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Liquefied Natural Gas




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Norm Seymour


- Member of the Massachusetts Fire Service since 1987
- Career firefighter with the Hopkinton Fire Department
 - Home of Peak Shaving LNG plant
 - Liquefaction/Regasification capabilities
 - 36 million gallon storage capacity
 - Opened in 1971
- Massachusetts Firefighting Academy Instructor since 1992
 - Instructor with Flammable Gas program since 1994
 - Coordinator – Flammable Gas Training Group since 2007
 - MFA Gas School has provided LNG training programs for over 30 years for Firefighters and Industry personnel from around the world
- Haz-Mat Technician with Massachusetts State Response Team since 1995

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Brief History


- **1912 - LNG was first used commercially to store natural gas in West Virginia**
- **1959 First ship transport**
- **1971 – 1980 Import terminals opened in MA, MD, GA & LA**

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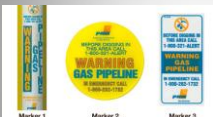
Brief History


- Approximately 100 LNG storage facilities in the U.S. (Peak Shaving)
- LNG now used in many commercial applications (paper mills, greenhouses, cleaners)
- Also being used as alternative fuel for trucking fleets and maritime operations

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Natural Gas UN 1971




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Natural Gas (NG)

- NG is Methane
- Methane is an odorless, colorless gas created by decomposition of organic materials
- Much of our NG supply is delivered from pipelines from the Gulf of Mexico and Canadian Maritime
- A smaller percentage is delivered as LNG via ships


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By product of landfills ,oil/gas wells and refineries

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Natural Gas Properties


- Non toxic, but is an asphyxiant
- Colorless
- Odorized with Mercaptan
- Flammable range 5% – 15%

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What is Vapor Density?


- The weight of an airborne concentration of a gas as compared to an equal volume of air.
- Why is that important?
 - Methane's vapor density is .50
 - This makes it lighter than air

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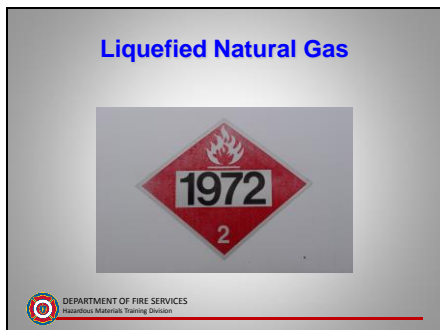
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Odorant

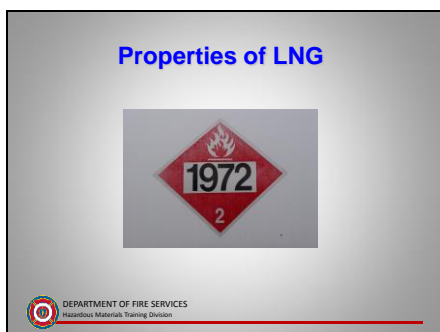
- Federal standards require the gas to be odorized to a concentration in air of 20% of the LEL
 - 20% of the LEL of NG is equivalent to 1% of gas in air

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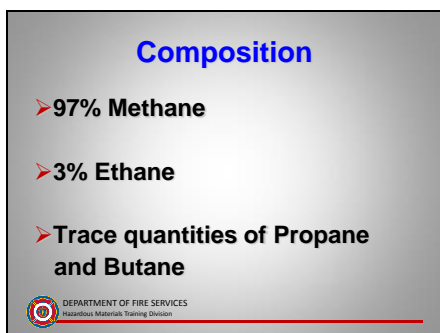
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Source

**Liquefied Natural Gas is produced by
cooling Natural Gas**




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Characteristics

- **Color –**
LNG is colorless
- **Odor –**
LNG is odorless




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Odor

- **An odorant is added to Natural Gas (Mercaptan)**
- **However no odorant is effective when added to LNG due to the very nature of the product**




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Toxicity

- LNG is non-toxic
- However it is an asphyxiant
- An asphyxiant will displace the oxygen that we need to survive




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Specific Gravity

- **0.421**
- Water is assigned a value of 1.0
- Any material with a specific gravity less than 1 will FLOAT on water
- Any material with a specific gravity greater than 1 will SINK in water




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Specific gravity refers to a materials density in comparison with water. Water is always given a value of 1. Anything with a specific gravity less than 1 will FLOAT on water, while anything with a specific gravity greater than 1 will SINK in water. Examples: Hydrocarbons will float and corrosives will sink.

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Weight

- LNG weighs **3.5** pounds per gallon
- Water weighs **8.3** pounds per gallon




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Solubility

➤ **LNG is NOT** soluble in water


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Vapor Density

➤ **.506**


- Air is assigned a value of 1
- Any gas less than 1 is lighter than air and will rise
- Any gas more than 1 is heavier than air and will collect in low spots such as ground level or basements, etc.

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Vapor Density


- **Heavier than air at -260° F**
- **Lighter than air at -170° F**

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Expansion Rate

- **600 to 1**
- Every cubic foot of liquid will create 600 cubic feet of vapor


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This is why Natural Gas is liquefied. For every truck load of liquid you would need 600 truckloads of vapor.

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Temperatures


- Storage Temperature
-260 degrees F
- Boiling Temperature
-260 degrees F

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LNG is a cryogenic.

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Fire Characteristics



- Flammable Range
5% to 15%
- Ignition Temperature
1,000 to 1,200 degrees F
- Flame Spread
300 to 400 feet per minute



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Burn back rate is the time it takes for the flame to spread from ignition source back to product. Compared to the flame spread of LPG at 900ft per minute, LNG is much slower, and more easily affected by weather conditions.

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Storage Pressures

- **Large capacity vertical tanks**
Typically **.5 to 1.0 psi**
- **Horizontal tanks**
Typically **20 to 270 psi**



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Relief valves for large capacity vertical tanks are usually set for $\frac{3}{4}$ of a pound. Large capacity vertical tanks hold millions of gallons of product. Horizontal tanks hold thousands of gallons.

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Small Vertical Tanks



Typically **60 to 70 PSI**

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Relief valves set for 175 PSI, much lower than propane tanks which operate between 250 and 375 psi.

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LNG in Storage




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Pressure in Transportation

- Normal over the road pressure in a transporter is **8 to 10 psi**


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BTU Comparisons

- LNG – 75,000 per gallon
- LPG (Propane) – 84,300 per gallon
- Gasoline (E10) – 111,800 per gallon


(** BTU's may vary due to impurities and fuel blends**)

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Specific Hazards

- **Flammable** – range **5 to 15%**
- **Explosive** – in confined spaces
- **Asphyxiant** – will replace oxygen
- **Cryogenic** – Frostbite, Tissue damage

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Extreme frostbite. Instant crystallization of living tissues.

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Extinguishment

- **Extinguishing Agent**
Dry Chemical
- **Extinguishing Method**
Stop the flow of gas

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After flow of gas is stopped, beware of puddles or areas of pooled LNG.

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Road Transportation



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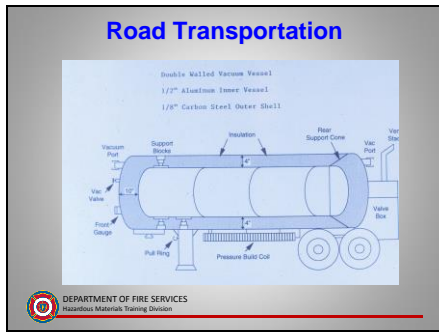
Road Transportation



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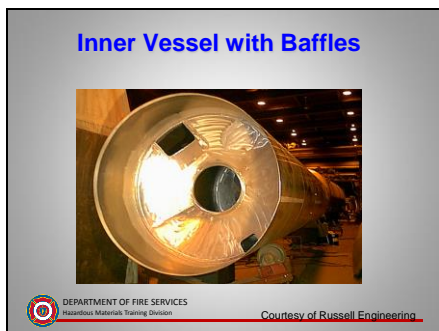
There are 3 distinct features of the LNG transporter. The size of the tank, the “bucket box” at the rear, and the pressure building coils under the belly of the tank. They are placarded 1972 and stenciled “Methane refrigerated liquid.” This means that they are “dedicated” transporters and will only carry LNG.

One of the few tanker trailers designed to rest on the landing gear while fully loaded.



Tank construction: Double shelled container. The outer shell is made of 1" carbon steel. The inner shell is made of 1/2" thick high-strength aluminum. There is an annular space between the two shells. This space contains an insulating medium, and is placed under a vacuum.

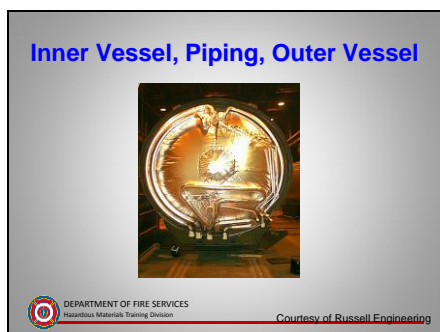
The insulating material is one of 3 types. Older trailers had an annular space filled with a white, fluffy material called perlite. Some of these trailers were retrofitted with what is known as fiberglass insulation. The newer transporters are now "super wrapped" during construction. During construction, the aluminum inner vessel is placed on a trundle and slowly turned. (Much like a composite SCBA cylinder) While it is turning it is wrapped with a foil backed paper insulation to a thickness of about 1/2". Again the annular space is placed under vacuum which makes the transporter act like a thermos bottle. These 3 types of insulation can be found on trailers at the present time. As a rule of thumb, Trans Gas trailers numbered 90 and above are "super wrapped" trailers.



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Portable vaporizers:

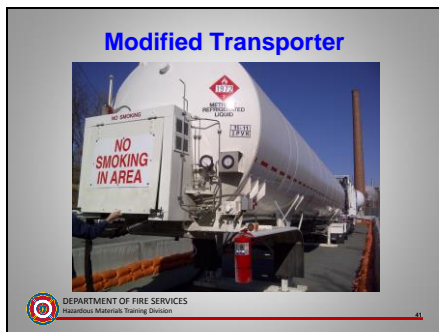
Portable vaporizers have become an integral part of LNG transport in this area. TransGas can now supplement gas supply to customers while plants are off line for maintenance etc.

These vaporizers would be used in connection with LNG transporters. They would be taken to a gate station where a connection to the main is located, and set up. The LNG would be off loaded from the transporter to the vaporizer where it is then converted back to Natural gas. The gas is then odorized prior to being injected into the gas main.



The northeast is now beginning to see the use of LNG as an alternative to Propane. LNG storage tanks are connected to portable/fixed vaporizers and odorant stations. This system in NH is being used to replace a 30,000 gallon LP tank. (Shown back left at base of smokestack)

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Storage tank has integrated UV, IR and CGI sensors with automatic shut-offs and alarms.

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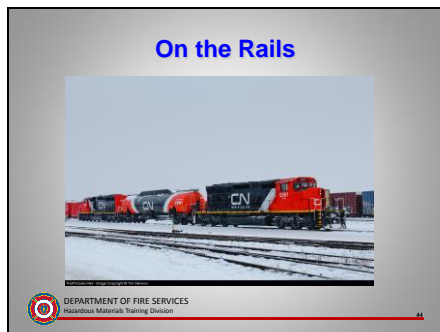
Dual vaporizers alternate on a 12 hour cycle due to icing. Methane vapors are odorized with Mercaptan and the gas is heated to 40 degrees Fahrenheit before entering the facility.

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A Large Gypsum producer in central Vermont is currently in the process of installing eight 15,000 gallon fixed LNG storage tanks to replace their use of #2 Fuel oil.

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Canadian National Railroad's LNG
Locomotive set currently being tested.

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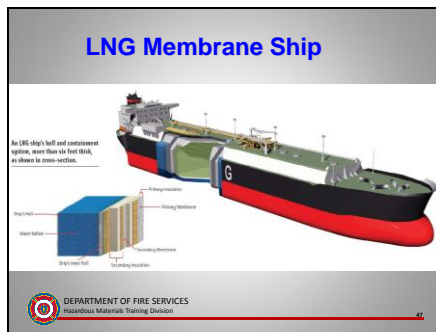


Canadian National Railroad's LNG
Locomotive set currently being tested.

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“Boeing’s SUGAR Freeze plane concept runs on cryogenically frozen liquid natural gas” Currently in development in conjunction with NASA

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There are already several large fleets that have converted to LNG. It is now starting to work its way into the Northeast. As the support infrastructure increases, the use by both commercial and private drivers will increase as well.

