Department of Fire Services
Massachusetts Firefighting Academy

Flammable Gas Firefighting Program

Massachusetts Firefighting Academy

Flammable
Gas
Program

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LPG/NG/LNG

1

Objectives

- Discuss combustible gas indicators and how they function
- Discuss considerations for using combustible gas indicators

2

Objectives

- Discuss propane and its properties
- Show examples of common Department of Transportation (D.O.T.) Cylinders
- Discuss overfilling of 20lb cylinders
- Discuss overfill protection/safety changes

3

Objectives

- Common American Society of Mechanical Engineers (A.S.M.E.) Containers
- Propane in transportation
- Discuss BLEVE's and how to anticipate them

4

Objectives

- Discuss NG and LNG and their properties
- Review the gas distribution systems
- Discuss over-the-road transportation of LNG
- Gain confidence in the use of hand held extinguishers, hose lines and CGI's during practical applications

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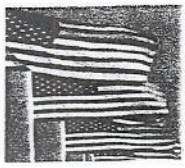
National Incident Management System (NIMS)

National Incident Management System



Emergencies occur every day somewhere in the United States. These emergencies are large and small and range from fires to hazardous materials incident to natural and technological disasters.

Each incident requires a response. Whether from different departments within the same jurisdiction, from mutual aid partners or from State and Federal agencies, responders need to be able to work together, communicate with each other, and depend on each other.

The events of September 11, 2001 have underscored the need for and importance of national standards for incident operations, incident communications, personnel qualification, resource management, and information management and supporting technology.

IS700 NIMS Course, pg. 1

National Incident Management System (NIMS)

- Created by Presidential Directive 8 following 9/11
- Designed to provide a single/uniform system for managing large scale incidents
- Took the Incident Command System used by the Fire Service and expanded it to include other agencies

ICS with Gas Incidents

- Accountable to only one supervisor
- Common Terminology
- Simple and expandable
- Can be used by Multiple Agencies
- Helps to maintain a manageable span of control, 3 to 5 is optimal

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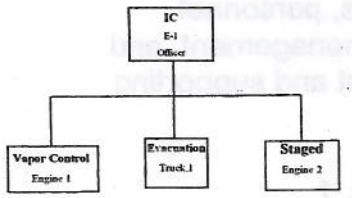
Incident Command System Fire Department



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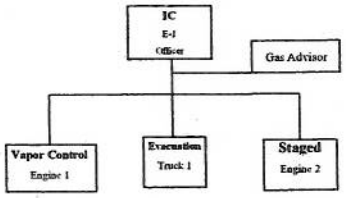
Example of a simple incident such as odor of gas in building.

Incident Command System Fire Dept./Gas Rep. Interface



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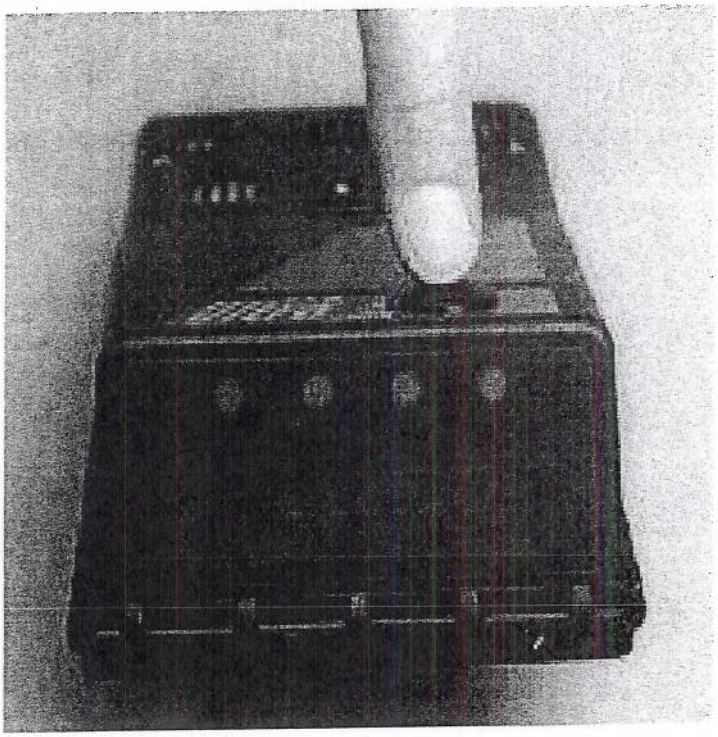
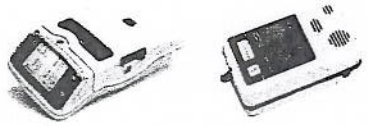
Here is an example of where the gas company representative fits into the organizational chart. More and more gas industry workers are becoming trained in ICS. The Gas Rep. is the FD IC's technical advisor. The FD IC is the Gas Company's technical advisor.

Metering Considerations



Combustible Gas Indicators (Multi-Meters)



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Meters are VERY important to gas incidents. What is your knowledge base, training and experience?

Combustible Gas Indicators

- A device used to test an atmosphere for concentrations of combustible/flammable vapors
- There are two types of combustible gas indicators:
  - Atmospheric
  - LEL

2

Multi-Meter

- A device used to test an atmosphere for multiple gases simultaneously
- Multi-Meters typically analyze three to four categories of gases

3

Multi-Meters

Scales used on various CGI models:

- Percentage of gas in air
- Parts Per Million (PPM)
- Percentage of lower explosive limit (LEL)

4

% LEL- Most common reading for flammable gases on fire services meters
% Gas in air- indicates in most cases oxygen readings
PPM- carbon monoxide and hydrogen sulfide

% of Gas in Air

- Oxygen-
- Normal O2 is 21% atmospheric
- A CGI will alarm at standards of:
  - 23.5% atmospheric as Oxygen enriched
  - 19.5 % atmospheric as Oxygen deficient

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Parts-Per-Million (PPM)

- There are several industry standards pertaining to metering.
- A CGI will typically alarm at standards of:
  - Hydrogen Sulfide (H2S) 10 PPM
  - Carbon Monoxide (CO) 35 PPM

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CGI

All CGI readings are relative to a calibration gas. When measuring another gas or vapor, the instrument still responds to the increased temperature of the filament

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In order to know what the exact levels are you must know what your meter is calibrated to, and what the conversion factors are.

CGI Response

- Per OSHA, a properly set low level alarm on a CGI meter is 10% of the LEL for the calibration gas
- The reason this percentage is fairly low is that it serves as a safety factor

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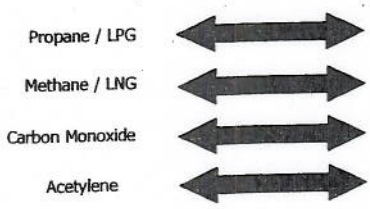
Most meters have some type of time delay between the taking of the sample and the display of the reading. By setting the alarm at 10% LEL, there is time for personnel to back out should they advance beyond the 10% point.
NOTE: Information of LEL came from technical services of Industrial Scientific

Explosive Limits



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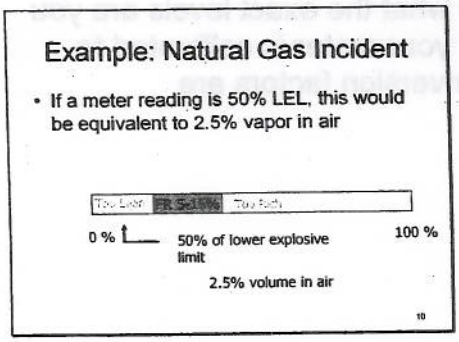
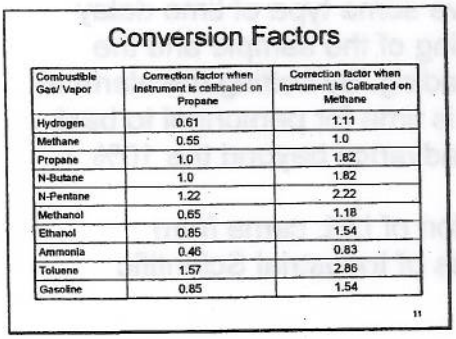
No one CGI can accurately read any and all flammable gases. The fire service responds to many different flammable gas investigations. CGI's require conversion charts

Notice the comparisons of materials with very narrow ranges, with those with very wide ranges. (The flammable range for acetylene is referenced from the Handbook of compressed gases...3rd edition. Compressed gas association and company)



REMEMBER this is indicating 50% of the LEL, and NOT 50% volume in air. This reading would actually be equal to 2.5% volume in air.



Combustible Gas/ Vapor	Correction factor when instrument is calibrated on Propane	Correction factor when instrument is Calibrated on Methane
Hydrogen	0.61	1.11
Methane	0.55	1.0
Propane	1.0	1.82
N-Butane	1.0	1.82
N-Pentane	1.22	2.22
Methanol	0.65	1.18
Ethanol	0.85	1.54
Ammonia	0.46	0.83
Toluene	1.57	2.86
Gasoline	0.85	1.54

This is an example of a partial conversion chart for a **PhD Ultra** combustible gas sensor. Many gas sensors are calibrated to Pentane. In order to get an accurate reading you must know what you are metering for. It is very important that students know what their gas meters are calibrated for, and where the conversion-chart is located. A suggestion might be to make a smaller chart of the materials found in the student's response areas, and tape it too the meter itself.
Down and Dirty: If meter is calibrated to methane and you are at a confirmed LP or gasoline incident; why bother multiplying by the above number. Be on the safe side and double your readings. Example: At an LPG incident; meter reads 8% of LEL; meter will not physically be going off but if the number is doubled the answer is 16%. The alarm would be sounding.

DON'T WAIT FOR THE ALARM!!!

MONITOR THE READINGS

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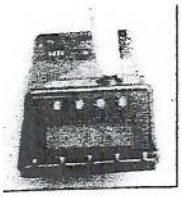
Instrument Operation



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Combustible gases enter the instrument, diffuse through a coarse metal filter, and come in contact with two hot filaments inside the sensor. Both filaments are heated to the same temperature and, therefore, have the same resistance. One filament is coated with a catalyst. Combustible gases burn on this catalytic filament; no combustion occurs on the uncoated filament. Combustion causes the filament with the catalyst to increase in temperature, causing an increase in resistance. This change in resistance causes an imbalance in the resister circuit. The change in resistance across the circuit is translated into a CGI meter reading.

Metering Considerations

- Turn meter on prior to entering a possibly contaminated atmosphere
- Confirm meter is reading properly in a non contaminated atmosphere
- Be aware of the limitations/reflex times of your meter
- Approach with full PPE

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CGI's must to be warmed up prior to operating. The Catalytic Plates for reading gases need to be heated up prior to them operating. Meters need to be zeroed also. Zeroing is essentially "sneezing" the meter and re-calibrating the 02 sensor. It is imperative you understand these operations on your particular meters.

Metering Considerations

- Begin sampling from a known safe environment
- Slowly work your way into the contaminated atmosphere
- Slowly take readings both high AND low, giving time for the meter to calculate the readings

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Metering Considerations

- Consider the need for metering both inside and outside
- Establish operating zones based on meter readings
- Do not rely on a single meter

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Concentrations Related to Metering

- Concentrations of gases are critical when metering
- A volume of gas may or may not be dangerous based on it's relation to its concentration (confined/unconfined spaces)
  - Examples-
    - Saltwater in a tub or a pond
    - Rum and Coke

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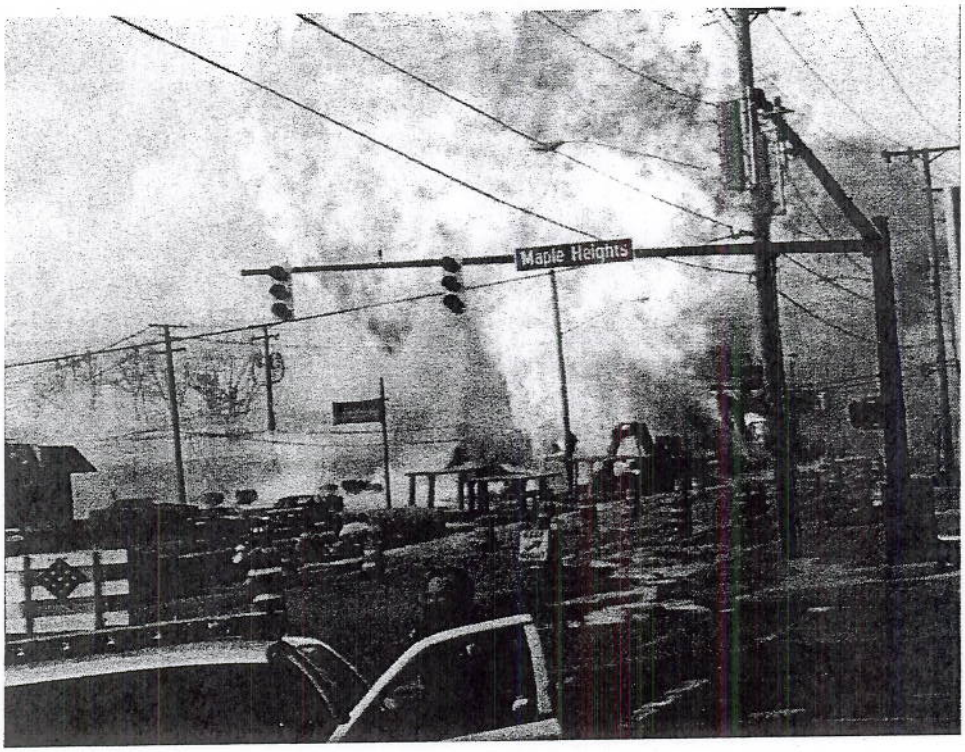

NATURAL GAS

Massachusetts Firefighting Academy

Natural Gas (NG) and Liquefied Natural Gas (LNG)

1

Natural Gas

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

2

By product from landfills, oil wells. Methane is produced when organic material decomposes.

Natural Gas Properties

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

3

This is the information that is important to remember. Knowing this will help to understand how the material will act, and where it might be found. This will help to protect the responders, AND the public.

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

4

Method of Delivery

- Transmission Pipelines
  - Large volume
  - High pressure
  - Long distances
- Distribution System
  - For local delivery
  - Lower pressures
  - Most common response for the fire service

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System Pressures

- Transmission Lines often range from 600 to 1440 psi
- Distribution system typically range from 200 psi or less, however, in some cases pressures maybe higher than 200 psi

6

Transmission lines have extremely high pressures. Distribution lines are typically between 60 and 80 psi. Gas flow after the regulator is down to approximately ½ psi.
In Massachusetts the Department of Telecommunications and Energy regulates the Gas Companies in the areas of rates, odorizing, specification for piping, and maintenance.
Federally it is the Department of Transportation (DOT), Office of Pipeline Safety
The National Standards Institute and the American Gas Association also set technological changes and safety controls.

Transmission Pipelines

- Commonly constructed of steel pipes 12 to 36 inches in diameter
- Valves could be several miles apart
- Commonly located in the same path as power lines
- Often run through populated areas

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This mostly describes new Maritime Pipeline.
New pipeline in Essex County thru Boston Harbor to Weymouth 1440 psi

Responding To A Transmission Pipeline Incident

- This is a significant incident
- Pipeline management is not the same as local distribution management
- Pre-Planning for an incident of this type is imperative

8

Distribution System

- Commonly 4 to 12 inch lines
- Intermediate pressure constructed of steel, Polyethylene (PE) pipes
- System pressures will vary throughout the community

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Responding To A Distribution Pipeline Incident

- These response vary from confirmed pipe breach to "smell of gas in the area"
- Prioritized by severity according to Gas Industry Standards
  - Priority 1- Requires immediate repair
  - Priority 2- not immediately hazardous but requires scheduled repair
  - Priority 3- non-hazardous at the time and is expected to remain non-hazardous

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Odor Investigations

- 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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Odor Investigations (cont.)

- Massachusetts has an exemption to this standard by being more restrictive
  - MA exemptions states that Odorant in NG should be detectable as low as .15% gas in air
  - MA has approximately 6X more odorant than national standards

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Odor Investigations (cont.)

DO NOT UNDER-ESTIMATE THE PRESENCE OF THE ODORANT.

THE ODORANT ***IS*** COMING FROM A GAS LEAK

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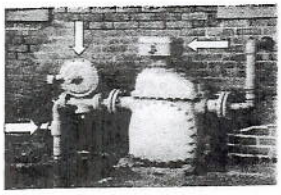
Unless you are dealing with an odorant plant or an odorant transport there must be gas present.

Gas Regulator, Meter, Shut Off



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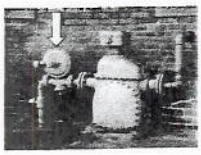
The round object above the shut off is the regulator; the box with the lock is the meter.

Gas Regulator

- Have been known to fail resulting in excessive pressure at appliance.
- If there is a failure in a regulator in a distribution system there may be multiple gas incidents over a large area.



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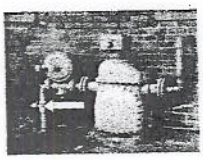
Shut Off Locations

- Street side / Curbside (*For use by gas company only*)
- Meter
- Appliance



Once it's off...IT'S OFF!

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Maple Heights Ohio

Video