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I. Proprietary Statement
The information provided within this document is proprietary and confidential. All prior versions, including updates and revisions forwarded separately, are also proprietary and confidential. The information provided by Agility Fuel Solutions to its customers is solely for the use of those customers. No portion of this manual may be reproduced or distributed without prior written consent of Agility Fuel Solutions. Agility Fuel Solutions reserves all rights, including intellectual property rights, contained within this publication.

II. Trademark Notice
Agility® and TUFFSHELL® are registered trademarks of Agility Fuel Solutions.

III. Preface
This manual contains specific inspection information for Agility Fuel Solutions CNG vehicle fuel system cylinders. It does not apply to cylinders made by other manufacturers.
This manual does NOT cover vehicle fuel system inspections or maintenance procedures. Refer to “Truck and Tractor CNG Fuel System Operation, Maintenance & Inspection Manual,” ENP-516 for system details.

IV. Warning Statements Used in this Manual

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

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

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

⚠️ NOTICE
Best practices or hints to help an operation or procedure go smoothly.
V. Obtaining Product Support, Service or Parts

Fuel system in- or out-of-warranty product support can be obtained by calling the Agility Fuel Solutions Customer Care Hotline at +1 949 267 7745. Toll free: +1 855 500 2445.

Customer Care: support@agilityfs.com
Parts: parts@agilityfs.com

Visit our website for more information, including CNG and LNG fuel system videos.

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1. Safety

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

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

1.2. Safety Equipment and General Safety Rules
1. CNG safety signage should be visible at all applicable locations as stipulated by federal, state and municipal law.
2. Natural gas rated fire extinguishers should be accessible and visible throughout all servicing and fueling areas. Be sure all fire extinguishers are charged and up to date.
3. Areas designated for CNG fueling systems must have adequate lighting that complies with NFPA and other applicable codes.
4. Search for leaks using only certified leak detecting solutions and equipment such as Swagelok Snoop®. Any other product or solutions are unacceptable.
5. Use tools that are in good working order with proper calibration.
6. Wear appropriate attire and personal protective equipment (PPE) while servicing or maintaining any CNG system.
7. Never use an open flame as a source of illumination near a CNG system.
8. CNG fuel systems are to be serviced in designated areas that comply with all federal, state and municipal laws and regulations.
9. CNG servicing and fueling areas must be well ventilated.

1.3. Emergency Response for Gas Leaks
If the vehicle has sustained damage or a gas leak is detected:
1. Do not approach the vehicle if any sources of ignition may exist such as fire, sparks, electrostatic charges, lights or electronic devices.
   a. If ignition sources may be present, vehicle fuel cabinet doors should remain closed.
   b. If no ignition sources are present, keep the vehicle and fuel cabinet doors open to prevent gas accumulation.
2. If the vehicle is indoors, move the vehicle outside and away from any ignition sources.
3. Do not use road flares.
4. Do not smoke or allow anyone else to smoke near the vehicle.
5. Turn the ignition switch off, set the parking brake and turn off the battery at the main disconnect.
6. If it is safe to do so, close the main shutoff valve and the cylinder valves. Check the fuel system near the damaged area for leaks by smell, sight, and sound. CNG is odorized.
7. Keep traffic and pedestrians away.
8. Beware that gas may continue to leak once ignition is turned off and the manual shutoff valves are closed.
9. Verify leak locations with suitable methane detection fluid.

**NOTICE**
Leaks must be repaired by a qualified technician.

### 1.4. Vehicle Fire Procedures
1. Always call 9-1-1 first.
2. Get passengers out of the vehicle as quickly as possible.
3. Evacuate the area.

**WARNING**
In case of fire, thermally activated pressure relief devices (PRDs) protect cylinders from rupturing. PRDs typically activate between 212°F and 220°F and will release high pressure CNG which may ignite and add to the fire.

### 1.5. Emergency Shut Down Procedure
1. Turn the ignition switch to “off” and set the parking brake.
2. Turn off the battery disconnect switch.
3. Shut off fuel at 1/4-turn valve on the FMM.
4. Inform emergency personnel.

### 1.6. Inspect Cylinders Immediately If:
1. The vehicle has been in an accident.
2. The fuel cylinder or vehicle has been subjected to fire, impact, excessive heat or any other means that may have caused external or internal damage.

3. Unusual behavior is observed. This may include but is not limited to, emission of natural gas odor, unexpected loss of gas pressure, snapping or hissing sounds, rattling and any indications of loose parts.

4. The fuel cylinder has been transferred to another vehicle or the cylinder installation has been altered significantly.

**CAUTION**  **WARNING**

A. Cylinders involved in an accident or incident should be depressurized prior to inspection.
B. Failure to perform regular or emergency inspections may put the vehicle and its operator at risk of serious injury or death.

### 1.7. CNG Inspectors: Certified vs Qualified

Agility Fuel Solutions provides Agility-specific CNG fuel system training, but does not have a certified or certification program. Agility recommends inspection and service technicians receive training and certification by third-party organizations such as CSA and NGVi (Natural Gas Vehicle Institute).

CNG fuel system inspectors are certified by CSA or NGVi after passing a written examination on CSA standards, NFPA 52 “Vehicular Natural Gas Fuel Systems Code” and NGV industry best practices.

An acceptable alternative to the certified status is a CNG fuel system inspector who is qualified and trained as described by the Compressed Gas Association (CGA) in its publication CGA C-6.4 “Methods for External Visual Inspection of Natural Gas Vehicle (NGV) and Hydrogen Gas Vehicle (HGV) Fuel Containers and their Installations.”

A qualified inspector must have at least one of the following qualifications: (a) two years’ experience conducting container inspections on the type of cylinder being inspected; (b) supervision by a person with two years’ experience relevant to the type of cylinder being inspected; (c) approved by manufacturer of the container being inspected; (d) certified as an inspector by one of the organizations with specific OEM-approved training centers with fuel gas cylinder standards’ recommended inspection guidelines; (e) certification as an inspector by a state or nationally recognized organization that tests for specific knowledge of applicable fuel gas cylinder standards’ recommended inspection guidelines; or certification as an inspector by the authority having jurisdiction.

### 1.8. Inspection Interval Confusion

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

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

1.9. CNG System Inspection Recommendations

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

These guidelines are intended to be consistent with the pending Recommended Practice (RP) from the American Trucking Association’s Technology & Maintenance Council and the recommendations from the NGVA Technology Committee Working Group on CNG Fuel System Inspections, of which Agility is a member and active participant. The working group is working closely with DOT, NHTSA and FMCSA to update FMVSS 304 to be consistent with the ATA-TMC (RP) and Agility guidelines.

Agility Fuel Solutions Recommends the Following

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

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

⚠️ CAUTION

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

⚠️ NOTICE

Some states have specific requirements for CNG fuel cylinder inspections, so the alternative schedule is not applicable.

1. Arizona: Inspection is required when the vehicle is placed into service and then annually. Inspection must be performed by an individual trained by the system manufacturer.
2. Kentucky: Inspection is required every 36 months or 36,000 miles, whichever comes first, and after collision. Does not state who performs the inspection.
3. **Oklahoma:** Inspection is required every 36 months or 36,000 miles, whichever comes first. Inspection is performed by a certified technician.

4. **Texas:** The owner of the vehicle must prove that the container meets the inspection criteria of FMVSS 304. (Every 36 months or 36,000 miles, whichever occurs first.)

5. **Utah:** Inspection is required every 36 months or 36,000 miles, whichever occurs first. Inspection must be performed by a CSA certified technician.

6. **West Virginia:** Does not state the frequency of inspection, however, all CNG activity must be overseen by a CSA certified technician. Note, this legislation is not signed into law yet.

7. **Ohio:** Coming soon

**NOTE:** Inspections must be performed by qualified inspectors using guidelines from the fuel cylinder manufacturer in addition to the guidelines listed in this manual.
2. Agility Fuel Solutions CNG Cylinders

Agility Fuel Solutions all-composite (Type 4) TUFFSHELL® NGV fuel cylinders are used to store CNG in vehicles.

The cylinders are made with a high-density polyethylene (HDPE) liner, aluminum bosses and a high strength composite wall consisting of carbon and fiberglass reinforcements in an epoxy resin.

They are designed and qualified to DOT FMVSS 304, ANSI/CSA NGV2 Canadian CSA B51-Part 2, METI/KHK, NFPA 52 and the requirements for Type 4 NGV2 fuel cylinders. A Type 4 NGV2 fuel cylinder is defined as “Resin impregnated continuous filament with a non-metallic liner.”

TUFFSHELL fuel cylinders are compliant with and can be certified to ISO 11439 or other national or international standards. All standards in this manual will be referred to as “applicable standards.”

Agility Fuel Solutions NGV fuel hybrid composite cylinders manufactured during or after December 1993 include patented TUFFSHELL construction to maximize resistance to damage-inducing events.

TUFFSHELL construction features

- A damage resistant outer layer
- Impact resistant, energy absorbing materials in the dome region
- An external coating to minimize effects of the environment and exposure to sunlight

![Figure 1. TUFFSHELL® Type 4 hybrid composite cylinder cut-away view.](image-url)
Figure 2. Agility Fuel Solutions all carbon cylinder (Type 4) cut-away view. The external foam cap provides an additional layer of protection.
3. Preparing for Cylinder Inspection

⚠️ WARNING
Composite fuel cylinders may be faulty without showing significant surface damage. Since the inspection depends primarily on visual observation, the surface of the cylinder must be accessible, clean and well illuminated. Removal of paint or fiber for visual inspection is not permitted unless damage depth is being determined. This may require removing small amounts of material for an accurate evaluation.

A record of the inspection (by cylinder serial number) should be made or updated if an inspection is performed on a cylinder or cylinder hardware. A sample record sheet is presented in the Reference Section.

Cylinder surfaces should be clean and free of dirt or other debris that impede inspection. Remove shields or covers as needed to ensure maximum access to the cylinder surface. It is not necessary to remove the cylinder from the vehicle if the vehicle protects visually inaccessible surfaces and there is little potential for damage.

Various vehicle and highway legislative agencies require warning and informational decals for CNG fueled vehicles. Cylinder manufacturer labels must be in place and legible. If Hexagon-Lincoln or Agility Fuel Solutions labels are damaged or missing, contact Agility Fuel Solutions Customer Care for replacement labels.

The guidelines in this manual also apply to Hexagon Lincoln CNG, Brunswick and General Dynamics, Lincoln Operations Type 4 cylinders and may not be appropriate for cylinders from other manufacturers.

Note: For cylinders manufactured after July 1999: If the label is missing or damaged, the serial number of the cylinder is etched on one of the bosses, and a replacement label can be supplied.

⚠️ CAUTION
If the cylinder label is not attached to the cylinder, and the manufacturer and serial number are not available or cannot be verified, the cylinder must be condemned.
Figure 3. The CNG cylinder manufacturer’s label must be in place and legible.

3.1. Tools and Supplies

Figure 4. A few of the tools needed for cylinder inspection.

Common hand tools are needed for CNG cylinder and inspection.

1. Depth gauge/micrometer
2. Leak detection fluid
3. Inspection mirror
4. Flashlight
5. Borescope
6. Creeper
7. Rags or shop towels
8. Coin for tap test
9. Notepad and vehicle record
10. Camera
11. Personal protective equipment (PPE), including eye protection, hard hat, reflective vest and fall arrestment harness as needed
3.2. Inspection Overview

Cylinder inspection consists of four primary elements.

1. Service History: The inspector reviews cylinder inspection and service records.

   a. Includes inspection of cylinder bosses, bushings and mounting blocks.
   b. See Section 3.4.

3. Tap Test: Because damage (delamination) may occur within the cylinder wall upon impact, the tap test is used to detect hidden damage by tapping the cylinder and listening for sound differences. The tap test must be limited to the main portion of the cylinder and not the dome ends. This test should be performed by a registered or experienced inspector. Any uncertainties shall be resolved by removing the cylinder from service and returned for factory inspection.

4. Factory Inspection: Cylinders known or suspected to have been subjected to a potentially damaging incident or show evidence of damage not acceptable, should be removed and may be sent to Agility Fuel Solutions for more extensive evaluation. Contact Customer Care for assistance.

3.3. The Six Damage Types

There are six types of composite cylinder damage. Damage depth determines damage level.

3.3.1. Cuts, Scratches and Abrasion

Cuts cause deep fiber breaks and loose fibers in the damaged area.

Scratches in the composite surface will typically be less than 0.010 inches (0.25 mm) in depth and cause minor fiber breaks.

Abrasion damage is caused by an object rubbing against the cylinder surface. Light load abrasion appears smooth and polished, while high loads appear as a group of parallel gouges or cuts.

High load abrasion should also be examined using impact damage inspection.

⚠️ CAUTION  ⚠️ WARNING

Cut, scratch and abrasion damage can lead to the unraveling of composite, see below. Unraveling is level 2b damage. Contact Agility Fuel Solutions Customer Care if any unraveling has begun.
3.3.2. Impact

**WARNING** **CAUTION**

Evidence of cylinder damage within the wall is considered major and should be condemned.

Agility Fuel Solutions cylinders are resistant to damage from minor impacts. However, severe structural damage can be caused from major impacts. Impact damage may be incurred during shipping, installing or while in service (vehicle accident).

Since composite cylinders tend to return to their original shape after an impact and typically do not dent like an all-metal tank, a simple visual check is not enough.

Impact damage differs from other forms of damage because severe damage may be hidden within the wall (delamination or fracture) as well as the cylinder surface. This is particularly true if the object impacting the cylinder is blunt and relatively smooth.

Known areas of impact and zones of detectable surface damage must be inspected for evidence of damage within the wall.

1. **Permanent deformation of the surface** resembling denting of an all-metal tank. Cylinders with deformation or denting should be investigated immediately for Level 3 damage.

**Note:** This condition does not include highly localized imprinting on the surface that might result from impact by a small stone or other debris. This minor type of damage may not exceed Level 2a damage to be acceptable for use. (Refer to the Damage Level and Disposition Table.)
2. **Softness or deflection** of the wall. The cylinder wall should be rigid and not easily deformable. Cylinders exhibiting this condition have Level 3 damage and are to be condemned and destroyed. If damage is localized to the dome areas only, the dome wall may be repairable.

3. **Damage to cylinder bosses.** Impact to the ends of the cylinder, including the valves, plumbing and pressure relief devices, should be investigated to ensure composite damage has not been sustained.

4. **Localized surface crazing.** Cylinders with circular, oval or linear zones of crazing on the composite surface. Surface crazing may be accompanied by a change in coloration. Each area with these indications should be subjected to the tap test. Questionable areas should be subjected to factory inspection.

**Note:** Small random hairline cracks in the resin surface parallel to the reinforcing fibers are common in composite pressure cylinders and are **not** a cause for concern.

5. **Differences in sound** during a tap test.

---

**NOTICE**

*Only a registered or experienced inspector should perform the tap test. Any uncertainties that result from the tap test shall be resolved by removing the cylinder from service and inspected by the factory.*

The tap test is a method to identify delamination within the composite wall and should be performed only when the composite surface has been impacted.

The tap test is performed by tapping the composite surface with a quarter or similarly size metal object grasped between the fingers. The tapping sound near damaged areas will sound different from un-damaged areas. The tap test must be confined to the main portion of the cylinder. False indications may be heard if the tap test is performed in the dome (end) areas.

Differences in sound are evidence of damage within the composite wall. Cylinders with this type of damage must be removed from service. Cylinders may be subjected to further field evaluation, factory inspection at Agility Fuel Solutions or condemned and destroyed.

Surface damage associated with impact loads may include cutting, gouging, scraping, scuffing, chipping, punctures, fiber breakage, loose fibers, resin cracking or change in coloration or appearance. The surface must be carefully examined for these types of indications. Accurate depth measurement of damage requires removing all loose fibers associated with the damage. Once the loose fibers are removed, the damage level can be determined using the measurements for cuts, scratches and abrasion.

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### 3.3.3. **Fire and Excessive Heat**

All NGV fuel cylinders manufactured under NGV2 or ISO 11439 have a maximum service temperature of 180°F (82.2°C). Excessive heating may occur if the cylinder is involved in a fire. Evidence of fire or heat damage includes darkening, charring or soot on the cylinder surface.
Severe exposure may result in resin removal and loose fibers. Other signs of heat damage are melting of the plastic on the labels and discoloration of the bosses. This is considered Level 3 damage and must be removed from service and condemned.

![Figure 6. Fire damage. Fire or excessive heat is Level 3 damage and must be condemned.](image)

### 3.3.4. Chemical Damage/Chemical Attack

The materials used in cylinder construction are resistant to chemical agents encountered in the normal fuel cylinder environment. However, chemical damage indicated by blistering, swelling, softening, resin removal, or fractures is Level 3 damage and must be removed from service and condemned.

Minor discoloration and etching is considered acceptable provided the chemical has been removed and the cylinder surface cleaned.

### 3.3.5. Weathering

The cylinder external coating may show degradation after prolonged exposure to sunlight and weather, resulting in discoloration or flaking. This condition is Level 1 and may be reworked by hand filing or sanding. Paint the area with a polyurethane paint.
3.3.6. Gas Leakage

Leaking cylinders must be removed from service. Contact Agility Fuel Solutions Customer Care to report the condition and obtain additional testing and disposition information. Cylinders with confirmed gas leaks must be condemned and destroyed.

Note: Bubbles may be observed on the composite surface for several hours after pressurization, usually after first-time fill or if the cylinder is nearly empty. The bubbles are caused by air trapped between the liner and composite being forced through the composite (permeation) when the cylinder is pressurized and the liner expands.
3.4. Cylinder Boss and Mounting Blocks

Refer to Figure 8. The cylinder boss, mounting blocks and bushings must be inspected for wear daily as part of the drivers' pre-drive visual check. This item is part of the broad category called “cylinder mounts” in inspection interval documents and guidelines. See Section 8, “Natural Gas Vehicle Cylinder Inspection Record.”

This section applies to sliding block part number 240105-01, commonly used with 16-inch and 21-inch cylinder families. The part number is engraved on the block.

3.4.1. Boss Wear

Boss wear up to 0.050-inches is acceptable for continued service. Anything over 0.050-in. up to .125-in. of wear requires cylinder re-work. Beyond .125-in of wear requires cylinder replacement. See Figure 9. Contact Agility Customer Care for assistance, and refer to Field Service Bulletin ENP-652, “CNG Cylinder Boss Wear, Inspection and Repair.”

*Figure 8. Cylinders with sliding blocks should be checked for excessive wear. The sling is needed only when lifting a defueled cylinder.*

*Figure 9. Cylinder boss wear measurement point. Boss wear up to 0.050-inches is acceptable for continued service. Wear from 0.050-in. to .125-in. can be repaired in the field. If wear exceeds 0.125-in., contact Agility Customer Care for further instructions.*
3.4.2. Delrin Bushing

Figure 10. The Delrin bushing allows cylinder movement in some cylinder mounting systems.

On some systems, a Delrin bushing (part number 240105-01) is incorporated into one of the cylinder mounting blocks to accommodate normal cylinder movement. This is called the “sliding block.” The other end is fixed and does not normally move, it is called the “fixed block” and does not include a Delrin bushing.

The bushing will normally wear over time, and should be replaced if excessive wear is discovered during the inspection process, to prevent damage to the cylinder.

If there is evidence of excessive cylinder movement, contact Agility Customer Care for assistance, and refer to Field Service Bulletin ENP-638, “Cylinder Mounting Block Bushing Replacement, Part Number 240105-01.”

3.5. Non-Structural Anomalies

Frequently, cylinders may exhibit superficial anomalies that have no effect on the structural quality. Non-structural anomalies include:

1. Fiber gaps on the surface of the dome area, see photo below. Fiber gaps do not include loose fiber that has separated from the surface of the composite.
2. Resin and paint runs, which may appear as a hard circle or spot on the cylinder surface.
3. Excessive resin on the composite surface.
4. Splices on the external TUFFSHELL wrap.
3.6. Damage Level Examples

**NOTICE**

Always measure damage to determine damage level. Although damage type may be the same (such as gouge), the depth determines level classification.

*Figure 12. Level 1 damage (use a depth gauge to verify) can be repaired with a coat of polyurethane paint. Damage depth: 0-in. ≤ 0.010-in. (0 mm ≤ 0.25 mm).*
Figure 13. Level 2a damage can be re-worked in the field. If loose fibers are present, remove them by sanding the area and apply a coat of polyurethane paint. Damage depth: 0.011-in. ≤ 0.035-in. (0.26 mm ≤ 0.89 mm).
Figure 14. Level 2b damage may or may not be repairable. Damage depth: 0.036 in. ≤ 0.050-in. (0.90 mm ≤ 1.27 mm).
Figure 15. Level 3 damage cannot be repaired. The cylinder must be condemned. Damage depth, gouge or impact: >0.05-in. (>1.27 mm).
Figure 16. A cylinder exposed to fire or excessive heat is classified as Level 3 damage and must be condemned.
4. Damage Level and Disposition

**WARNING**

Depressurize and DEFUEL the cylinder before any rework on the cylinder and/or related hardware is performed.

<table>
<thead>
<tr>
<th>Damage Level</th>
<th>Damage Type</th>
<th>Depth Measurement</th>
<th>Disposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Minor damage inconsequential for safe cylinder operation</td>
<td>0 ≤ 0.010-in. 0 ≤ 0.25mm</td>
<td>Paint with polyurethane paint.</td>
</tr>
<tr>
<td>Level 2a</td>
<td>Loose fibers, cut, scratch, abrasion</td>
<td>0.011 ≤ 0.035-in. 0.26 ≤ 0.89mm</td>
<td>Customer rework: Remove loose fibers or rough edges of a cut or gouge by hand sanding. Paint with polyurethane paint.</td>
</tr>
<tr>
<td>Level 2b</td>
<td>Loose fibers, cut scratch, abrasion, unraveling</td>
<td>0.036 ≤ 0.050-in. 0.90 ≤ 1.27mm</td>
<td>Remove cylinder from service and contact Customer Care for factory inspection and possible rework.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Gouge damage</td>
<td>&gt; 0.05-in. &gt; 1.27mm</td>
<td>Remove from service and condemn.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Impact damage</td>
<td>Not applicable</td>
<td>Remove from service and condemn.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Fire damage, fire exposure</td>
<td>Not applicable</td>
<td>Remove from service and condemn.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Chemical Damage / Chemical Attack</td>
<td>Not applicable</td>
<td>Remove from service and condemn.</td>
</tr>
</tbody>
</table>
Cylinders inspected using these guidelines will have one of four dispositions:

1. No damage or Level 1: Acceptable and may remain in service. Re-work with paint if necessary.
2. Level 2a: May be reworked in the field and the cylinder can be returned to service.
3. Level 2b: Cannot be fully assessed in a field inspection and must be factory inspected.
4. Level 3: Must be condemned, removed from service and destroyed.

5. Cylinder Decommissioning and Destruction

**WARNING**

A. Residual gas remains in the cylinder after depressurization and must be removed before destruction. Vent all pressure from the cylinder and displace residual fumes with compressed nitrogen. If compressed nitrogen is not available, flushing the cylinder with water will displace residual fumes.

B. NEVER use compressed air to purge the cylinder.

C. Wait at least 10 minutes to ensure no gas remains before drilling holes.

Before condemning a cylinder, the cylinder owner must be notified. Condemned cylinders must be clearly marked "CONDEMNED" at the time of inspection. The marking shall be affixed to the manufacturer's label and the duplicate manufacturer's label, if used.

To prevent unauthorized pressurization, the cylinder must be destroyed by drilling two or more holes one-half inch or greater completely through the cylinder wall and internal liner.

*Figure 17. Condemned cylinders must be properly prepared and destroyed to prevent use.*
6. CNG Cylinder and System Inspection Regulations, Codes and Guidelines

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

2. ANSI/IAS NGV2, “Basic Requirements for Compressed Natural Gas Vehicle Fuel Containers”
3. ANSI NGV2-PRD-1, “Pressure Relief Devices for Natural Gas Vehicle (NGV) Fuel Containers”
8. Cylinder manufacturer guidelines

7. Glossary

**Abrasion damage**: Damage to composite caused by wearing, grinding or rubbing away of composite material by friction.

**All-composite (Type 4)**: A fuel cylinder made primarily from non-metallic materials such as plastic and high strength fiber reinforced composites. May incorporate metal ports for valves and other plumbing devices.

**Boss (see “Ports”)**: The aluminum fittings at the ends of the tank, which contain the ports for installation of valves, pressure relief devices and blank plugs.

**Blank plug (see “Solid plug”)**: A threaded plug with O-ring seal.

**Carbon fiber**: One type of reinforcement fiber used in fuel cylinder composite overwrap.

**CNG**: Compressed natural gas

**Condemned cylinder**: A fuel container that has been damaged beyond repair and must be removed from service and rendered unusable. See “Destroyed.”

**Cylinder**: Preferred term for “tank” in CNG applications and systems.

**Delamination**: An induced separation between composite layers. This type of damage occurs from localized impact or resin burn out.

**Destroyed**: Alteration of a fuel cylinder to make it unusable.
Drop-N-Go™: Agility Fuel Solutions side- or rail-mounted systems featuring mounting brackets that simplify installation.

Factory inspection: An inspection and evaluation performed at an approved Agility Fuel Solutions facility, utilizing comprehensive testing techniques that are not available in field inspection.

Field inspection: Inspection performed at a location other than an Agility Fuel Solutions facility.

Impact damage: Cylinder damage caused by dropping or by a blow from another object. Impact damage may be at the surface, internal to the structure or both.

Level 1 Damage: Minor damage that is considered inconsequential to safe cylinder operation.

Level 2 Damage: Damage which is more severe than Level 1. Additional evaluation and/or rework may allow the cylinder to be returned to service.

Level 3 Damage: Damage that is not repairable and renders a tank unfit for continued service. Cylinders with Level 3 damage must be condemned and destroyed.

Liner: An internal component of a Type 4 cylinder that serves as a permeation barrier, preventing gas leakage through the composite structure.

Manufacturer’s Label: The label or labels containing the official markings required by the U.S. DOT, FMVSS304, ANSI/CSA NGV2, ISO 11439, CSA B51-Part 2 (Canada), and/ or other applicable standards. The label markings shall include a “CNG Only” designation, manufacturer's symbol or trademark, manufacturer's model number, type designation, serial number, month and year of manufacture, service pressure, the inspector’s symbol or trademark and the date when the service life expires.

Maximum Fill Pressure: The fill pressure allowed to obtain the settled service pressure at 70°F (21°C). For all tanks, maximum fill pressure under ANSI/ CSA NGV2 is 125% of the rated service pressure.

NGV: Natural gas vehicle.

Pressure relief device (PRD): A device installed in direct contact with internal pressure in the cylinder that will release the contained gas in specific emergency conditions. Excessive temperature, excessive internal pressure or both may activate the device depending on the PRD design. Thermally activated pressure relief devices are required in all installations.

Resin: Epoxy material in the composite overwrap filling the space and transfers the load between individual reinforcing fibers.

Solenoid valve: A valve which is turned on or off electrically.

Tank: Usually refers to liquefied natural gas (LNG) storage vessels. For compressed natural gas (CNG), use the term “cylinder.”

TUFFSHELL®: Agility Fuel Solutions registered trademark for Type 4 cylinders. Includes protective features such as foam inserts on the ends and a glass overwrap to absorb impact and abrasion damage.

Vent line: A high-pressure line used to conduct gas away from a pressure relief device to a location outside of the vehicle.
8. Natural Gas Vehicle Cylinder Inspection Record

<table>
<thead>
<tr>
<th>Examination Features</th>
<th>Accept</th>
<th>Reject</th>
<th>Comments (Include damage level if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder and brackets cleaned prior to inspection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder installation</td>
<td></td>
<td></td>
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<tr>
<td>1/2-in. clearance around cylinder when mounted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bracket condition</td>
<td></td>
<td></td>
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<tr>
<td>Mounting pads/isolators in good condition</td>
<td></td>
<td></td>
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<tr>
<td>Labels in place</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinders not expired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder service pressure meets or exceeds vehicle service pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve condition</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PRD condition</td>
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<td></td>
<td></td>
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<tr>
<td>Plug condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel lines secure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vent lines secure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vent lines free of debris or moisture</td>
<td></td>
<td></td>
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<tr>
<td>Interfaces free of leaks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder dome with valve condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder dome no valve condition</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>