The Maintenance of CNG Vehicles

What Is a Typical CNG Vehicle?

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CNG Vehicles
They Come In All Shapes and Sizes

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CNG is a Proven Technology

Sedans, Pick-ups, Vans/Wagons

Honda

All GMC brands

Ford/Mercury/Lincoln via SVMs

Work/Vocational Trucks

Peterbilt, Freightliner,

Crane Carrier, Condor,

Isuzu, GM, Workhorse, Ottawa…..

Dozens of up-fitters in the work sector

Bus and Shuttle

NABI, Orion, New Flyer, Creative Bus,

El Dorado-National, Champion, Supreme,

Blue Bird, Thomas Built, Optima and Specialty

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CNG Statistics

- ≈11 million NGVs in use worldwide; ≈110K operating on US roads
- Natural gas is compressed to enable the maximum onboard fuel storage
  - 5.660 pounds = 1 Gasoline Gallon Equivalent (GGE) (≈125 scf)
  - 6.360 pounds = 1 Diesel Gallon Equivalent (DGE) (≈ 140 scf)
- Octane rating of 117

How is a CNG Vehicle Different Than a Diesel to Maintain?

- Engine Maintenance
- Fuel System Maintenance
- Fuel Cylinder Maintenance and Inspection

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Engine Operation and Maintenance

- CNG engines operate in a similar way as a gasoline engine but at a higher temperature
- Spark plugs or another ignition source are required for fuel ignition
- CNG engines come in similar power and torque ranges as a gasoline or diesel engine
- CNG is cleaner, extending the oil change intervals out substantially
- Cummins ISLG oil and filter change intervals are 15,000mi/6mo or 500 runtime hours

ACUA CNG Scheduled PM Intervals

	Hours	Distance	Months
Oil and Filter	500	15,000 mi	6
Spin-on Fuel Filter	1,000	15,000 mi	12
Spark Plugs	1,500	22,500 mi	18
Engine Coolant	2,000	30,000 mi	24
Overhead Adjustment	2,000	30,000 mi	24

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Fuel System Components and Maintenance

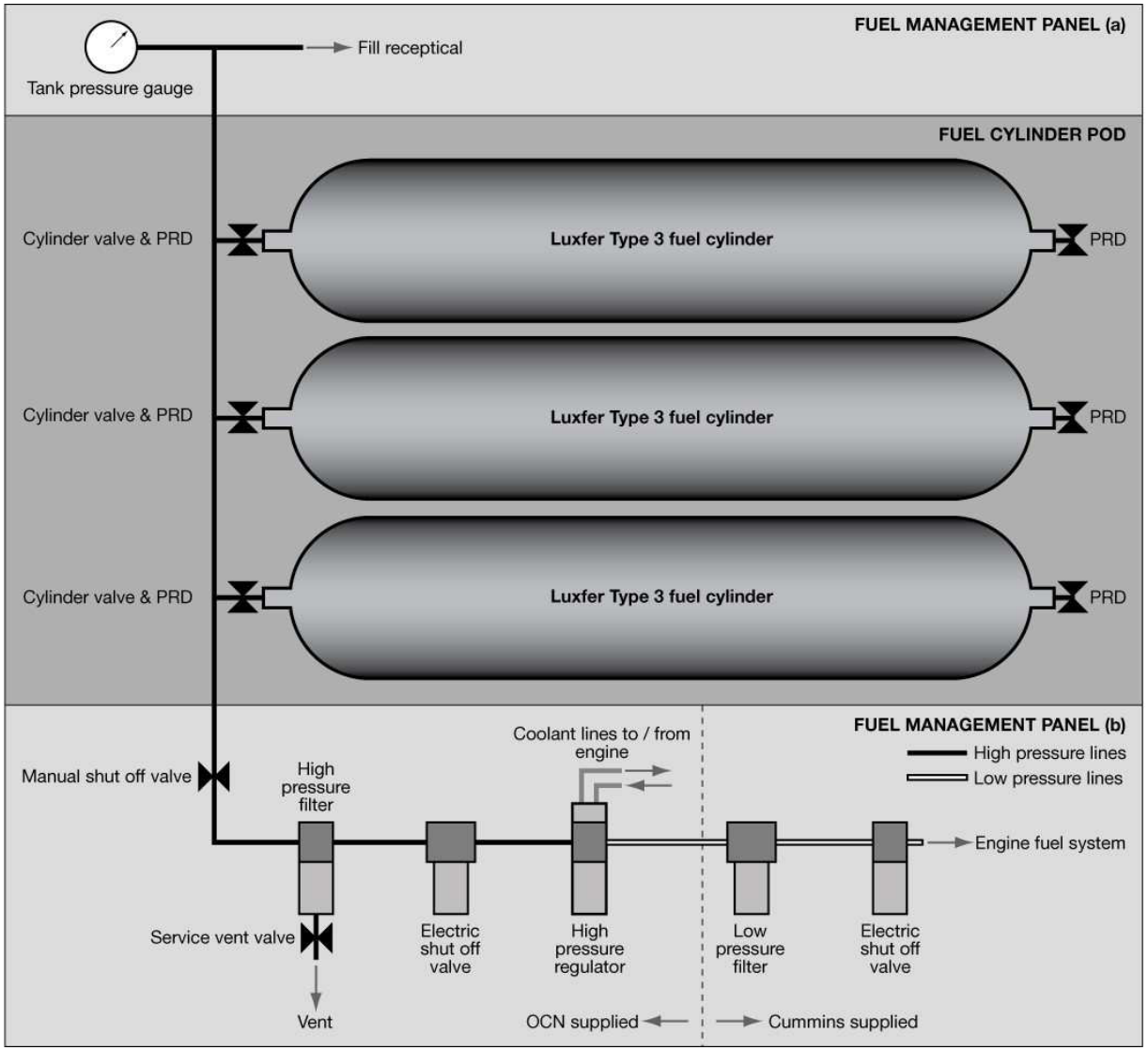
High Pressure 3600 psi max.

- Fill nozzle (O-ring)
- Tank pressure gauge
- Cylinder shutoff valve
- Pressure Relief Device
- Main shutoff valve
- High pressure filter (cartridge)
- Service vent
- Electric shutoff valve
- High pressure regulator

Low Pressure, Engine Supply Approximately 100 psi

- Low pressure filter (cartridge)
- Electric shutoff valve
- Engine supply tubing and lines

CNG Fuel System Details



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CNG Safety Devices

- As a gaseous fuel, **CNG is lighter than air** and will rise quickly with no pooling on the ground as with other vehicle fuels.
- Tank(s) are specifically designed to quickly vent through a Pressure Relief Device (PRD) if enveloped in fire without rupturing the tank.
- There is a manual shutoff valve which can isolate each tank. Note: The PRD is still actively protecting the tank when the shutoff is closed.
- Electro-solenoid valves will also isolate the tank(s) and fuel system piping when the vehicle is turned off.
- An Excess-flow Valve on each cylinder prevents gas leakage in the case of a rapid pressure change past the cylinder.

CNG Fuel Cylinder Types

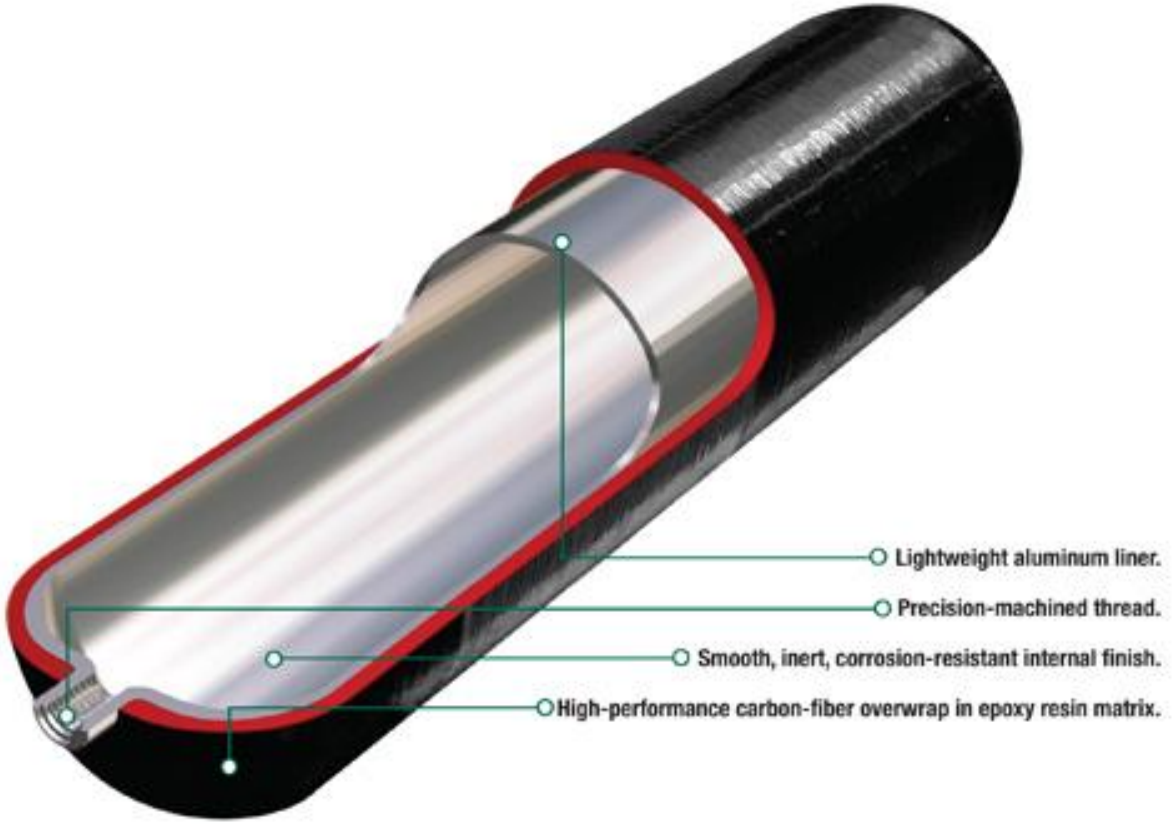
TABLE 1

A COMPARISON OF ONBOARD FUEL STORAGE CYLINDERS

TYPE	SIZE	CAPACITY	WEIGHT
Type 1 Example: All-Steel	74" x 15"	1,820 SCF	387 lbs.
Type 2 Example: Hoop-Wrapped Aluminum Composite	74" x 15"	1,820 SCF	290 lbs.
Type 3 Example: Fully-Wrapped Aluminum Composite	74" x 15"	1,820 SCF	141 lbs.
Type 4 Example: All-Composite	74" x 15"	1,820 SCF	141 lbs.

Onboard 3600 psi vehicle cylinders; 4 types of onboard cylinders; all meet the same national safety standards FMVSS 304 and ANSI NGV2.

Fuel Cylinder Design Type 3



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Fuel Types and Combustion Properties

Range of Flammability

Fuel	Lean Limit	Rich Limit	Flash Point	Auto Ignition Temperature
Diesel	0.60%	7.50%	145°F	420°F
Ethanol	3%	19%	55°F	690°F
Gasoline	1.40%	7.60%	<-40°F	475°F
Hydrogen	4%	75%	gas	930°F
Propane	2.2%	10%	gas	890°F
Natural Gas	5%	16%	gas	1070°F

CNG Tank Safety

- Vehicle tanks and fuel systems should be inspected at least every 3 years/36000 miles or when the vehicle is in a motor vehicle accident
- Inspectors should be accredited by CSA Standards with a CNG Fuel System Inspector Certification
- CSA is recognized by the Occupational Safety & Health Administration (OSHA)
- American National Standards Institute (ANSI) NGV2
- Find an inspector at: http://peoplesearch-csa-america.org

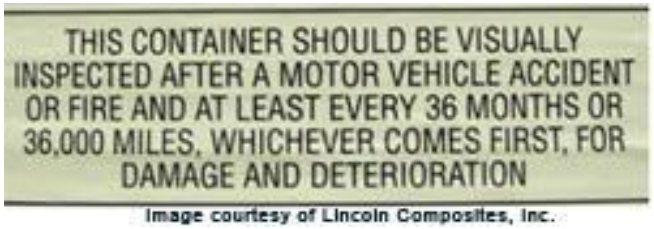


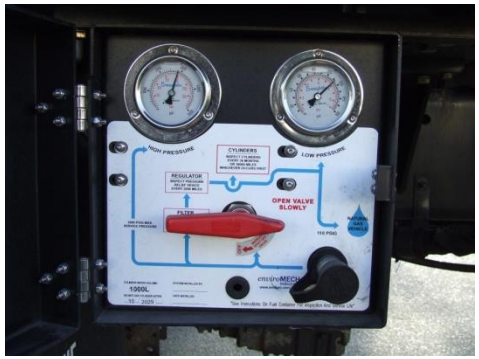
Image courtesy of Lincoln Composites, Inc.

Maintenance Center Precautions

- Released Natural Gas will pool in the ceiling of a service garage if not ventilated
- Exhaust fans and gas detection systems added
- Open flame heating sources eliminated
- Fleet technicians will need training on CNG
- Service safety procedures must be defined and followed by the fleet service technicians
- Gas leak detection service tools added

Staff Training Drivers

- Driver Training
  - Daily routines
  - Fueling procedures and safety
  - Use you ears and nose



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Staff Training Mechanics

- Mechanic Training
  - Factory train your mechanics on the fuel system that is installed on your vehicles
  - Require engine system training from manufacturer
  - Cylinder manufacturers may also offer training
  - Train on safe maintenance procedures associated with CNG: high pressure, venting methods and combustible safety
  - Encourage and incentivize ASE certifications and other alternative fuel education

Training and Standards Organizations

- National Alternative Fuels Training Consortium (NAFTC)
- Natural Gas Vehicle Institute (NGVI)
- Clean Vehicle Education Foundation (CVEF)
- National Automotive Technician Education Foundation (NATEF)
- National Institute for Automotive Service Excellence (ASE)

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CNG Fueling is Here at the ACUA

- ACUA built a CNG fueling station, partially funded by a DOE Clean Cities grant
- Station Dedicated in October 2010
- ACUA is committed to the full transition of its collection fleet to CNG
- Currently 5 CNG refuse trucks are operating, 10 more will arrive in the spring 2011
- First fleet accessible station in southern NJ, all fleets are welcome

Why CNG?

- **Burns Cleaner**

80% less ozone forming emissions than diesel/gasoline vehicles

- **Less Expensive**

Natural gas is between $0.50 and $ 1.00 cheaper than diesel per gallon equivalent

- **Produced Domestically**

CNG Cleaner, Cheaper and Better

QUESTIONS ?

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