FIREFIGHTER NEAR MISS

Auto Fire with Compressed Natural Gas (CNG) Fuel Tank Explosion

Prepared By Operations Division

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Incident #26564, March 26, 2007

• Dispatch 0230 hours for car fire (Engine 10)
• E10 arrived and requested FIB for multiple vehicles with possible structural exposures (freeway columns and overpasses)
• 12 vehicles damaged or destroyed
• Firefighter near miss when CNG vehicle exploded as E10 crew approached with a handline (approximately 50-75’ away)
• Determined to be arson
Debris from the explosion was thrown up to 100' in all directions including on the overpasses above the incident.
Rear of vehicle
Roof is blown completely off vehicle and doors blown open.
Metal mounting straps for CNG tank
Tank initially landed here, about 100’ away then was moved down the hill for extinguishment.
Evidence indicates it may have ricocheted off the underside of a freeway overpass (next picture).
Rear bumper frame 90'+ away
Bumper shrapnel
(note burn marks on ground)
Roof section about 75’ away
This may be your only warning of a CNG – fueled vehicle. Typically located on the trunk lid or bumper.
Composite tank is carbon-fiber / fiberglass wrapped for strength – similar to our SCBA tanks.
Airport Taxis, Shuttles Convert to Natural Gas

New contract requires fleet conversions to improve air quality

The Port of Seattle Commission today authorized the renewal of contracts with two major providers of ground transportation at Seattle-Tacoma International Airport. The contracts, with the Seattle Tacoma International Taxi Association (STITA) and Shuttle Express, will require the two organizations to make major investments to convert their fleets to clean-burning natural gas.

Under its new contract, STITA will be required to convert its entire 160-cab fleet to natural gas in the next three years. By converting more quickly, STITA will earn the right to extend the contract from five to seven years.

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Historical Information

• Several NHTSA (National Highway Traffic Safety Administration) investigations
  – Example: January 27, 2003; Ford Crown Victoria on fire with flame impingement on CNG tank. The tank failed catastrophically prior to Pressure Relief Device (PRD) functioning.
  – Vehicle recall with dealers installing additional insulation behind back seat.
  – Number of vehicles still needing repair???
Code of Federal Regulations

- CFR 49, Part 571
  - Standard 304
    Compressed Natural Gas Fuel Container Integrity

*Flame Test Standard:*
*Flame impingement generating 1550-1650 °F. at the surface for the length of the cylinder for 20 minutes or until fuel is completely vented through PRV.*
CNG Properties

- Compressed to 3,600 psi in fuel cylinder
- CNG rated at 117 octane fuel
- BTU per # = 22,800 (gasoline = 18,900)
- *Not* a liquid when compressed (it becomes a very close dense gas)
- *Not* the same as Liquified Natural Gas – LNG (cryogenic: -260° to become liquified)
- Lighter than air when released ( .6 air)
CNG Properties

- LEL / UEL = 4 – 16% (gasoline = 1.3 – 7.6)
- 1 cubic foot of CNG = 245 cu.ft. of natural gas at sea level (uncompressed)
- 1 cubic foot of CNG weighs 13#
- 5.66# = 1 Gasoline Gallon Equivalent (GGE)
- Honda Civic tank = 8 GGE
- Note: 1 gallon of gasoline properly vaporized has the explosive equivalency of 83 pounds of dynamite (CDC).
Cylinder Properties

• Four Cylinder Types:
  – Type 1: all metal (steel or aluminum)
  – Type 2: hoop wrapped steel or aluminum
  – Type 3: fully wrapped steel or aluminum
  – Type 4: all-composite (non-metallic)*

*Early model Honda Civic uses Type 4; later models use Type 3
Note: The pressure relief device (PRD) activates similar to a fusible link – it fails versus resealing like a spring-assisted pressure reducing valve (PRV). The gas is vented out the vent tube until the tank is empty. Discharge time depends on fuel level.
Ongoing Investigation

The tank was wrapped and secured at the FD Commissary for subsequent investigation by engineers from the various component manufacturers.
Ongoing Investigation

• Stakeholders have demonstrated a serious commitment to determining the cause and developing corrective recommendations
  – Honda Motor Company sent four engineers from Japan and the U.S.
  – The tank manufacturer sent an engineer from their Nebraska facility
  – The valve manufacturer sent an engineer from their Ontario, Canada facility
Ongoing Investigation

After an initial site investigation, the tank was shipped to Honda Motor Company for scientific analysis. Results are pending.
Ongoing Investigation

• Additional inquiries have been received from:
  – U.S. Department of Transportation
  – National Highway Traffic Safety Administration
  – State of Washington Department of Transportation

• A “Firefighter Near Miss” has been posted on-line
Lessons Learned / Best Practices

- Approach from 45° angle to vehicle ends
- Be aware of CNG vehicles
  - Cabs, city vehicles, shuttles
- Look for CNG placards
- Watch for other hazards, i.e. bumper struts; hood and tailgate struts; airbags; burning fuel runoff; hazardous vehicle contents; exploding tires; other traffic
- Consider cooling streams from a distance
Best Practices – Honda Civic

The **Best Way** to Stop CNG Flow and Turn Off the Engine: **KEYS**

*Turn off the ignition switch, and remove the key.*

Turning off the ignition switch automatically shuts off the flow of CNG from the fuel tank. It also turns off power to the airbags and the seat belt tensioners within 3 minutes.
Best Practices – Honda Civic

The **Second-Best Way** to Stop CNG Flow and Turn Off the Engine: **ELECTRICAL**

*Remove the main fuse, and disconnect the battery negative cable.*

This method should be used if the ignition switch is in the ON (II) position, you cannot reach the key or the CNG manual shutoff valve, but you can reach under the hood.
Best Practices – Honda Civic

The **Second-Best Way**, continued:

Removing the main fuse shuts off the flow of CNG from the fuel tank and turns off the engine. Disconnecting the battery negative cable cuts power to the airbags and the seat belt tensioners within 3 minutes. It also prevents the engine from being restarted.
Best Practices – Honda Civic

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Best Practices – Honda Civic

Least-Desirable Way for Stopping CNG Flow and Turning Off the Engine: GAS

Turn off the CNG manual shutoff valve.

This method does not disable the airbags or the seat belt tensioners. It should be used only if the engine is running, you cannot reach the key, and you cannot reach under the hood.

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Civic CNG Shutoff Valve

CNG Manual Shutoff Valve
The Civic GX has a CNG manual shutoff valve to stop the flow of CNG from the fuel tank. The red handle of the valve is on the bottom of the car, near the left rear tire and the splash guard.
Civic GX (1998-2006)

- Fuse Box
- "NGV" ID on Rear Doors
- CNG Tank
- Blue "CNG" Label on Rear
- 12V Battery
- High-Pressure CNG Lines
- Cut Zone
- 2006 Manual Shut-off Valve*
- 1998-2005

*On driver's side. Turn one-quarter turn clockwise to shut off CNG.
SAFETY SUMMARY

- Determine vehicle type during size-up
- Use 45° approach angle
- Watch for additional hazards
- Consider cooling streams from a distance
- If CNG vehicle, remember best practices:
  - #1 – KEYS
  - #2 – ELECTRICAL
  - #3 – GAS
NOTICE:

For questions regarding the content of this presentation or the incident referenced herein, please contact:

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