

Presented by:



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DISCLAIMER!!!!



Opinions Expressed By These Presenters
DO NOT Reflect Those of
The State Fire Marshal
The Department of Administrative Services
The Governor nor
The State of Connecticut

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OBJECTIVES



- Understand the basic physical properties of Propane and Natural Gas
- Describe the expansion ratio of LP-Gas liquid to Vapor
- Describe the 2 types of LP-Gas storage containers/cylinders
- Describe Key Components for gas piping

Propane & Natural Gas House Explosions



Why we are here!



- Case in North Canaan Connecticut
 - No Permit was taken/no inspection made by LBO or LFM
 - Work being done on a 30,000 gallon aboveground LP-Gas Container.

Why we are here!



- Case in North Canaan Connecticut
 - Piping was left unsupported incorrectly for a month.

Why we are here!



- Case in North Canaan Connecticut
 - Leak occurred on a liquid pipe.

Why we are here!



- Case in North Canaan Connecticut
 - Town evacuations occurred.

Evacuations Ordered



- 500 Residences and Businesses



Why Training Was Ordered



- Charges were filed against the contractor.
- As a result of the courts finding
- Part of the settlement was a fine to be paid for training.

Training



- Connecticut Department of Administrative Services
- Division of Construction Services in Conjunction With The Connecticut Department of Consumer Protection.

Lets Look at Case Studies & Understand Why Evacuations



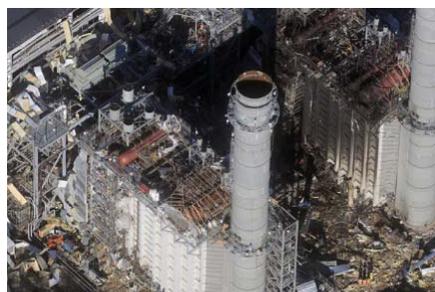
- Ghent West Virginia
Country Store
- Kleen Energy and ConAgra
Purging of Piping
- Iowa
Turkey Farm
- Local Cases

Propane Explosion in Ghent



Disc 2, #10

Gas Explosions at ConAgra & Kleen Energy



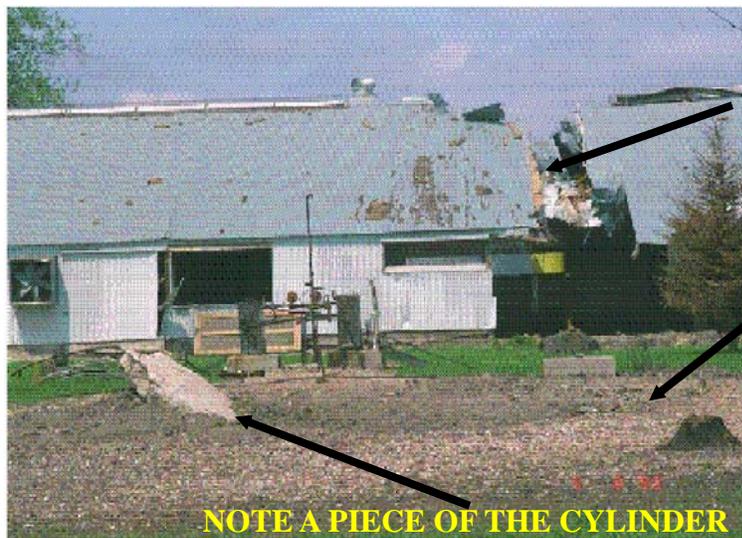
CSB disc #2 video #2

IOWA INCIDENT Turkey Farm



- TURKEY FARMER HAD ATV'S ON PROPERTY
- YOUTHS STOLE ATV'S AND STARTED DRIVING THE ATV'S NEAR THE COOPS
- 18,000 gallon w.c. LP-Gas cylinder used to heat the coop's brood, LP-Gas liquid was the fuel
- 1 ATV struck the liquid pipe line feeding the barn
- 1st due heard loud noise like jet engine

Gas go boom !!! Propane Explosion Results in death of 2 Volunteer Fire Fighters, Hospitalization of 6 other FF's and Deputy Chief in Iowa



Some of it went here

IT Was here

Case Study Shelton, CT

- Open-end gas pipe explosion



Case Study, Lightning Strike Madison, CT



CSST Corrugated Stainless Steel Tubing



History/Features



- Recognized By National Fuel Gas Code Since 1988
- An economically favorable alternative to steel
- Available in four nominal sizes,
 - 3/8", 1/2", 3/4" and 1"

History/Features



- Capable of installation in a continuous run reduces number of joints and number of potential leak sites
- Flexibility of CSST permits it to “bend but not break”
- Eliminates repetitive measuring, cutting, threading and joint assembly

Lightning is the enemy



NFPA SOURCE



- 141 CSST Incidents where lightning strikes occurred from 1983-2008

The Good and Bad



- In 2007, an Arkansas court approved a \$29 million [settlement agreement](#) following a class action lawsuit against CSST manufacturers.
- The lawsuit alleged flexible gas line poses an unreasonable risk of fire due to lightning strikes because CSST tubing is not thick enough, and manufacturers failed to warn consumers about the danger.
- **If you have not filed a claim yet, claims may be filed until September 5, 2007.**

MARKETING CHANGES Each Settling Defendant:



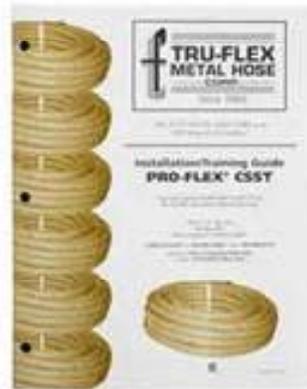
will include in its installation guidelines or technical documents with

- reference to the risk posed by lightning to CSST systems.
- requirement that its CSST product must be installed in accordance with the installation instructions and applicable codes and regulations.
- requirement that a CSST gas-piping system must be electrically continuous and bonded to a grounding electrode, consistent with NFPA 70.
- statement that the owner of the structure should consider whether a lightning protection system is necessary or appropriate, along with a reference to NFPA 780.

Home Depot



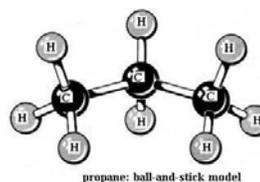
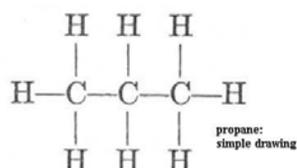
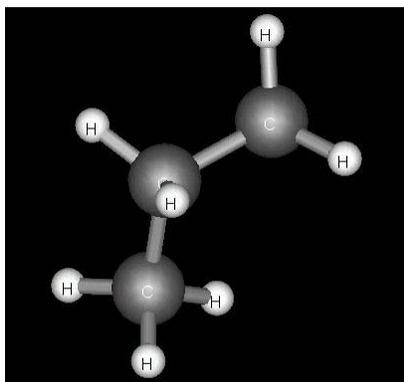
LOWES'



Case Study Church In Canton CT.



Understanding LP-Gas Properties

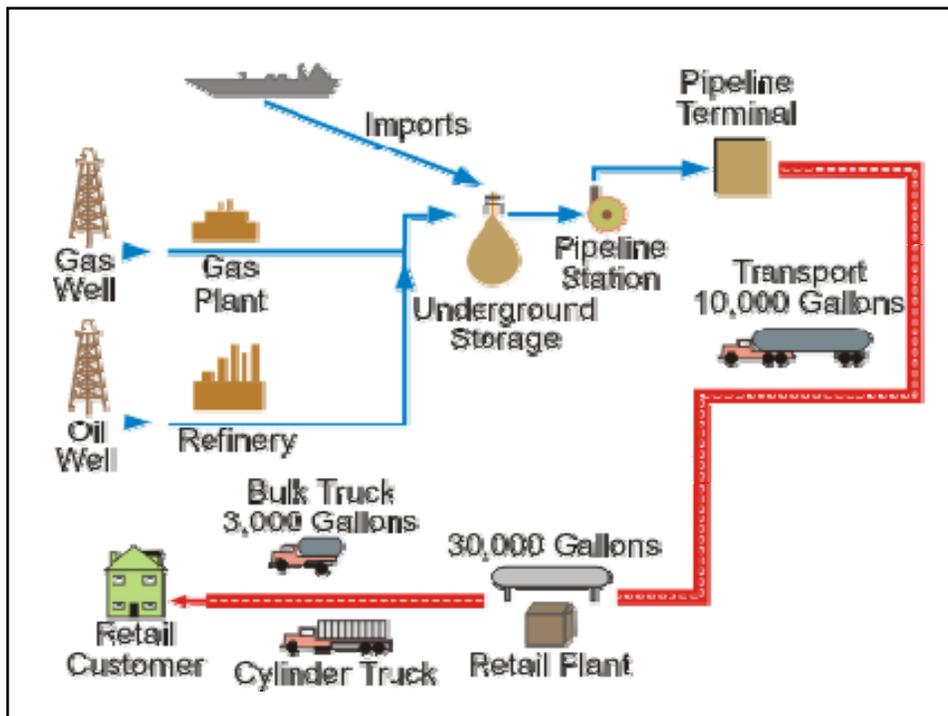
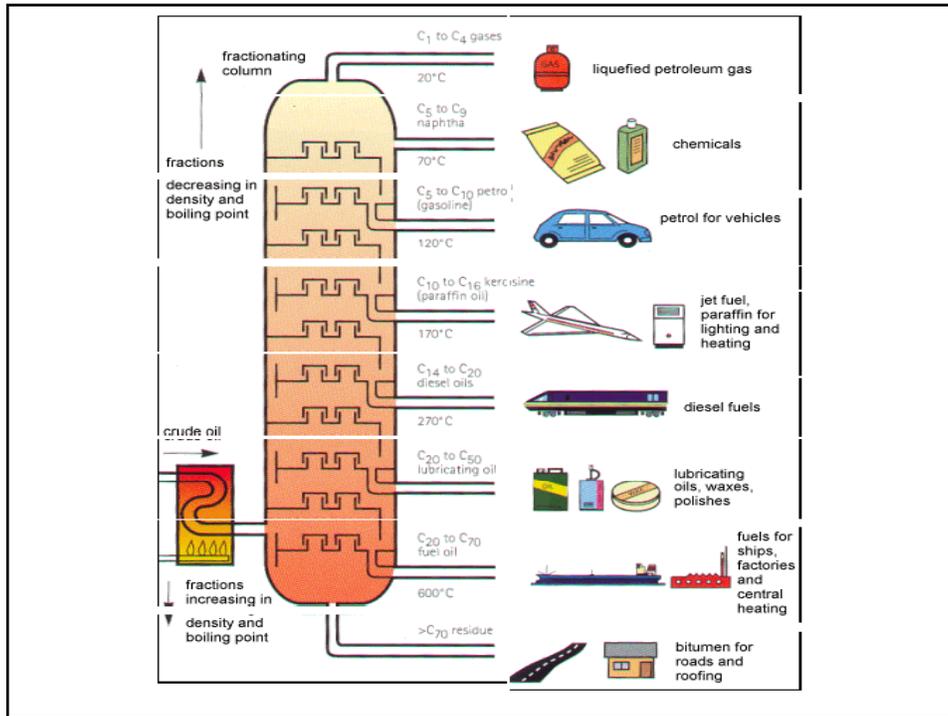


WHERE DOES LP-GAS Come From



- SOURCES ARE NATURAL GAS AND CRUDE OIL
- In a refinery or natural gas processing plant, LP-Gases are removed from the base of gas and crude oil and liquefied.





Properties of Commercial Propane



- LP-Gas Liquefies Under Moderate Pressure
- LP-Gas Is Non-Toxic & A Simple Asphyxiant
- Propane Vapor is Heavier Than Air
Specific Gravity of Vapor (air = 1) at 60°F
Propane = 1.50

Properties of Commercial Propane

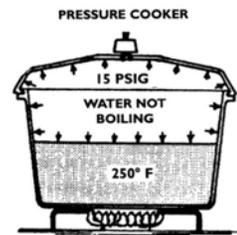
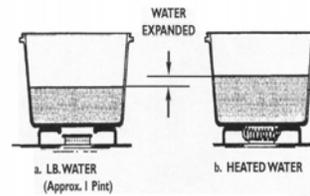


- Propane Liquid is Lighter Than Water
Specific Gravity of Vapor (water = 1) at 60°F
Propane = 0.509
- Propane will ignite @ 920°F
- Temperature of flame can reach 3,595 °F

Properties of Commercial Propane



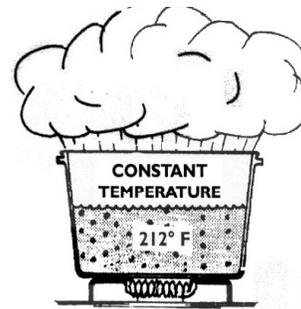
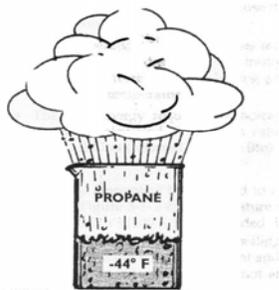
- The Pressure in a container increases with temperature
- 70 °F 127 psig
- 130 °F 287psig



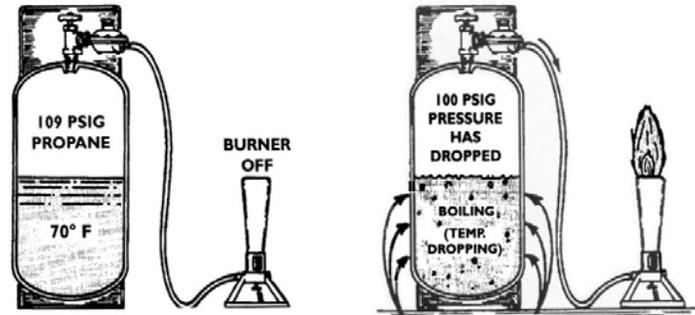
Properties of Commercial Propane



- Propane boils at -44°F
- WATER BOILS AND GIVES OFF VAPOR



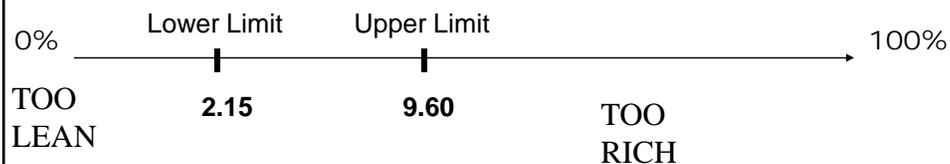
Properties of Commercial Propane



Flammable Limits



- ❖ The Upper Limit Is the Percentage of Gas in the Richest (Most Gas) Mixture That Will Support Combustion.
- ❖ The Lower Limit Is the Percentage of Gas in the Leanest (Least Gas) Mixture That Will Support Combustion.



Properties of Commercial Propane



- @60°F-1 gallon Propane weighs 4.2. Lbs.
- 20-lb cylinder weighs about 17.5 lbs.
- Holds about 5 gallons of liquid.

Properties of Commercial Propane



- **1 GALLON OF LIQUID EXPANDS TO 270 TIMES IN VAPOR STATE**
- 1 GALLON OF LIQUID PRODUCES 36.38 Cu Ft of Vapor

Properties of Commercial Propane



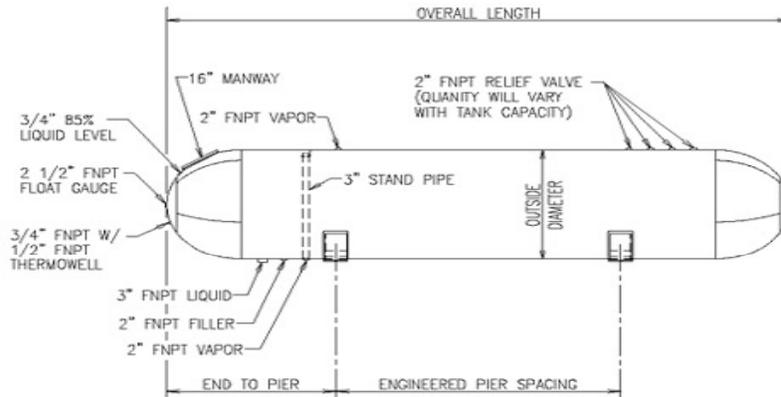
- Can't smell Propane in it's natural chemical state.
- Odorant is added by % (rotten egg smell).
- Ethyl Mercaptain is the chemical used to aid in detection of LP-Gas.
- Not all persons senses can detect the odorant.
- Colchester Oder Fade incident.

LP-GAS 101



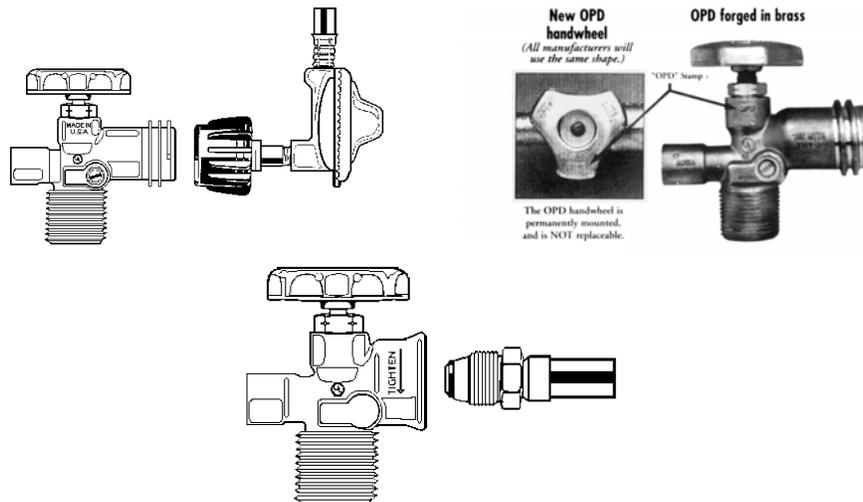


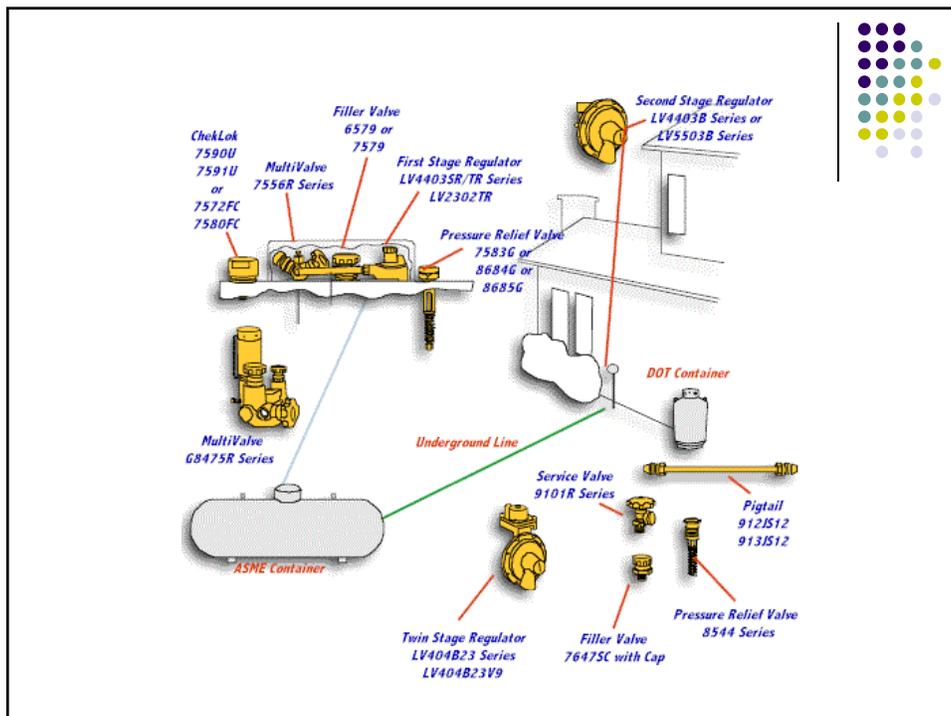
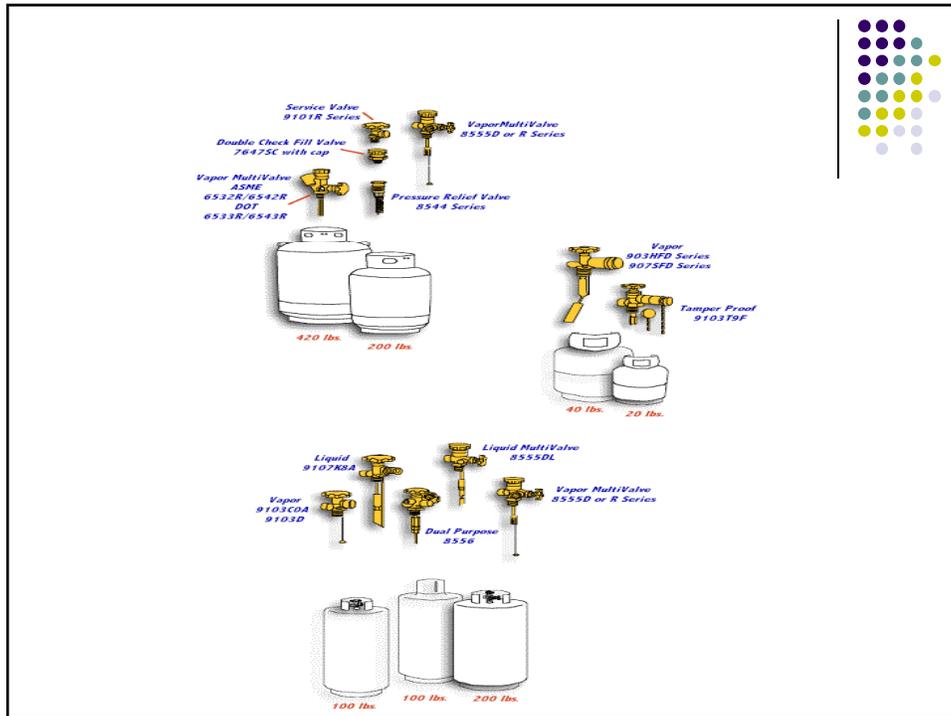
TANK DESIGN ASME



STORAGE VESSEL DIAGRAM

VALVES





Fittings Accessories



Where Does Natural Gas Come From?



- Most (88 percent) of the natural gas consumed in the United States is produced in the U.S. Canada provides much of the rest (10.5 percent), with 1.5 percent imported as liquefied natural gas (LNG).
- Production from the lower-48 states remains the largest component of U.S. natural gas supply.
- In Alaska, huge quantities of natural gas found in the North Slope region are only the tip of the iceberg in terms of the state's total natural gas resources, but these supplies will remain stranded there until an Alaskan natural gas pipeline is built.

How Is It Distributed



Nationwide Delivery System

- Natural gas is delivered to customers through a safe, sound, 2.4-million mile underground pipeline system that includes:
 - 2.1 million miles of local utility distribution pipes; and
 - 300,000 miles of transmission lines.

Properties of Natural Gas



- **Natural gas is nontoxic**
Natural gas contains no toxic poisonous ingredients that can be absorbed into the blood when inhaled.
- **Natural gas is lighter than air**
If natural gas escapes into the atmosphere, it dissipates rapidly. A heavier-than-air gas, such as propane or gasoline fumes, would settle and accumulate near the ground.

Properties of Natural Gas



Natural gas is colorless

When mixed with the proper amount of air and ignited, invisible natural gas burns with a clean, blue flame. It is one of the cleanest burning fuels, producing primarily heat, carbon dioxide and water vapor.



Properties of Natural Gas



- **Natural gas is odorless**

When taken from the ground, natural gas is odorless. Local utilities add a non-toxic chemical odorant called mercaptain to supplies to make leaks easy to smell.

- However, there may be times when the smell of the odorant is weak or not present, even though there is a leak.
- If you suspect a leak for any reason, get to a safe place immediately and call the emergency number or 911.

Properties of Natural Gas



- **Natural gas's narrow combustion limits**
This helps ensure predictable, safe use. Natural gas will only ignite when there is an air-and-gas mixture of between 5 and 15 percent natural gas.
- Any mixture containing less than 5 percent or greater than 15 percent natural gas will not ignite.
- Too Lean or Too Rich

Code Stuff SECTION 105 PERMITS



105.1 Required. Any owner or authorized agent who intends to construct, enlarge, alter, repair, move, demolish, or change the occupancy of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any electrical, **gas**, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the building official and obtain the required permit.

Adopted Standards in Part



- 101.4.2 Fuel Gas. In part gas equipment and piping shall comply with CGS, 29-329 which adopts NFPA 54/1996, and CGS 29-331 which adopts NFPA 58/1995.
- 101.4.3 Mechanical., IMC
- 101.4.4 Plumbing., 2003 IPC

Connecticut Liquefied Petroleum Gas Code



Connecticut General Statutes



- **29-330. Definitions**
- **29-331. Regulations concerning liquefied petroleum gas and liquefied natural gas.**
- **29-331. Inspections; report of leak or discharge.**
- **29-333. Variation or exemptions.**
- **29-334. Appeal.**
- **29-335. Penalty.**
- **29-335a. Transportation and handling of propane gas. Definitions. (Repealed)**

Replaced by 96-6

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DCS Regulations



- **29-331-1.** The Connecticut Liquefied Petroleum and Liquefied Natural Gas Code: Purpose and Applicability.
- **29-331-2.** Authority Having Jurisdiction.
- **29-331-3.** Security at Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LP-Gas) Facilities.
- **29-331-4.** Adopted Standard.
- **29-331-5.** Connecticut Supplement to NFPA 58 / 1995.

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The Connecticut Liquefied Petroleum Gas and Liquefied Natural Gas Code



Consists of NFPA 58 / 1995

**Liquefied Petroleum Gas Code
And CT Supplements**

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LP-Gas Code



- | | |
|--|--|
| Chapter 1: General Provisions | Chapter 6: Vehicular Transportation |
| Chapter 2: LP-Gas Equipment
& Piping | Chapter 7: Buildings & Structures |
| Chapter 3: Installation of LP-
Gas Systems | Chapter 8: Engine Fuel Systems |
| Chapter 4: LP-Gas Liquid
Transfer | Chapter 9: Refrigerated Storage |
| Chapter 5: Storage of
Containers | Chapter 10: Marine Shipping |
| | Chapter 11: Publications |
| | Appendices A through J. |

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Chapter 1: General Provisions



(1-1.2) Application:

(1-1.3) Nonapplication:

(1-1.5) Retroactivity:

(1-2) Acceptance of Equipment & Systems

- Systems or components assembled to make up systems shall be approved.
- Acceptance applies to a complete system, or to individual components of which it is comprised.

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Chapter 1: General Provisions



(1-4) Notification of Installations.

- Stationary:
- Temporary (< 6 months):

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Qualification of Personnel



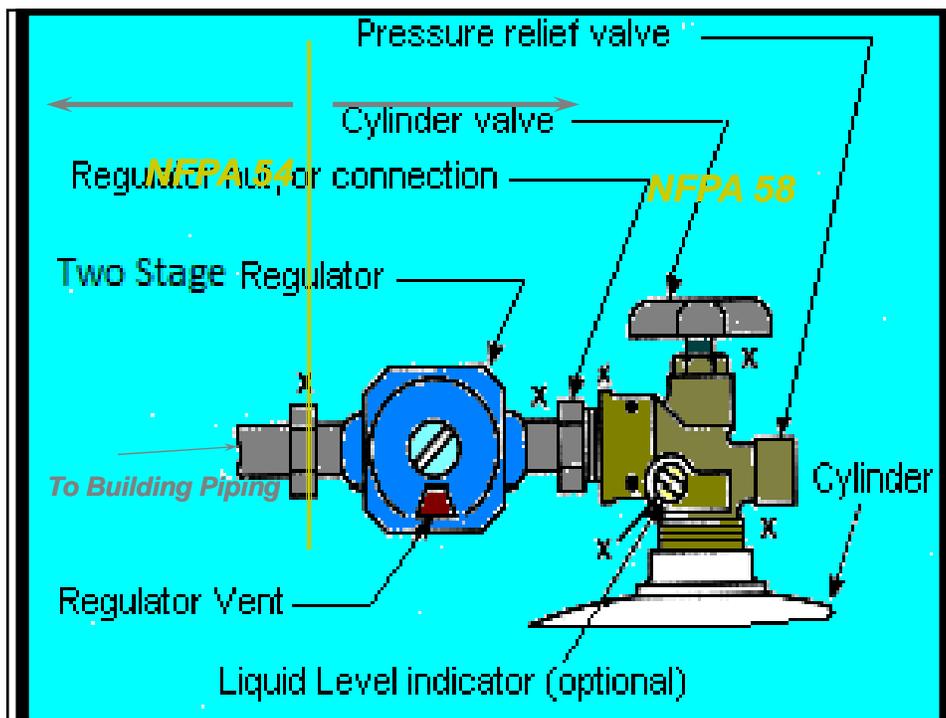
CT Supplement 1-5:

Persons shall be trained by the employer to:

1. *The physical hazards of the LP-Gases;*
2. *System and equipment operation*
3. *Maintenance requirements;*
4. *Emergency procedures, which the employer shall document.*
5. *Retraining shall be required at least once every two years.*



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Chapter 2: LP-Gas Equipment & Appliances.



(2-1) Scope:

- Covers all individual components, containers and container assemblies, or complete container systems.

2-2 Containers

2-3 Container Appurtenances

2-4 Piping (Incl. Hose), Fittings & Valves

2-5 Equipment

2-6 Appliances

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Chapter 2: LP-Gas Equipment & Appliances.



- **(2-2.1) Containers:** section includes
 - design,
 - fabrication, and
 - marking for containers,
 - container openings,
 - apertures requiring these openings to be gastight,
 - physical damage protecting devices, container supports.

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Chapter 2: LP-Gas Equipment & Appliances.



2-2.1.3 Containers shall be designed, fabricated, tested and marked in accordance with (See also Appendices C & D).

- ASME
 - No Retest or Requalification Required.
- DOT Requalification
 - 5 year visual (most common)
 - 12 full hydro (rare for Propane cylinders)

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Chapter 2: LP-Gas Equipment & Appliances.



- (2-2.1.4) Containers shall be permitted to be reused, reinstalled, or continued in use as follows:
 - Shall not be filled if unsuitable for continued use.
 - DOT cylinders must be qualified.
 - Containers involved in fire must be requalified and/or tested.
- (2-2.1.6) Containers showing serious denting, bulging, purging, or excessive corrosion shall be removed from service.

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Chapter 2: LP-Gas Equipment & Appliances.



Type of Test	Requalification Period	Letter Indicator	Example
Full Hydrostatic Test	12 Years	None	"8-91"
Simple Hydrostatic Test	7 Years	"S"	"8-91S"
Visual Examination	5 Years	"E"	"8-91E"

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Chapter 2: LP-Gas Equipment & Appliances.



- **Container Openings:**
 - (2-2.3.1) suitable for service in which they are used.
 - (2-2.3.2) Containers.>30 and < 2,000 gal w/c filled volumetrically must be equipped for filling into the vapor space.
 - (2-2.3.3) 125 through 2,000 gal w/c be provided with an opening for an actuated liquid withdrawal excess-flow valve.

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Chapter 2: LP-Gas Equipment & Appliances.



- (2-2.3.4) Containers >2,000 gal w/c need an opening for a pressure gauge.
- (2-2.3.5) pressure relief valves - installed as to have direct communication with the vapor space.
- (2-2.3.6) Containers filled volumetrically - equipped with a fixed level gauge capable of indicating maximum permitted filling level.

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Chapter 2: LP-Gas Equipment & Appliances.



- Container Marking and Recordkeeping.
- (2-2.6.1) Containers have to be marked in accordance with code for which they were fabricated
- (2-2.6.2) Portable DOT containers designed to be filled by weight, including those optionally filled by volume shall be marked with water capacity in LB and tare weight in LB.

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2-2.6.3 ASME containers shall be marked:



- Stainless steel attached nameplate.
- Service for which it is designed (UG, AG).
- Name & address of container supplier or trade name.
- Water capacity in LB or US gallons.
- Design pressure in psi.
- Working vapor pressure at 100°F.
- Tare weight.
- Outside surface area.
- Year of manufacture.
- Shell thickness head thickness
- OL___ OD___ HD___
- Manufacturer's serial number.
- ASME code symbol.

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Chapter 2: LP-Gas Equipment & Appliances.



- (2-2.6.4) Warning labels:
- (2-2.6.5) ASME containers containing non-odorized LP-Gas products shall be marked "NOT ODORIZED".

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Chapter 2: LP-Gas Equipment & Appliances.



- Container appurtenances.
 - Be fabricated of materials suitable for LP-Gas service (2-3.1.2)
 - Have a rated working pressure of at least 250 psi.(2-3.1.3)
 - Gaskets used to retain LP-Gas in containers shall be resistant to the action of LP-Gas. (2-3.1.4)

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CT Supplement 2-3.1.5



Container appurtenances,shall be maintained in operating condition at all times to provide the service for which they were designed and installed.

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Chapter 2: LP-Gas Equipment & Appliances



Pressure Relief Devices.(2-3.2)

- Containers must have Pressure Relief Devices, designed to relieve vapor.
- DOT Cylinders have Pressure Relief Valves or Fuse Plugs per DOT.
- Small DOT Containers: Pressure Relief Device to Prevent “Rocketing” in a fire.
- ASME Containers: Spring-Loaded Pressure Relief Valves (UL 132)

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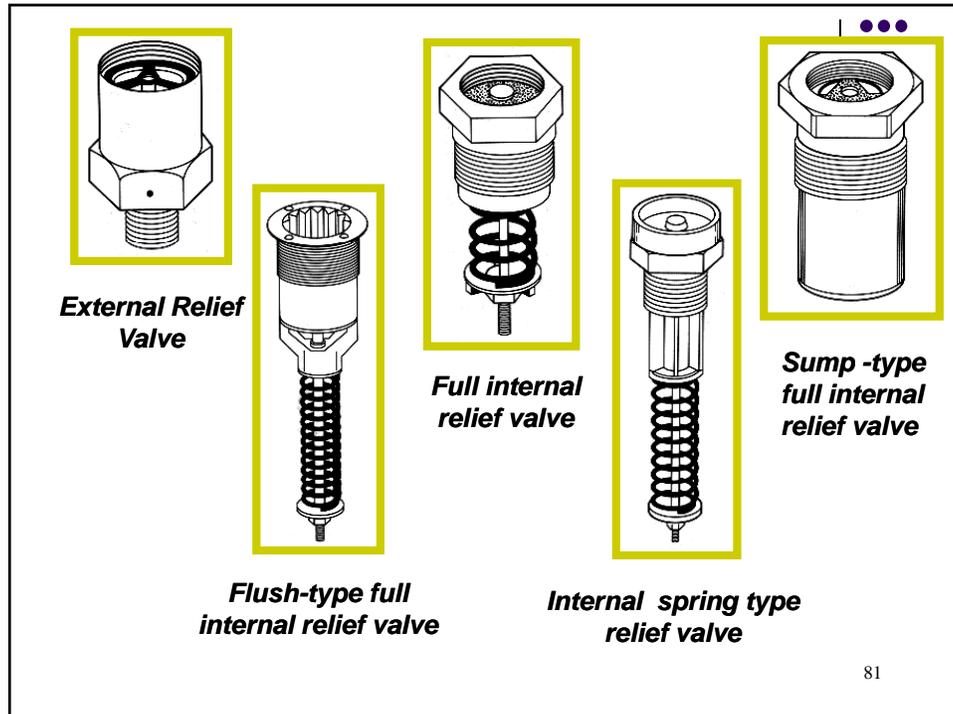
2-3.3.2 Containers over 2,000 gal (7.6 m3) water capacity.



Other Required Appurtenances:

- Internal Spring-Type, Flush-Type Full Internal, or External Pressure Relief Valve.
- Fixed Liquid Level Gauge.
- Float Gauge, Rotary Gauge, or Slip Tube Gauge, or a Combination of These Gauges.
- Pressure Gauge, and Temperature Gauge.

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Chapter 2: LP-Gas Equipment & Appliances.



- Piping (Including Hose), Fittings, & Valves.(2-4)
 - basic design provisions and material specs for piping, tubing, / fittings, valves, hose,/connections, and flexible connections used to connect container appurtenances with the balance of LP-Gas systems.

2-4 Piping (Including Hose), Fittings, and Valves.



- Pipe and Tubing Materials Listed in 58, or be Investigated & Tested to be Safe &, Recommended by the Manufacturer, & Acceptable to the AHJ.
- Liquid Piping that can be Isolated by Valves Must have a Hydrostatic Relief Valve @ 350 PSI Design Pressure.
- Valves Must be Steel, Iron or Brass.
- Valve Design Pressure: 250 PSI min, 350 if Used Above Container Pressure.

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2-4.2 Pipe



- Wrought Iron or Steel (black or galvanized), Brass, Copper, or Polyethylene OK
 - Wrought-iron pipe; ANSI B36.10M
 - Steel pipe; ASTM A 53
 - Steel pipe; ASTM A 106
 - Brass pipe; ASTM B 43
 - Copper pipe; ASTM B 42
 - Polyethylene pipe; ASTM D 2513
 - Other materials OK if Recommended by Manufacturer and Acceptable to the AHJ

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2-4.3 Tubing



- Steel, Brass, Copper, or Polyethylene OK
 - Steel Tubing; ASTM A 539
 - Brass Tubing ASTM B 135
 - Copper Tubing
 - Type K or L, ASTM B 88
 - Air Conditioning and Refrigeration Tubing, ASTM B 280
 - Polyethylene Tubing; ASTM D 2513
 - Other Materials OK if Recommended by Manufacturer and Acceptable to the AHJ

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2-4.4 Fittings for Pipe and Tubing



- Steel, Brass, Copper, Malleable Iron, Ductile (Nodular) Iron, or Plastic OK.
- Cast- Iron Pipe Fittings **Can not** be Used.
- Polyethylene Fittings Must Comply With ASTM D 2513, and be Recommended For Lp-Gas Use by the Manufacturer.
- Anodeless Risers OK for Polyethylene.

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Chapter 2: LP-Gas Equipment & Appliances.



- Emergency shutoff valves shall be approved and incorporate all of the following means of closing(2-4.5.4)
 - Automatic shutoff through thermal activation. Fusible elements melting point not to exceed 250°F.
 - Manual shutoff from remote location.
 - Manual shutoff at the installed location.

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(2-4.6) Hose, Quick Connectors, Hose Connections, and Flexible Connectors.



- Hose and quick connectors shall be approved(2-4.6.2) .
- Hose, hose connections used for conveying LP-Gas liquid or vapor at pressures in excess of 5 psi shall comply with the following:(2-4.6.3)
- Hose designed with working pressure of **350 psi** , 5 to 1 safety factor, continuously marked “LP-Gas,” “Propane,” “350PSI Working Pressure” and manufacturer’s name or trademark.
- Hose assemblies, after connections application , shall have design capacity of not less than 700 psi.

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2-6 Appliances.



- Approved appliances.(2-6.1)
- Provisions For Appliances.(2-6.2.1)

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3-2 General Provisions



- LP-Gas Containers are Usually Located Outside of Buildings Except for Portable Containers with Specific Limitations.
- Portable Containers Being Filled in Buildings Designed for Filling Containers on LP-Gas Vehicles.
- Containers Used with Stationary or Portable Engine Fuel Systems.
- Containers Used with LP-Gas Fueled Industrial Trucks.

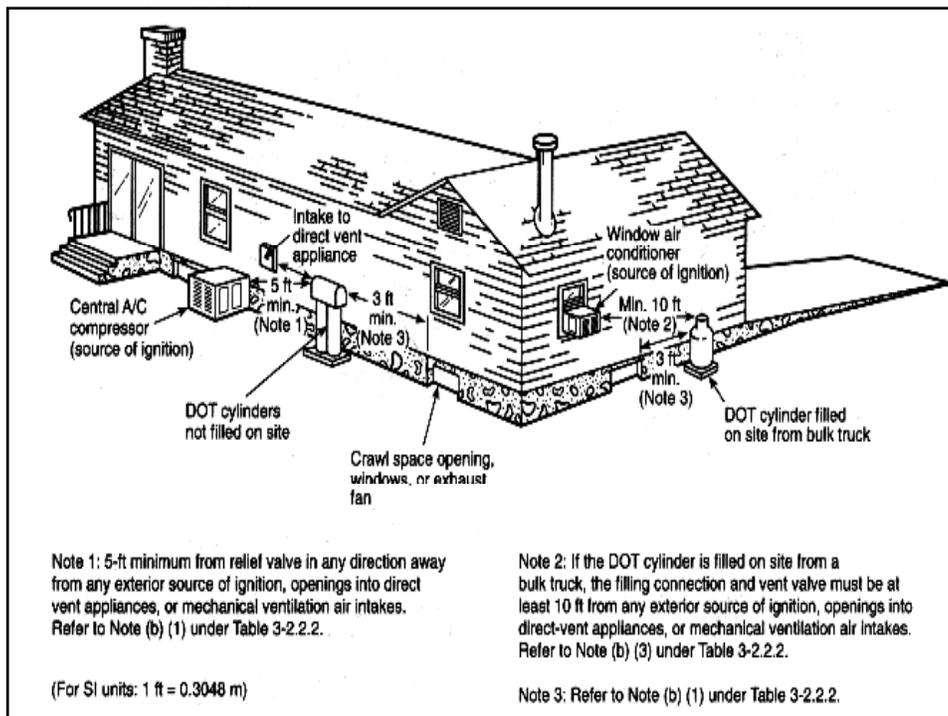
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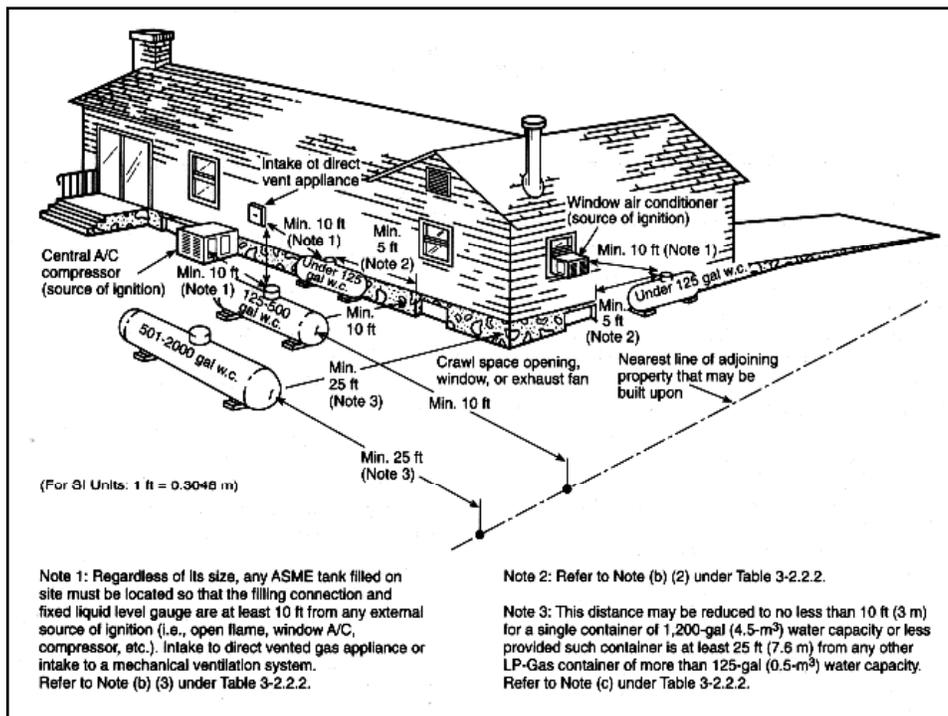
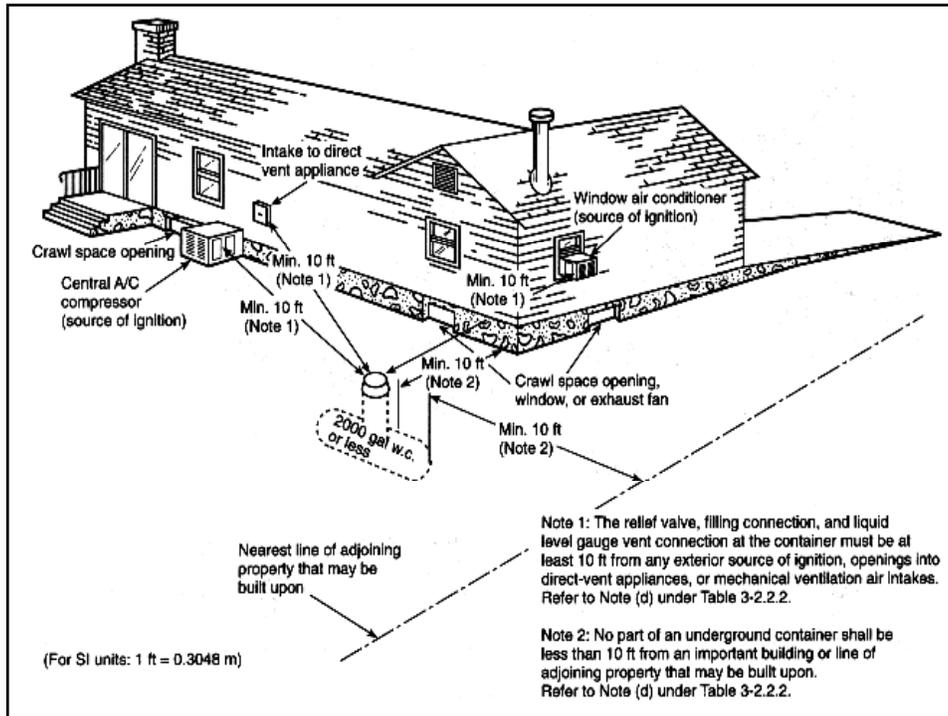
**Table 3-2.2.2
Minimum Distances**



Water Cap Gallons	Underground Containers	Aboveground Containers	Between Containers
< 125	10 ft	None	0
125 - 250	10 ft	10 ft	0
251 - 500	10 ft	10 ft	3 ft
501 - 2,000	10 ft	25 ft	3 ft
2,001 - 30,000	50 ft	50 ft	5 ft
30,001 - 70,000	50 ft	50 ft	*
70,001 - 90,000	50 ft	100 ft	*

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3-2.2.7 Additional Container Installation Provisions



- Containers can not be Stacked one Above the Other.
- No Combustible Material or Weeds and Long Dry Grass Within 10 ft.
- No Accumulation or Flow of Liquids Having Flash Points Below 200°F Under Adjacent LP-Gas containers.
- LP-Gas Containers at Least 10 ft From Dikes Containing Flammable or Combustible Liquids.

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3-2.2.7 Additional Container Installation Provisions



- Flood Areas Containers Must be Anchored Where Flotation is Possible.
- LP-Gas Containers Stored near other Compressed Gases, Marked to Identify Content.
- LP-Gas Containers must be 6 ft Horiz. from a Vertical Plane Beneath Overhead Electric Power Lines, over 600 volts.
- Structures (Fire Walls, Fences, etc.) must be Avoided Around or Over Installed Non-refrigerated Containers.

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Installation of Containers CT Supplement 3-2.4.1 (c)



- LOCATIONS EXPOSED TO VEHICULAR TRAFFIC and other common hazards by means of one or more of the following:
 - noncombustible peripheral fence, guard rail/post of metal or concrete, building walls, or natural or man-made barriers enclosing containers and piping.

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3-2.4 Installation of Containers.



General Rules

- DOT cylinders Only Aboveground & a Firm Foundation.
- The Pressure Relief Valve Must Communicate with the Vapor Space.
- Where Physical Damage to LP-Gas Containers is Possible - Take Precautions.
- Field Welding Limited to Attaching Non-pressure Parts.
- Aboveground Containers must be Kept Properly Painted.

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3-2.4.2 Installation of ASME Containers



- Permanent Horizontal Aboveground ASME containers:
 - On Masonry or Noncombustible Structural Supports on Concrete, or
 - On Insulated Steel (2 hour)
 - Except in temporary use for 6 months or less
 - Except if in isolated locations
- Permanent Vertical ASME Containers >125 gal, on Reinforced Concrete or Steel (2 hour rating) on Reinforced Concrete Foundations.

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3-2.4.8 Underground Containers



- At least 6" Below Grade.
- If Subject to Damage from Vehicles, at Least 18" Below Grade or Protection Provided (Concrete Slab, etc).
- Within 10' of Vehicular Traffic, Protect the Fitting Housing, Cover, Connections, & Piping.
- Interchangeable Aboveground-Underground Container Assemblies: Container shell >12" below grade.

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3-2.4.8 Underground containers



- Anyone Working Near a Buried Container Must Determine Its Location & Protect the Container & Piping Against Vehicular Traffic.
- The portion of the Container to Which the Fitting Cover is Attached must be Covered.
- The Regulator Vent Discharge Must be Above the Highest Probable water level.
- Protect Containers from Corrosion Using Good Engineering Practice.

101

3-2.5 Installation of Container Appurtenances



- Pressure relief devices must release gas upward away from the container to the open air on:
 - ASME Containers over 125 gal (0.5 m³)
 - >2000 gal 7' above container
 - Portable Storage Containers.
 - Portable Containers of 120 gal or more.
 - Cargo tanks, and Fuel Containers on Vehicles.

102

3-2.5 Installation of Container Appurtenances



- Water Must be Kept out of Relief Valves.
- Relief Discharges Must be Upward at Least 7 ft Above the Top of the Container > 2,000 gal.
- Relief Valve Piping Must be Metallic and Have a Melting Point over 1500°F.
- Shutoff Valves can not be Installed Between Relief Devices and the Container, or the Discharge Piping.

103

3-2.6 Installation of Regulators



- Install as Close to the Container or Vaporizer as Practical.
- Install First Stage Regulating Equipment Outside of Buildings.
- Regulators must be Securely Attached.
- Protect All Outdoor Regulators from the Elements (freezing rain, sleet, snow, ice, mud, or debris).
- Regulator Pressure Relief Discharge >3' from any Building Opening below it.

104

3-2.7 Piping System Service Limitations



- LP-Gas Liquid or Vapor can be Piped at all Normal Operating Pressures Outside of Buildings.
- Polyethylene Piping systems are Limited to Outdoors, Underground only.
- Vapor Service not Exceeding 30 psig .Outside.
- Vapor Service not Exceeding 20 psig In Bldgs.
- LP-Gas Vapor can not be Above 20 psi in Buildings, Except in Buildings Under Construction.

105

(3-2.8) Installation of Pipe, Tubing, Pipe and Tubing Fittings, Valves, and Hose.



- All metallic LP-Gas piping shall be designed and installed in accordance with ASME B31.3 (3-2.8.1) suitable for appropriate working pressure. (3-2.8.2)
- Metallic pipe joints shall be permitted to be threaded, flanged, welded or brazed. (3-2.8.3)
- Metallic tubing joints shall be permitted to be flared or brazed (3-2.8.4) .

106

Chapter 3: Installation of LP-Gas Systems



- *Protection of Aboveground piping and*
- *Underground polyethylene piping systems*

107

Chapter 3: Installation of LP-Gas Systems



3-2.8.7

Aboveground piping shall be **supported** and protected against physical damage.



Chapter 3: Installation of LP-Gas Systems



- *Underground metallic piping.... protected against corrosion and LP-Gas piping shall not be used as a grounding electrode.(3-2.8.8)*
- *Flexible components be installed in accordance with the mfg's instructions and (3-2.8.9) :*

109

Chapter 3: Installation of LP-Gas Systems



- (3-2.9) Hydrostatic Relief Valve Installation.
- (3-2.10) Testing Piping Systems.

110

Chapter 3: Installation of LP-Gas Systems



- (3-2.12) Corrosion Protection.
- (3-2.--) Equipment Installation.

111

3-2.8.10 Emergency Shutoff Valves



Required on Systems of Over 4,000 gal

- Liquid Piping >1 1/2" Within 20' of the end of the Piping Connected to the Hose or Swivel-Type Piping.
- ESV's Must Close on
 - 250°F <5' from the end of hose or swivel piping
 - Manual shutoff from a remote location
 - Manual shutoff at the valve
- ESV's Must be Anchored.
- Anchorage & Breakaway on the Cargo Tank Side for Transfer from a Rail Car.

112

3-4 LP-Gas Systems in Buildings



- The Portable use of Containers is Limited to Where the use of Portable Containers Necessary and Location Outside is Impractical.
- Containers Max 100 lb LP-Gas Each, and Piping: Minimum Pressure 250 psi.
- Hose: Minimum Pressure 350 psi.
- Hose length as Short as Practical.
- Filling containers on Roofs or Balconies is Prohibited.

113

3-4.3 and 3-4.4 Buildings Under Construction Major/Minor Renovation



Use of Cylinders in Buildings Closed to the Public:

- OK when Building is not Occupied with the Approval of the AHJ.
- OK when the Public is in the Building When:
 - The maximum water capacity is 20', and
 - The No. of Containers does not Exceed the No. of Workers using LP-Gas, and
 - Containers are not Left Unattended.

114

3-4.5 Buildings Housing Industrial Occupancies.



Containers can be used in Industrial Buildings for Processing, Research, or Experimental Purposes when:

- Total LP-Gas < 300 lb . Additional 300 lb, 20' Away.
- The amount of LP-Gas for Research and Experimental use is the Smallest Practical Quantity.
- Containers for Temporary Heating is OK in Noncombustible Industrial Buildings, if Essential & Permanent Heat not Practical.

115

3-4.6 Buildings Housing Educational and Institutional Occupancies.



Containers can be Used in these Occupancies for Research and Experimental Purposes, but not in Classrooms, when the Maximum Capacity of Containers is:

- 20' LP-Gas in Educational Occupancies.
- 5' LP-Gas in Institutional Occupancies.
- Additional Containers in the Same Room, Separated by at least 20'.

116

3-4.7 Temporary Heating in Buildings in Emergencies



Containers can be used in Buildings for Temporary Emergency Heating:

If necessary to Prevent Damage to the Buildings or Contents, and If the Permanent Heating System is Temporarily out of Service, Provided the Temporary Heating Equipment is ALWAYS ATTENDED.

117

3-4.8 Use in Buildings for Demonstrations or Training, or Use in Small Containers



- 3-4.8.1 Containers having a maximum water capacity of 12 lb [nominal 5 lb (2 kg) LP-Gas capacity] shall be permitted to be used temporarily inside buildings for public exhibitions or demonstrations, including use in classroom demonstrations.

118

3-4.9 Portable Containers on Roofs or Exterior Balconies.



- 3-4.9.2 Containers >21/2 lb w.c. (1 kg) [nominal 1 lb (0.5 kg)] LP-Gas capacity shall not be located on balconies above the first floor that are attached to a multiple family dwelling of three or more living units located one above the other.
- Exception: Where such balconies are served by outside stairways and where only such stairways are used to transport the container.

119

3-5 Installation of Appliances.



- Covers Installation of LP-Gas Appliances in Accordance with Section 2-6.
- For Appliances in Buildings Served by a Fixed Gas Supply use NFPA 54.
- Installation of appliances on commercial vehicles is covered in Section 3-8.

120

3-7 Ignition Source Control.



- Provisions to Minimize Ignition of LP-Gas Air resulting from the Release of LP-Gas.
- Lightning Protection Equipment is not Required on LP-Gas Storage Containers.
 - NOTE: For information see NFPA 78, Lightning Protection Code.
- Grounding and Bonding are not Required on LP-Gas systems.
 - NOTE: Liquefied petroleum gas need not be electrically conductive or electrically bonded . For information see NFPA 77, Recommended Practice on Static Electricity.

121

3-7 Ignition Source Control.



- Table 3-7.2.2 Provides Extent of Classified Areas for Class 1, Divisions 1 and 2.
- Distances Provided for:
 - Containers
 - Tank Vehicles
 - Relief Devices
 - Pumps, etc.

122

(CT SUPP. 3-10.4) Written Emergency Plans.



- The fire safety analysis referred to in section 3-10.2.3 and the special fire protection provisions of section 3-10.3, if required at the facility, shall be incorporated into a facility emergency plan which shall be in writing and amended as required every two years.

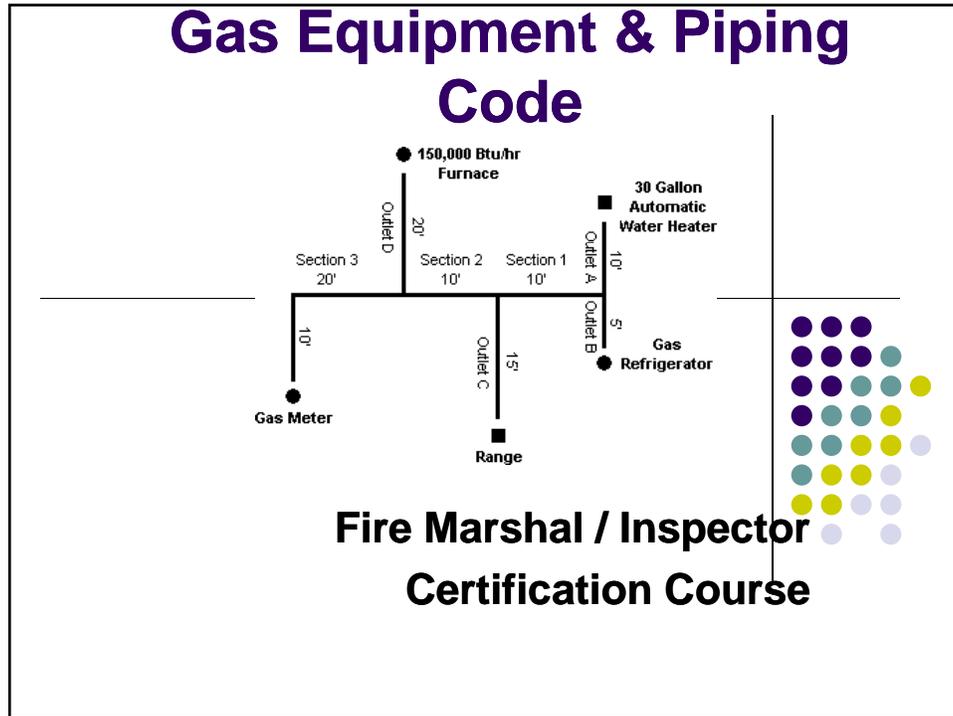
123

LP-Gas Code



- Chapter 4: Transfer Operations**
- Chapter 5 : Storage**
- Chapter 6 Transportation of LP-Gas**
- Chapter 7: Buildings or Structures Housing LP-Gas Distribution Facilities.**
- Chapter 8 Engine Fuel Systems**
- Chapter 9 Refrigerated Storage**
- Chapter 10 Marine Shipping and Receiving**
- Chapter 11 Referenced Publications**

124



Gas Equipment & Piping



Section 29-329: Regulations concerning Installation and Operation of Gas Equipment and Piping. Variations and Exemptions.

Regulations - Gas Equipment & Piping



- Section 29-329-1: Connecticut Gas Equipment and Piping Code: Purpose and Applicability
- Section 29-329-2: Authority Having Jurisdiction
- Section 29-329-3: Adopted Standards:
 - NFPA 52 - 1992 Standard for Compressed Natural Gas Vehicular Systems
 - NFPA 54 - 1996 National Fuel Gas Code
 - NFPA 57 - 1996 Standard for Liquefied Natural Gas Vehicle Fuel Systems
- Section 29-329-4: Connecticut Supplement to NFPA 52-1992

National Fuel Gas Code
NFPA 54 / 1996
No CT adjustments
11 point errata 12/23/96



National Fuel Gas Code



- Part 1: General Provisions
- Part 2: Gas Piping System Design, Material & Components
- Part 3: Gas Piping Installation
- Part 4: Inspection, Testing & Purging
- Part 5: Equipment Installation
- Part 6: Installation of Specific Equipment
- Part 7: Venting of Equipment
- Part 8: Procedures for Placing Equipment in Operation
- Part 9: Modifications for Existing Appliances

National Fuel Gas Code



(1-1) Scope:

(1.1.1) Applies to fuel gas piping systems, fuel gas utilization equipment, and related accessories as follows:

Piping systems from “**point of delivery**” to connections with each gas utilization device.

National Fuel Gas Code



- **(1.1.1) Point of Delivery:**

- Gas systems other than undiluted LPG: point of delivery is the outlet of service meter assembly or outlet of service regulator or service shutoff valve.
- LPG systems: point of delivery is the outlet of the final pressure regulator, exclusive of line gas regulators, in the system.

National Fuel Gas Code



- Maximum operating pressure
 - 125 psig (see exceptions)
 - LP-Gas piping systems limited to 20 psig
- Requirements include design, materials, components, fabrication, assembly, installation, testing, inspection, operation & maintenance.
- Requirements for gas utilization equipment and related accessories shall include installation, combustion, and ventilation air and venting.

National Fuel Gas Code



- Code does not apply to: (18 categories)
 - Portable LP-Gas equipment not connected to fixed fuel systems.
 - Installation of Farm Equipment
 - Oxygen-fuel gas cutting & welding
 - Industrial Gas applications
 - LP-Gas piping for buildings under construction or renovation

National Fuel Gas Code



Does Not Apply con't

- LP-Gas and compressed natural gas systems on vehicles
- Gas piping, meters, gas pressure regulators , and other appurtenances used by gas supplier in gas distribution
- and Other Industrial Applications

National Fuel Gas Code



- **(1.1.2) Other Standards**

- Reference shall also be made to the manufacturer's instructions and the serving gas supplier.

National Fuel Gas Code



(1.2) Alternate Materials, Equipment & Procedures.

(1.3) Retroactivity.

(1.4) Qualified Agency.

(1.5) Interruption of Service

- Turn gas off:
- Work Interruptions:

National Fuel Gas Code



Part 2: Gas Piping System Design, Materials, and Components

National Fuel Gas Code



(2.1) Piping Plan:

(2.1.1) Installation of piping system:

(2.1.2) Addition to Existing System.

(2.2) Provision for Location of Point of Delivery.

(2.4) Sizing of Gas Piping Systems.

(2.5) Piping System Operating Pressure Limitations.

National Fuel Gas Code



(2.6) Acceptable Piping Materials and Joining Methods

(2.6.2) Metallic Pipe:

(2.6.3) Metallic Tubing.

(2.6.4) Plastic Pipe, Tubing, and Fittings.

(2.6.5) Workmanship and Defects.

(2.6.6) Protective Coating.

(2.6.9) Plastic Piping, Joints, and Fittings.

National Fuel Gas Code



(2.7) Gas Meters. (Premises NOT Gas Co.)

(2.7.2) Location.

(2.7.3) Supports.

(2.7.4) Protection.

(2.7.5) Identification.

National Fuel Gas Code



(2.8) Gas Pressure Regulators. (Premises NOT Gas Co.)

(2.8.1) Where Required.

(2.8.2) Location

(2.8.3) Regulator Protection

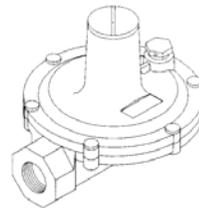
(2.8.4) Venting:

Line Gas Pressure Regulators & Second Stage LP-Gas Regulators.

Gas Appliance Pressure Regulators in accordance with Chapter 5.

(2.8.5) Bypass Piping.

(2.8.6) Identification:



National Fuel Gas Code



(2.9) Overpressure Protection Devices.

(2.12) Shutoff Valves.

(2.13) Expansion and Flexibility

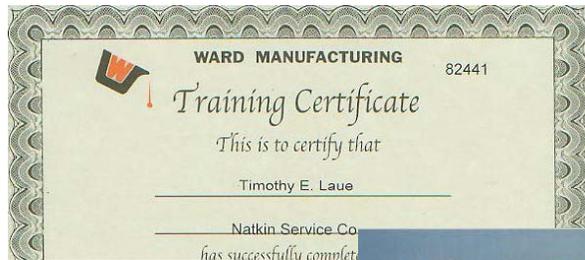
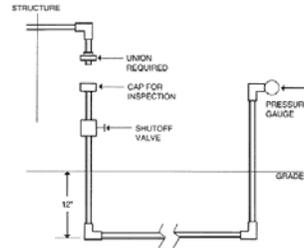
National Fuel Gas Code

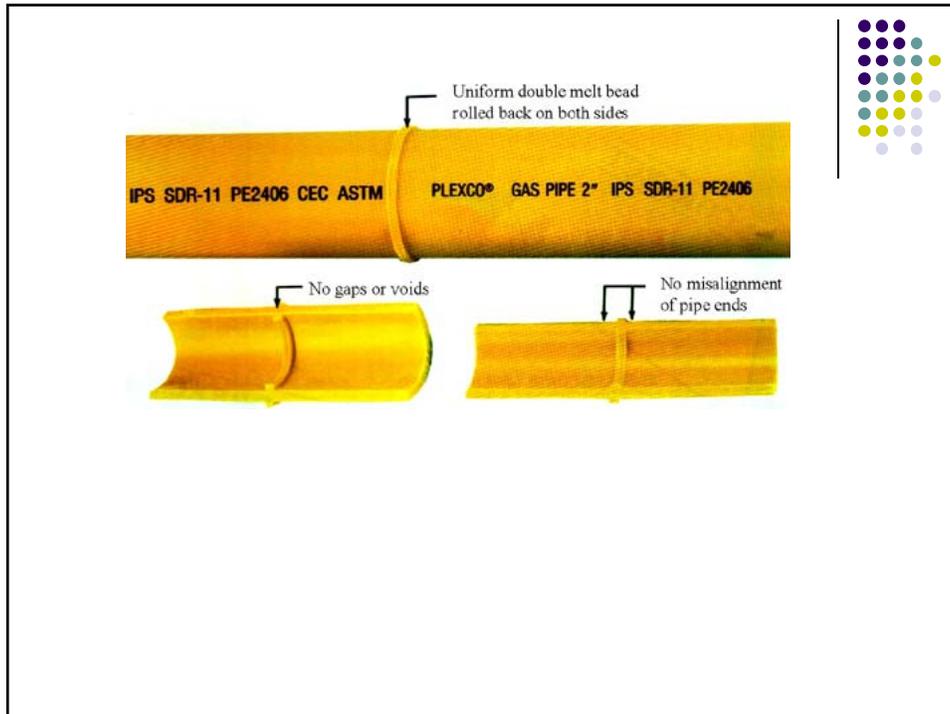


Part 3: Gas Piping Installation

(3.1) Piping Underground.

- (3.1.1) Clearances.
- (3.1.2) Protection Against Damage.
- (3.1.3) Protection Against Corrosion.
- (3.1.4) Protection Against Freezing.
- (3.1.5) Piping Through Foundation Wall.
- (3.1.6) Piping Beneath Buildings
- (3.1.7) Plastic Piping.





National Fuel Gas Code

- (3.2) Aboveground Piping Outside.** Piping installed aboveground shall be securely supported and located where it will be protected from physical damage. Where passing through an outside wall, the piping shall also be protected against corrosion by coating or wrapping with an inert material approved for such application. Where piping is encased in a protective pipe sleeve, the annular space between the gas piping and the sleeve shall be sealed at the wall to prevent the entry of water, insects, or rodents.

National Fuel Gas Code



(3.3) Piping in Buildings.

- (3.3.1) Building Structure.
- (3.3.3) Gas Piping to be Sloped.
- (3.3.4) Above-Ceiling Locations.
- (3.3.5) Prohibited Locations.
- (3.3.6) Hangers, Supports, and Anchors.
- (3.3.7) Removal of Pipe.

National Fuel Gas Code



(3.4) Concealed Piping in Buildings.

- (3.4.1) General.
- (3.4.2) Connections in Original Installations.
- (3.4.3) Piping in Partitions.
- (3.4.4) Tubing in Partitions.
- (3.4.5) Piping in Floors.
- (3.4.6) Reconnections.

National Fuel Gas Code



- (3.5) Piping in Vertical Chases.
 - Pressure Reduction (if required)
 - Construction
 - Ventilation
- (3.6) Gas Pipe Turns. Changes in direction of gas pipe shall be permitted to be made by the use of fittings, factory bends, or field bends.

National Fuel Gas Code



(3.6) Gas Pipe Turns. Changes in direction of gas pipe shall be permitted to be made by the use of fittings, factory bends, or field bends

- Metallic Pipe
- Plastic Pipe
- Mitered Bends
- Elbows

National Fuel Gas Code



(3.7) Drip and Sediment Traps

(3.7.1) Provide Drips Where Necessary.

(3.7.2) Location of Drips.

(3.7.3) Sediment Traps

See 5.5.7 Under Equipment Installation

National Fuel Gas Code



(3.8) Outlets.

(3.8.1) Location and Installation.

(3.8.2) Cap All Outlets.

National Fuel Gas Code



(3.10) Manual Gas Shutoff Valves.

(3.10.1) Valves at Regulators.

(3.10.2) Valves Controlling Multiple Systems.

Accessibility of Gas Valves.

Shutoff Valves for Multiple House Lines.

(3.10.3) Emergency Shutoff Valves.

National Fuel Gas Code



(3.14) Electrical Bonding and Grounding.

(3.15) Electrical Circuits.

(3.1.6) Electrical Connections

Safety Controls Fail Safe

National Fuel Gas Code



Part 4: Inspection, Testing, and Purging

National Fuel Gas Code



(4.1) Pressure Testing and Inspection.

- (4.1.1) General.
- (4.1.2) Test Medium
- (4.1.3) Test Preparation
- (4.1.4) Test Pressure.
- (4.1.5) Detection of Leaks or Defects.
- (4.1.6) Test Records.

National Fuel Gas Code



(4.2) System and Equipment Leakage Test.

(4.2.1) Before Turning Gas On.

Before gas is introduced into a system of new/existing piping inspection made that there are no open fittings.....

Shelton and New Milford Cases!

(4.2.2) Test for Leakage.

(4.2.3) Placing Equipment in Operation.

National Fuel Gas Code



(4.3) Purging.

(4.3.1) Removal from Service.

See Table III

(4.3.2) Placing in Operation. (Piping)

See Table IV

(4.3.3) Discharge of Purged Gases.

(4.3.4) Placing Equipment in Operation. After the piping has been placed in operation, all equipment shall be purged and then placed in operation, as necessary.

National Fuel Gas Code



Part 5: Equipment Installation

(5.1) General.

- (5.1.1) Appliances, Accessories, and Equipment To Be Approved.
- (5.1.3) Type of Gas(s).
- (5.1.4) Safety Shutoff Devices for Unlisted LP-Gas Equipment Used Indoors.
- (5.1.9) Installation in Residential Garages
- (5.1.10) Installation in Commercial Garages.

National Fuel Gas Code



(5.1) General. (con't)

- (5.1.12) Gas Equipment Physical Protection.
- (5.1.15) Adequate Capacity of Piping.
- (5.1.16) Avoid Strain on Gas Piping.
- (5.1.17) Gas Appliance Pressure Regulators.
- (5.1.18) Venting of Gas Appliance Pressure Regulators
- (5.1.20) Combination of Equipment.
- (5.1.21) Installation Instructions.
- (5.1.22) Protection of Outdoor Equipment.

National Fuel Gas Code



(5.2) Accessibility and Clearance.

(5.2.1) Accessibility for Service.

(5.2.2) Clearance to Combustible Materials.

National Fuel Gas Code



(5.5) Equipment Connections to Building Piping.

(5.5.1) Connecting Gas Equipment.

(5.5.2) Use of Gas Hose Connectors.

Indoors

Outdoor.

(5.5.3) Connection of Portable and Mobile Industrial Gas Equipment.

(5.5.4) Equipment Shutoff Valves and Connections.

National Fuel Gas Code



(5.5) Equipment Connections to Building Piping. (con't)

- (5.5.5) Quick Disconnect Devices.
- (5.5.6) Gas Convenience Outlets.
- (5.5.8) Installation of Piping.

National Fuel Gas Code



- (5.6) Electrical.
 - (5.6.1) Electrical Connections.
 - (5.6.4) Continuous Power.



Photo 5. A gas furnace supplied by a branch circuit that has a metal gas piping system supplying it

National Fuel Gas Code



Part 6: Installation of Specific Equipment.

- (6.1) General. This part is primarily applicable to non-industrial type gas utilization equipment and installations. Listed gas utilization equipment shall be installed in accordance with their listing and the manufacturer's instructions, or as elsewhere specified in this part.
- Unlisted equipment shall be installed as specified in this Part as applicable to the equipment.

National Fuel Gas Code



Part 7: Venting of Equipment

- (7.1) General. This Part recognizes that the of venting materials and the methods of installation of venting systems are dependent on the operating characteristics of the gas utilization equipment.
- Equipment should be installed in accordance with the manufacturer's instructions and according to its listing.
- (7.10.4) Two or More Appliances Connected to a Single Vent.

National Fuel Gas Code



Part 8: Procedures to be Followed to Place Equipment in Operation.

- This part deals with the placing of a gas utilization equipment into operation.
- (8.7) Operating Instructions. Operating instructions shall be furnished and shall be left in a prominent position near the equipment for the use of the consumer.

Thank You!

