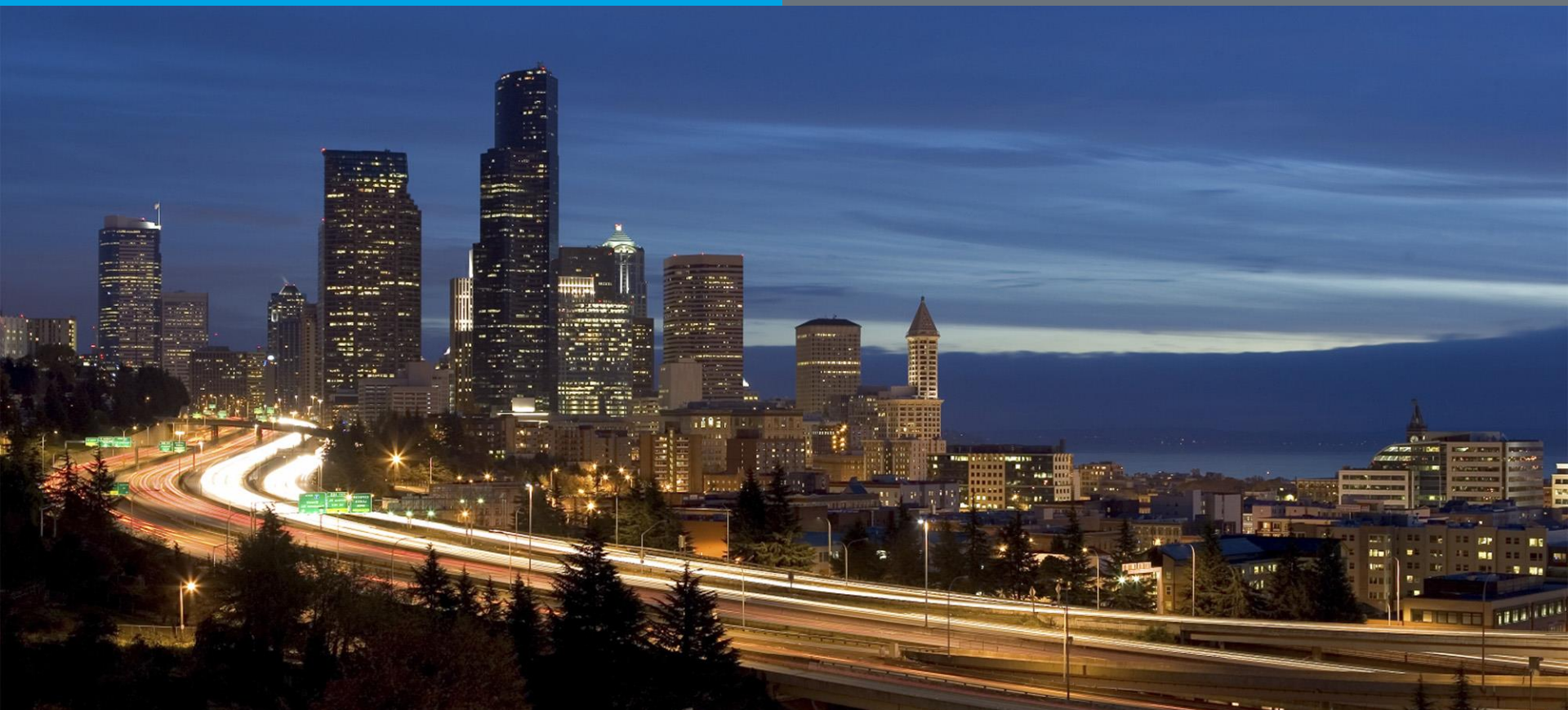


# Alt Fuel Vehicle Incidents—Fact and Fiction



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**Marathon Technical Services**

- All fuels have inherent risks and all vehicle types are subject to fire and other incidents.
- The incidents reported herein are limited to CNG, but all vehicles including battery technologies have incident risk and should be treated with respect.

- Average of 152,300 automobile fires per year in 2006-2010 causing an annual average:
  - 209 civilian deaths, 764 civilian injuries, and \$536 million in direct property damage.
- Automobile fires-10% of U.S. fires, 6% of U.S. fire deaths.
- 17 fires were reported per hour—4 deaths every week.
- Mechanical or electrical-66% of automobile fires. Collisions and overturns-4% of vehicle fires and 60% deaths.
- 2% of fires began in fuel systems-caused 15% of deaths.

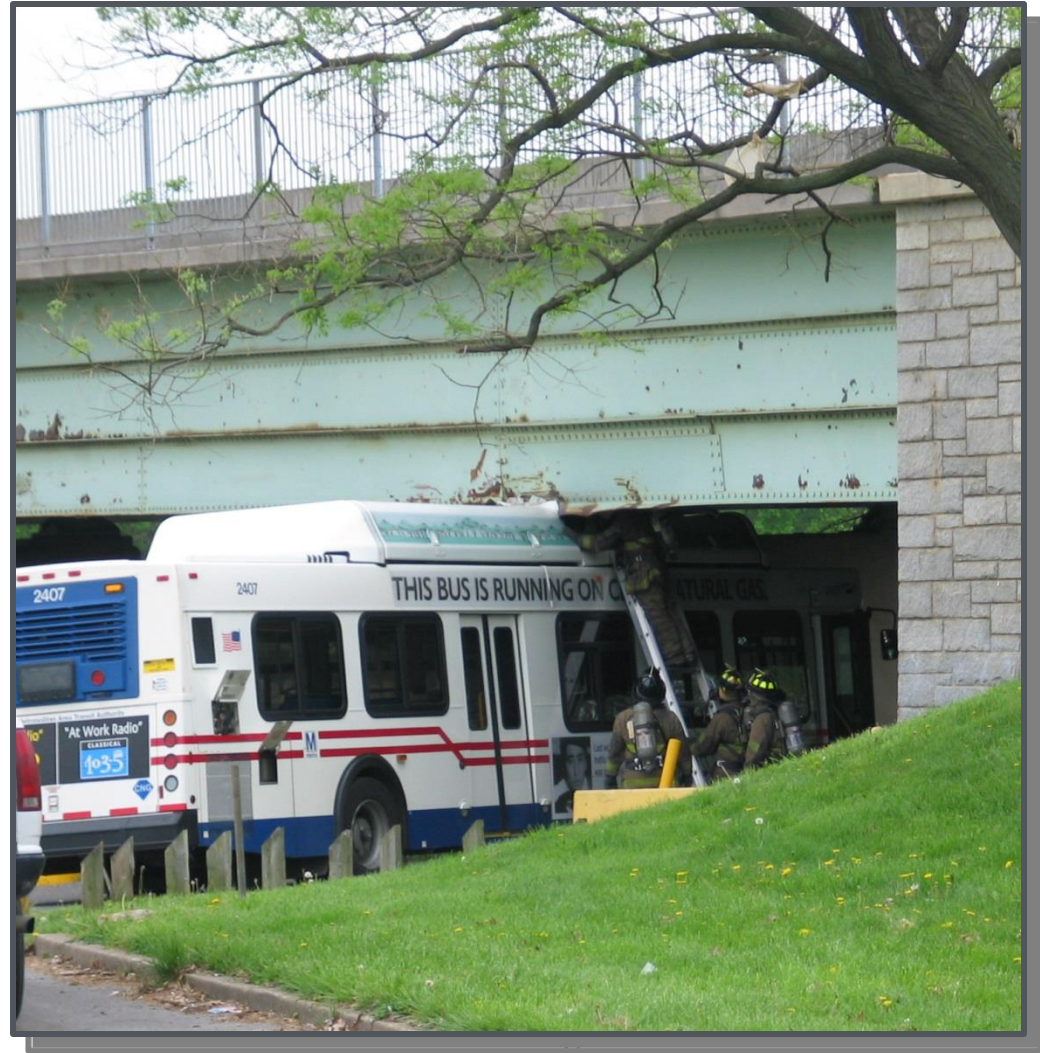
Source: NFPA's "[Automobile Fires in the U.S.: 2006-2010 Estimates](#)" report by Marty Ahrens, September 2012.

# Incident 1

## Vehicle Impact of Overpass

# 1-Impact of Overpass

- Bus driver used an unapproved route for football stadium shuttle.
- Overpass was marked but driver drove the 11'-4" bus into the overpass.



# 1-Impact of Overpass

- One cylinder was scraped and gouged.
- One line on the cylinder was severed—internal solenoid valve stopped flow.



- No cylinders vented down.
- No ignition/fire or explosion occurred.
- Gas detection system sensed gas (line leak) and shut down the bus-isolating the gas cylinders.
- No personnel injury or third party property damage occurred.
- One cylinder was replaced. The bus roof was repaired and the bus was successfully placed back in service.



## **Incident 2**

# **Improper CNG Cylinder Installation**

# 2-Improper CNG Cylinder Installation



Cylinder improperly mounted on steel ring



No shielding of exposed cylinder under vehicle – this dome failed



- Poorly installed cylinder was damaged by road debris or from the mounting ring.
- Damaged cylinder failed during fueling cycle.
- Shrapnel from the failed cylinder caused a second cylinder to fail.
- One serious personnel injury – no deaths.
- Vehicle destroyed.

# 2-Improper CNG Cylinder Installation



Vertical cylinder landed 200 ft away



Dome of vertical cylinder found in truck



Dome of under mount cylinder failed

## **Incident 3**

# **CNG Cylinder Accident Damage**

# 3-CNG Cylinder Accident Damage

- Van was rear-ended on May 6, 2007 by Honda Civic which “submarined” under the rear of the van.



- Cylinder a Comdyne Type 3 (fully over-wrapped aluminum lined).
- Cylinder added aftermarket. Installation not code compliant—vulnerable location on vehicle and not shielded.
- Unclear what inspection after accident.
- Van body damage was repaired.
- It is believed that the cylinder was not inspected prior to final fueling incident.



- Comdyne Type 3 Cylinder ruptured during fueling, killing the driver who was fueling the vehicle.



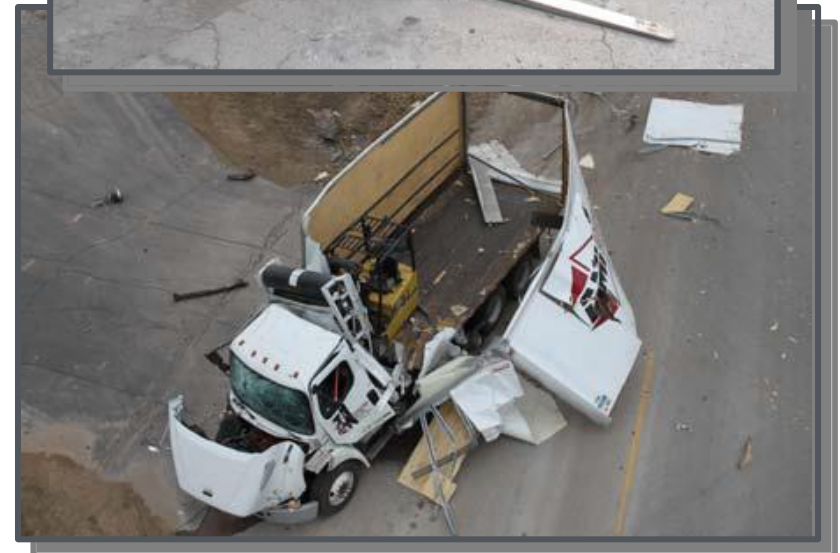
- Cylinder was within rated life and rated at 3600 psig but failed at 2650 psig.
- It is believed that the cylinder failure was due to Stress Corrosion Cracking related to the exposure of the cylinder to battery acid during the traffic accident. At least 3 incidents with Comdyne cylinders attributed to battery acid.
- The vehicle driver was killed during the fueling incident.

- Ensure cylinders are within rated life and rated  $\geq$  operating pressure of the vehicle.
- Train staff for regular cylinder inspections, or hire a qualified 3<sup>rd</sup> party inspector.
- Inspect cylinders according to required intervals (typically 3 years or 36,000 miles).
- Maintain cylinder inspection records.
- Vehicle inspection after incident—not all damage is apparent from inspection. Safely remove and dispose of cylinders if there is uncertainty of the integrity of the cylinder.

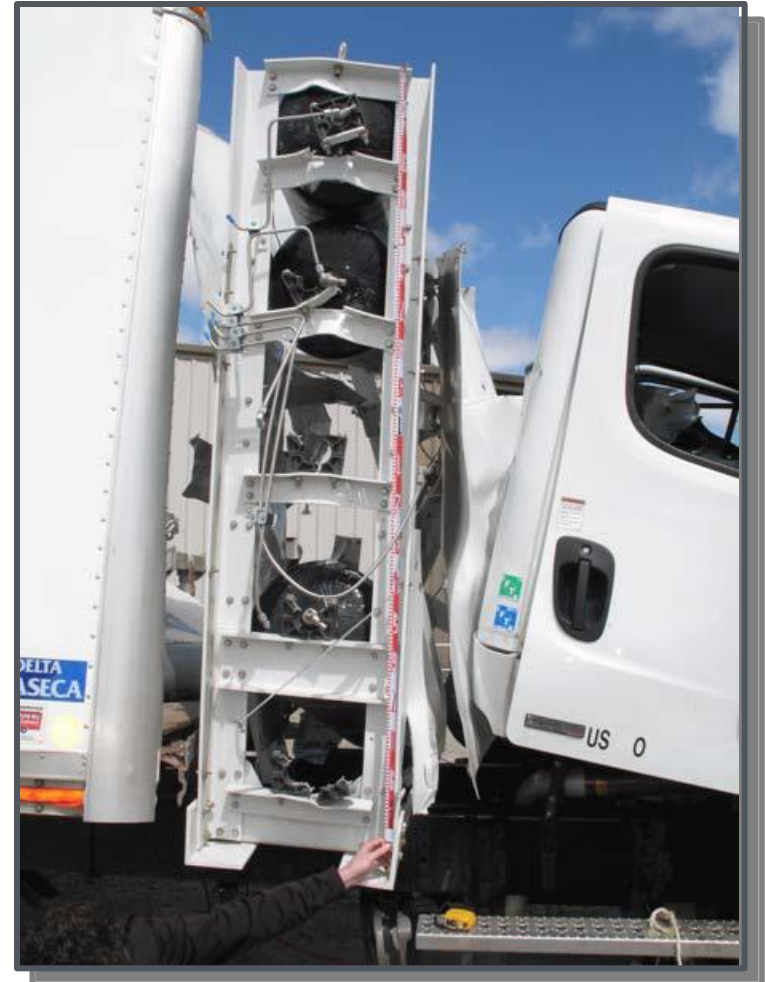
## **Incident 4**

# **CNG Cylinder Damage by Forklift**

- Yale Type E forklift loaded unsecured in cargo box Freightliner M2 112
- Driver and passenger both seatbelted.
- Driver was braking to initiate a right turn into a driveway



- Forklift shifted forward as a result of the deceleration
- One of vehicle's 5 CNG cylinders punctured by left forklift fork
- Cylinder failed catastrophically.



- The driver died at the scene.
- Passenger sustained incapacitating injuries and was hospitalized for one day.
- No fire or secondary damage.
- Vehicle was fueled the previous evening.



# **Incident 5**

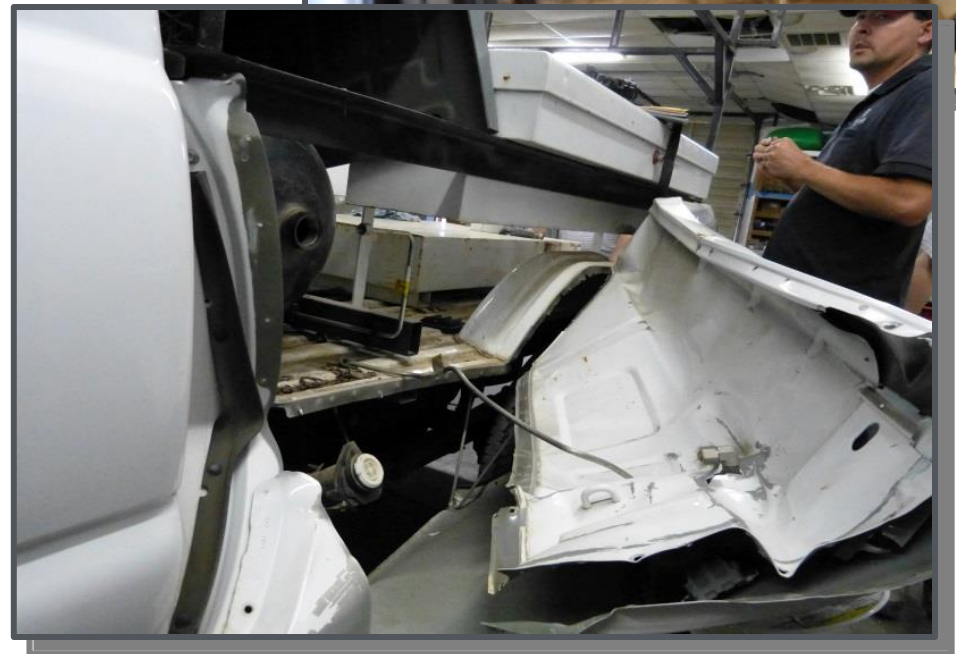
## **CNG Cylinder Valve Removal Incident**

- It is believed that internal solenoid valve failed closed.
- Cylinder valve was removed without using standard procedures prescribed by manufacturer.





- Manual override tool that allows for safe tank venting was not used to determine if cylinder was pressurized.
- Incomplete venting lead to valve being launched at the technician, who was fatally injured



- Driver and Technician error causing an incident or escalating one—training is required.
  - Vehicle accidents
  - Driving a vehicle with a brake dragging to the point of a fire starting
  - Unsafe maintenance practices
- Vehicle non fuel system design issues such as:
  - Electrical short circuits/fires
  - Hydraulic system leaks
  - Poorly shielded hot surfaces (manifolds and cat converters)
  - Turbocharger oil leaks
- Vehicle fuel system design deficiencies such as:
  - Lack of safe defueling provision
  - PRDs that do not sense fire quickly enough
  - PRDs not vented to the safest location
  - Poor cylinder/fuel system installation or inspection practice

- All fuels have inherent risks and all vehicle types are subject to fire and other hazards.
- Industry must research and learn from incidents—then improve codes, vehicle and component design and training.
- Many incidents would be avoided or minimized by more effective training for maintenance staff and vehicle operators.

# Thank You!

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