High Pressure Fuel Storage Cylinders Periodic Inspection and End of Life Issues

DOE

Vehicular Tank Workshop

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The Facts

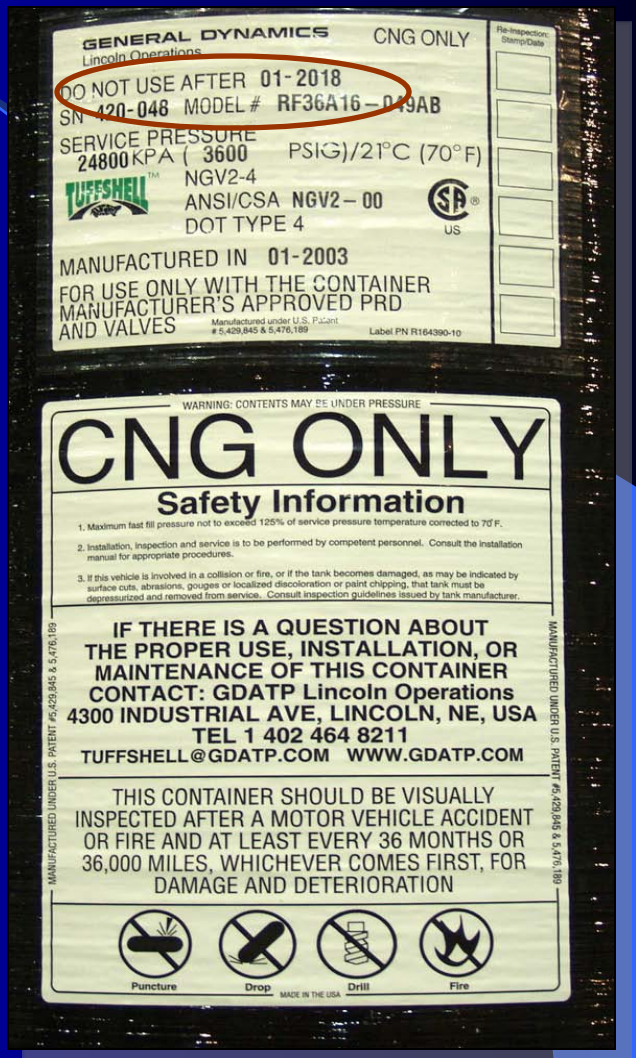
- High pressure Type 4 gaseous fuel tanks are now designed under standards that specify finite lifetimes of 15, 20 and 25 years based on specific design and testing (the HGV2 standard under development had a life as short as 10 years as an option)
- It is unique within the transportation industry to have a critical device (the fuel tank) with a designated life that may be shorter than the vehicle itself
- Although vehicle owners are told up front of the limited life fuel storage cylinders some tend to forget after 15 years
- A parallel concern is the requirement for these fuel tanks to be inspected every 3 years or 36,000 miles

Lessons Learned - CNG

- Presently there is no mechanism to insure that cylinders are removed and destroyed at end of life or that cylinders are inspected as required
- OEMs do not notify customers that their cylinders should be replaced nor do they have inspections as part of their warranty service
- Fueling station owners allow fueling without verifying inspection or end of life dates
- Some states capture vehicle registrations by fuel type but they do not track end of life or inspection dates
- The industry is just now looking to develop a response to these issues – we thought that in 15 years the problem would solve itself!

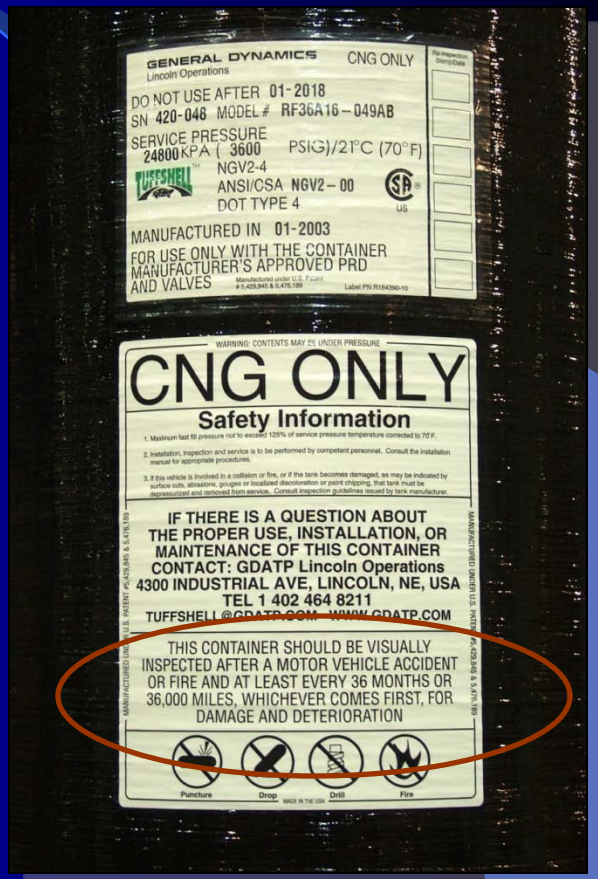
Cylinders have a Limited Life

- Remove cylinders at their end of life date and replace if vehicle will continue to operate
- Cylinders removed at end of life or from scrapped vehicles should be destroyed according to the manufacturers instructions
- CVEF is looking at mechanisms to track cylinders by end of life date and to require notification of owners



Cylinder and fuel system inspections are critical to safe operations

- Visual inspection of CNG fuel systems is, at this time, the best method of monitoring the overall safety of NGVs
- CVEF under contract to DOE developed a “CNG Fuel System Inspector Study Guide” for the CSA administered CNG Cylinder Inspectors Certification Test
- CVEF under the same contract provided scholarship funding for training over 250 inspectors
- NFPA 52 was recently changed to require notices at each fueling dispenser about inspection of cylinders



Proposed Solutions

- There are two issues facing the CNG industry
  1. The legacy fleet of vehicles with cylinders now approaching end of life
  2. New vehicles produced by OEMs, SVMs and Conversion of existing vehicles
- For the purpose of this meeting we will focus on the second bullet since it also concerns hydrogen
- Where the codes, standards and laws (FMVSS 304) require both periodic inspections and specific lifetimes for cylinders there is no credible enforcement. CVEF proposes using the vehicle registration process at the state level to enforce these requirements

Registration Enforcement

- Require each state vehicle registration agency capture vehicle fuel type and end of life date for the oldest cylinders installed on the vehicles
- The vehicle may not be registered if they have reached the cylinder end of life date with out proof of cylinder replacement
- OEMs or SVMs and Converters of existing vehicles would be required to furnish fuel type and end of life data to the owner/state agency for the vehicle to be registered
- OEMs could include this information in the VIN (as they now do for fuel type) or a separate method for end of life

Registration Enforcement for Periodic Inspections

- Require each state vehicle registration agency to capture the three year inspection date for cylinders as many now capture the annual emission inspections (the 36,000 mile requirement may need to be reconsidered for this to work)
- The vehicle may not be registered if they have not had their cylinders inspected as required
- OEMs or SVMs and Converters of existing vehicles would be required to initially provide written notification of the requirements for inspections and the OEMs should consider including the inspections as part of their warranty maintenance plans.

Questions

- Please contact CVEF personnel as noted below:

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Do TYPE 4 Cylinder Properties Change in 15 Years

- In the slides presented below is the first recorded failure from physical force of Type 4 cylinders that have reached their end of life date
- The uniqueness of this failure may call into question how Type 4 cylinders age after over 14 years of daily use
- CVEF as part of our incident investigation has obtained a number of cylinders from sister vehicles that have seen the same service for 14 years and has proposed a test plan to determine if there has been any unexpected degradation in physical properties
- The cylinders are now at the NASA facility at White Sands and we are in the process of looking for 50% co funding (about $30,000) to begin the evaluation.

Type 4 Cylinder Incident Physical Damage

- Two Type 4 Brunswick cylinders failed during fueling
  - The cylinders were 14 years old with one mounted horizontally under the truck and the other mounted vertically inside the truck body directly above the horizontal cylinder
  - The vertical cylinder had the valve end dome mounted on a rubber padded steel ring with the valve and piping exposed under the vehicle
  - It is believed that the horizontal cylinder failed first due to unknown road damage and when it failed the floor of the truck was forced upward with the steel ring cutting into the dome of the vertical cylinder which then failed.
  - The initial report has been completed by CVEF and additional evaluation of the cylinders will be made by NASA (White Sands)

Type 4 Cylinder Incident Physical Damage

Typical installation in multiple vehicles of the same vintage

- No shielding of exposed cylinder under vehicle
- PRD on vertical cylinder isolated from cylinder exposure

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