shielding to protect against road debris, contamination or heat exposure. Use the following criteria when inspecting the completed assembly for proper clearances and shielding:
  - Is any portion of the fuel storage cylinder or cover closer than 1.0” (25 mm) from any other component or assembly?
  - Is there any heat source within 4” (102 mm) of the fuel storage module covers or an area where the fuel storage module does not have a cover or shield between the cylinder and the heat source?
  - Is there any heat source within 8” (204 mm) where a cover or shield is not present between the cylinder and the heat source?

Refer to Fuel Storage Module Cover Modifications in this manual for additional information and instructions.

Complete the FSM Final Inspection Form found in the back of this manual. Refer to Appendix B in this manual for the form.
Fuel Storage Module Cover Modifications
In some installations, it may be necessary to make modifications to some of the CNG fuel storage module covers. Modification of the CNG fuel storage module covers may result in creating a potentially hazardous condition. In some cases even if the covers are not modified, additional covers or shielding may be required to ensure the system is safely installed and protected.

Once you have determined the FSM will physically fit in the target area on the vehicle, you must also inspect for components or brackets on the frame that may interfere with the FSM covers or may even become an abrasion hazard for the CNG cylinder.
You must also evaluate the environment for heat sources, the FSM should be mounted at least 4" (102 mm) from any heat source. In the event a heat source is in close proximity to the FSM covers or the cylinder is exposed to direct heat from the heat source steps MUST be taken to protect the FSM and the CNG cylinder.

NFPA 52 States:
6.3.2.1 Fuel supply containers shall be protected with a means to prevent damage that can occur due to road hazards, loading, unloading, direct sunlight, exhaust heat, and vehicle use, including accidental cargo leakage.
6.3.7 Fuel supply containers located less than 8 in. (200 mm) from the exhaust system shall be shielded against direct heat.

Important: Failure to adequately insulate or protect the fuel storage module and its components may result in damage to the fuel storage module or its components resulting in potential fuel leakage.

It is the responsibility of the installer to ensure that the CNG fuel storage module and its components are protected against debris and direct heat sources. The following guidelines must be observed before the vehicle is operated using this fuel storage module.

Mounting to Fuel Storage Module Covers

- Any fastener that is added or replaced in the CNG fuel storage module covers must not contact the CNG fuel cylinder.
- Any fastener that is added to the CNG fuel storage module covers shall not point toward the CNG fuel cylinder. In the event of an accident these fasteners may damage the CNG fuel cylinder.
- DO NOT USE self drilling or pointed fasteners to secure panels or components to the CNG fuel storage module covers.
Heat Sources:

**WARNING**

Gaps or openings in the fuel storage module covers may result in exposure of the CNG fuel storage module or components to excessive heat or damage from road debris. Any gaps or openings in the fuel storage module covers must be examined to determine if a hazard may exist. If it is determined that a hazard may exist, the gap or opening must be covered. Failure to follow these instructions may result in serious injury or death.

1. An exhaust system component is well within the 4” (102mm) distance for FSM heat shields. The preferred solution to the installation shown would be to install a 2” (51mm) spacer kit between the frame and the FSM to provide more clearance to the exhaust system components.

   Even if these spacers would have been installed, the FSM cover would still be within 4” (102 mm) and would still require additional heat shielding

2. A bracket for an exhaust system component is actually extending to the inside of the FSM cover.

   Ideally the bracket would be moved if possible or the FSM would be spaced away from the frame to prevent this condition.

3. If neither of these two options are feasible the cylinder should be thoroughly shielded from the exhaust system bracket that is protruding to the inside the cover.
In the illustration to the right, a number of heat related issues need to be addressed to make this a safe and approved installation.

If additional heat shielding insulation is required, you will need to fabricate shielding as required or contact your Quantum distributor for an insulation kit.

4. If a heat source such as an exhaust system component is located less than 4” (102mm) from any CNG fuel storage module cover or the CNG fuel cylinder, an additional heat shield and or a thermal insulating material MUST be placed between the heat source and the CNG fuel storage module.

5. If a direct heat source such as an exhaust system component is located less than 8” (204mm) from the CNG fuel cylinder or PRD valve, and there is no shield between the heat source and the CNG cylinder, a heat shield MUST be installed.

6. You will note that there is a space between the exhaust components and the FSM covers allowing the CNG cylinder to be subjected to direct heat from the exhaust.

If this opening is not properly heat closed with proper shielding the cylinder and or FSM components could be damaged.

Installation of an optional spacer kit may help to establish adequate clearance between the fuel storage module and any heat sources.

The spacer kit can also be used to help space the fuel storage module away from the vehicle frame to clear other vehicle brackets or components.

If adequate clearances cannot be achieved between the fuel storage module and the vehicle exhaust system components, it will be necessary to relocate the exhaust system components.
Debris and Impact Protection:

![WARNING]

Gaps or openings in the fuel storage module covers may result in exposure of the CNG fuel storage module or components to excessive heat or damage from road debris. Any gaps or openings in the fuel storage module covers must be examined to determine if a hazard may exist. If it is determined that a hazard may exist, the gap or opening must be covered. Failure to follow these instructions may result in serious injury or death.

Any opening in the fuel storage module covers that could allow a direct impact from road debris or that may allow for introduction of contaminates from the cargo area or from the road, must be covered with an additional protective cover or shield.

For example the opening (B) that has been made in the FSM cover for FSM valve access, may allow debris to enter the interior of the FSM and potentially damage the CNG cylinder or FSM components. Even though this is a design feature, it may be necessary to build a shield or cover for this opening to prevent system damage.

Modifications for Clearance

Contact between the FSM covers and base vehicle components may result in squeak rattle complaints but more importantly may result in unexpected loads being introduced into the FSM cover structure. Any additional loads or vibrations introduced into the cover assembly may result in damage to the FSM.

1. If a cover must be modified to allow for clearance of a bracket or component mounted on the vehicle frame, the modification to the CNG fuel storage module cover should allow for 1" (25mm) clearance between the cover modification and the base vehicle component.

2. If the cover is being modified to allow clearance to a base vehicle component that may have movement separately or in a different direction of the vehicle frame and components, the cover must be modified to ensure contact will not occur at any time. Additional clearance may be required.

3. At no time shall any base vehicle component or bracket be allowed to be within 1" (25mm) of the CNG fuel cylinder.

4. If there is a concern regarding the 1" clearance where debris intrusion is a possibility, a soft seal or barrier such as foam or rubber may be used.

5. It is the responsibility of the installer modifying the CNG fuel storage module covers to ensure the modifications do not weaken the assembly to a point that a failure occurs.

6. If there is potential for fluids or contaminates from the cargo area leaking onto the FSM, it is strongly recommended to install a barrier between the cargo department and the FSM.
Installation Information

Service Specifications

CNG Cylinder Service Life........................................................................................................... See Cylinder Labels
CNG Storage Cylinder Nominal Pressure Range ................................................. 290 psi (2 MPa) to 3600 psi (24.8 MPa)
CNG Storage Cylinder Temp. Range......................................................................... -40°F (-40°C) to 185°F (85°C)

Torque Specifications

Cylinder support brackets To Frame (5/8-11 Lubricated) ........................................... 180 lb-ft. (244 Nm)
Storage Module End cap Brackets To Frame (5/8-11 Lubricated) ............................... 180 lb-ft. (244 Nm)
Cylinder Strap Nuts ....................................................................................................................... See Note 1
Fuel Storage Module Cover Fasteners .................................................................................... 25 lb-ft. (34 Nm)
All 3/8 ORFS Fittings .................................................................................................................... 30 lb-ft. (41 Nm)
9/16 (-6) SAE O-Ring Joints (Stainless to Aluminum or Brass) ...................................... 22 lb-ft. (30 Nm)
9/16 (-6) SAE O-Ring Joints (Stainless to Stainless) .............................................................. 35 lb-ft. (48 Nm)

Note 1: The strap nut is tightened until the installed height of the spring on each end of the cylinder strap is 1.23” ±0.08” (31mm ± 2mm) with the cylinder pressure below 500 psi (34.5 bar).
Fuel Cylinder Handling Instructions

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 Purge Instructions in this manual.
**Purge Instructions**

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](http://www.qtww.com/service).

To vent the purge gas from the fuel storage module, refer to the *Fuel Cylinder Venting* procedure in this manual.
Cylinder Initial Pressurization/CNG Cylinder Valve Initial Interface Leak Test

**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**

Compressed Natural Gas (CNG) is extremely flammable. If something accidentally ignites it, you could 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.

**CAUTION**

Verify any equipment used is rated for the highest pressure that can be generated during the procedure. Failure to do so may result in 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 personal 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 injury.
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.

**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.

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 a appropriate test fixture before proceeding.

2. Connect the gas supply to the CNG cylinder or the system fill valve.

3. 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.

4. 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.

5. If inert gas was used for this procedure, then vent the cylinder following the [Fuel Cylinder Venting](#) procedure in this manual.
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 could 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 and a high flow, 3600 psi, ISO 14469-2 compliant fill valve. Either fill valve may be used with no additional actions required by the system operator.
**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 could 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°F (-18°C) may result in damage to the components within the FSM. Allow the FSM to warm to room temperature >60°F (13°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°F (-40°C). Both the rate of fueling and cold ambient temperatures may drop the temperature within the FSM below -40°F (-40°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°F (-40°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.
Leak Checking the System

**WARNING**

CNG is extremely flammable. If something ignites it, you could 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 personal injury or death.

Before proceeding with this or any repair or maintenance, read and understand the [Important Safety Information](#) contained in the front of this manual.

Use this procedure if a CNG fuel system leak is suspected. 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.
**Fuel Cylinder Venting**

**WARNING**

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 could 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.

All CNG Fuel Cylinders installed in an enclosed area require venting to the outside of the vehicle. 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 odor in the vehicle if mounted in a passenger compartment.

Quantum does not recommend mounting Type 4 cylinders in enclosed passenger compartments. If a Type 4 cylinder will be mounted in a passenger compartment, the entire cylinder and valve connections should be covered with a vent “bag” or system to capture and route any gas that escapes from the cylinder to the outside of the passenger compartment.
Venting Storage Cylinders

**WARNING**

Operating the system with the system vent valve in the open position and with the end cap removed, may 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 may result in serious injury or death.


2. Confirm the system vent valve 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 on the outlet port.

**NOTICE**

*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.

5. Open the manual shut off valves on the fuel cylinders 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 [Purge Instructions](#) 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 so that it is perpendicular to the line as shown.

11. Remove the vent line.

12. Reinstall the valve port end cap and torque to 22 lb-ft (30 Nm).
Long Term System Storage

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.


Fuel Storage Module Accessories

There are a number of accessories that may be needed to ensure a safe installation or may simply make installation easier. Below is a reference for all the modules and accessories currently available.

PN 116505 1" (25mm) Spacer Kit
PN 116506 2" (51mm) Spacer Kit
PN 116544 Insulation Kit
Appendix A

Cylinder Support Mounting Bracket Template

Dimensions:
- 3.48" (88.5 mm)
- 1.43" (36.2 mm)
- 1.97" (50.0 mm)
- 10.2" (259.0 mm)

Holes:
- 8x Ø 11/16" (17.5 mm)
Cylinder Cover End
Cap Mounting Template

Hole pattern shows center of bolt holes, actual holes in cover will be slotted.
Appendix B

Quantum FSM Final Inspection

Date ________________________________ Cylinder SN ________________________________
Technician ___________________________ Mileage ________________________________

✅ = OK  X = Needs Repair  N = Not Applicable

☐ Document The Distance Between The FSM And Kingpin

☐ Inspect Completed FSM And Note Any Damage

☐ Verify Cylinder Strap Spring Installed Height Is Properly Adjusted

☐ Verify All Critical Fasteners Have Been Properly Tightened

☐ Verify Adequate FSM Clearance To Vehicle Components

☐ Verify Any Openings Or Gaps In The FSM Covers Will Not Allow Debris Intrusion

☐ Verify All Heat Sources Are A Minimum of 2” (51 mm) From the FSM

☐ Verify Any Heat Source Closer Than 4” (102 mm) To The FSM Has Been Properly Shielded

☐ Verify The FSM Ground Clearance Meets Regulatory And Customer Requirements

☐ Verify The Bottom Step Height is Lower Than 24” (610 mm) From The Ground

☐ Verify Cylinder Inspection Label Has Been Completed And Installed

☐ Purge Fuel Storage Cylinder

☐ Fill and Leak Check the Fuel Storage System

Comments:

________________________________________

( RECORD DISTANCE HERE)
Revision History:

A: Initial Release
B: 9/12/13 Update multiple illustrations, revised installation to match new CNG pipes, added accessory list, updated final inspection form, and revised installation work sheet.
C: Graphic updates, Canadian information added, and revised installation to match new CNG pipes.
D: Back cover updates, graphic updates, and installation instructions.
E: Torque section update, image updates, title change, updated maintenance schedule, and updated tool section.
G: Update FSM part numbers, remove Warranty section.

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