

# Compressed Natural Gas Vehicles: Fuel System Inspector

## **Instructor's Manual**



National Alternative  
Fuels Training Consortium

A Program of

 West Virginia University

# Natural Gas Vehicle Fuel System Component Requirements

Compressed Natural Gas Vehicle Fuel System Inspector

## CNG Cylinder Requirements

Notes

CNG cylinders should be mounted in convenient locations on the

### Note:

Do not install the cylinder in a pressurized state, as the recommended torque values will not be sufficient to hold the cylinder in place when depressurized. Do not under any circumstances pressurize cylinders above the temperature-compensated pressure rating of the cylinder. Over pressurization lowers the margin of safety, decreases cylinder life, and can lead to rupture of a damaged cylinder.

vehicle, if at all possible. In larger vehicles, cylinders are usually mounted under the vehicle, which is more practical for CNG conversions. If properly vented, the cylinder can be mounted in the trunk, which is the most common approach for OEM vehicles. Venting prevents asphyxiation and accumulation of combustible gas. Cylinders must be mounted with equal weight distribution in the vehicle. They can be mounted horizontally, vertically, or in bundles.

The following points to consider when inspecting CNG cylinder installations are based on NPPA 52 guidelines.

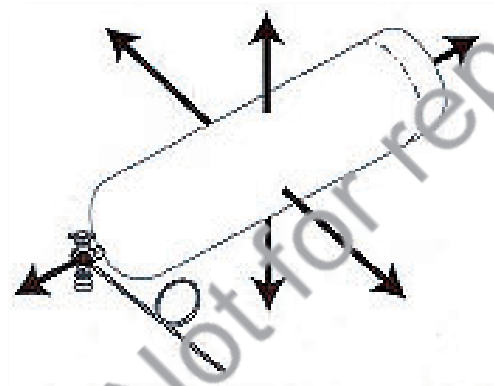
- Grinding is not permitted (NFPA 52, 2010; 4.4.6.3)
- Welding can only be applied to saddle plates, lugs, or brackets (NFPA 52, 2010; 4.4.7.1)
- Cylinders may be located within, below, or above the driver or passenger compartment. All connections to the cylinder must be vented to the outside
- Cylinders must be protected from road hazards, loading, unloading, direct sunlight, and exhaust heat
- Direct contact is to be avoided between the shield and the fuel supply container. Shields must not trap materials between the shield and fuel supply container
- The cylinder must not come into contact with vehicle frame members, body panels, brake lines or electrical wiring

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- Cylinders under the vehicle must not be mounted ahead of the front axle or behind the rear bumper. Cylinder valves must be protected from physical damage using the vehicle structure or proper shields
- No part of the cylinder or connected devices should extend beyond the sides or top of the vehicle
- Each cylinder rack must be mounted to the vehicle body, bed, or frame. The container rack must withstand a static force in the six principle directions of eight times the weight of a fully pressurized cylinder. In addition, each cylinder in the rack must also withstand a static force in the six principal directions of eight times the weight of the fully pressurized cylinder



**Figure 2-5:** Cylinder mounting showing forces in the six principal directions. Photo Courtesy of NAFTC.

- The cylinder weight must not be supported by outlet valves, manifolds, or other fuel connections

- Cylinders located less than 8 in. (200 mm) from the exhaust system are to be shielded against heat

- The mounting system must minimize fretting corrosion between the cylinder

(NFPA 52, 2010; 6.3.1 through 6.3.9)

- The minimum clearance from the road to the cylinder is to be measured from the lowest component to the road. If the vehicle wheel base is less than or equal to 127 in. (3230 mm), the minimum road clearance must be 7 in. (180 mm) or greater. If the wheel base is greater than 127 in. (3230 mm), the minimum road clearance must be 9 in. (230 mm) or greater (NFPA 52, 2010;6.3.11).



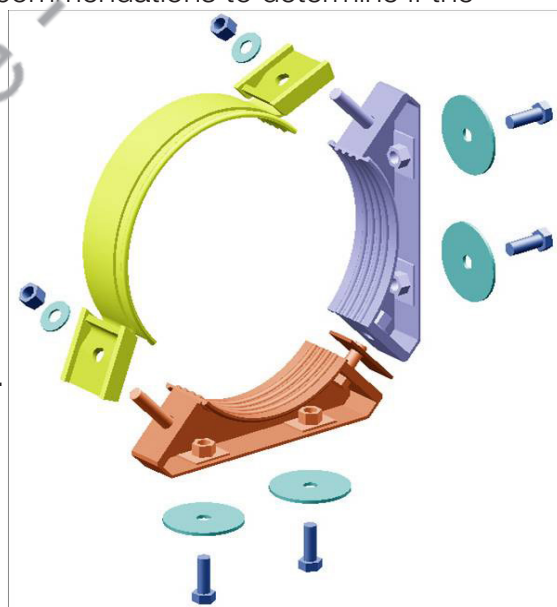
## Notes

Some points to consider when inspecting CNG cylinder bracket installations are as follows:

- Cylinder mountings must use manufacturer's recommended brackets and torque value settings
- Brackets must be secured to prevent rotation or jarring
- Brackets must be installed on solid surfaces
- Brackets must use manufacturer's recommended torque specifications
- The cylinder must be positioned so that the cylinder valve handle is accessible

A rubber belt insulator must be installed between the cylinder and brackets. Metal clamping bands and their supports must not be in direct contact with a cylinder. A resilient gasket must be installed between the clamping bands and the cylinder to help prevent galvanic corrosion (NFPA 52, 2010; 6.3.10 through 6.3.10.2).

CNG cylinder bracket manufacturer brands and types must not be intermixed. As cylinders are filled and emptied, they expand and contract. Although they may look alike, each type of bracket (and insulator) is actually designed for a specific cylinder. **Figure 2-6** shows a typical mounting bracket assembly. Examine the cylinder manufacturer's recommendations to determine if the correct cylinder and bracket combination has been installed on the vehicle. Some cylinder manufacturers are currently researching the possibility of having the cylinder become part of the vehicle superstructure.



**Figure 2-6:** CNG cylinder mounting bracket assembly. Photo Courtesy of NAFTC.

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When designing the CNG cylinder fit, you should anticipate the worst possible collision the vehicle may ever experience, and visualize how the cylinder will be affected. Think “safety first” at every step of the design layout and conversion. NFPA 52 provides a complete list of safety considerations, including details on recommended practices. Keep in mind that the most vulnerable element of the fuel cylinder assembly is the cylinder valve.

### Cylinder Valves

Currently, there are two basic designs of valve assemblies, but their function is the same: to shut off the flow of gas from the cylinders. The two types of cylinder valves are manually-operated and electrically-operated. Every cylinder must be equipped with either a manual valve or a normally closed, remotely actuated shutoff valve that will allow the cylinder to discharge contents manually (NFPA 52, 2010; 6.6.1).

When a manual cylinder valve is shut off, fuel cannot escape from the cylinder, but fuel can still pass through the valve if the valve port is plumbed in parallel with other cylinders or to a fuel supply line. For example, if the valve shown in **Figure 2-7** below had fittings connected to both threaded ports and the valve was closed, gas would still pass through the ports.



**Figure 2-7:** Manually-operated CNG cylinder valve, in cut-away Type 2 cylinder with pressure valve (PRD). SAE threads and O-ring shown. Photo Courtesy of NAFTC.