LEAK SURVEY

How and Why?

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Pipeline and Hazardous Materials Safety Administration

PHYSICAL CHARACTERISTICS OF NATURAL GAS

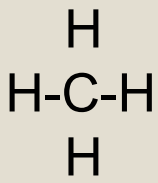
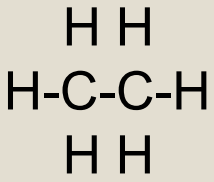
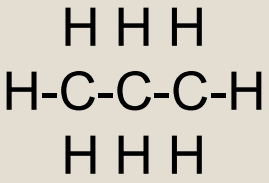
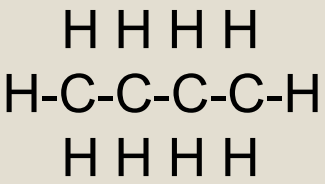
Natural Substance

NATURAL SUBSTANCE

- By-products of decaying organic materials
- Literally, dead dinosaurs and plants

PARAFFIN SERIES OF HYDROCARBONS

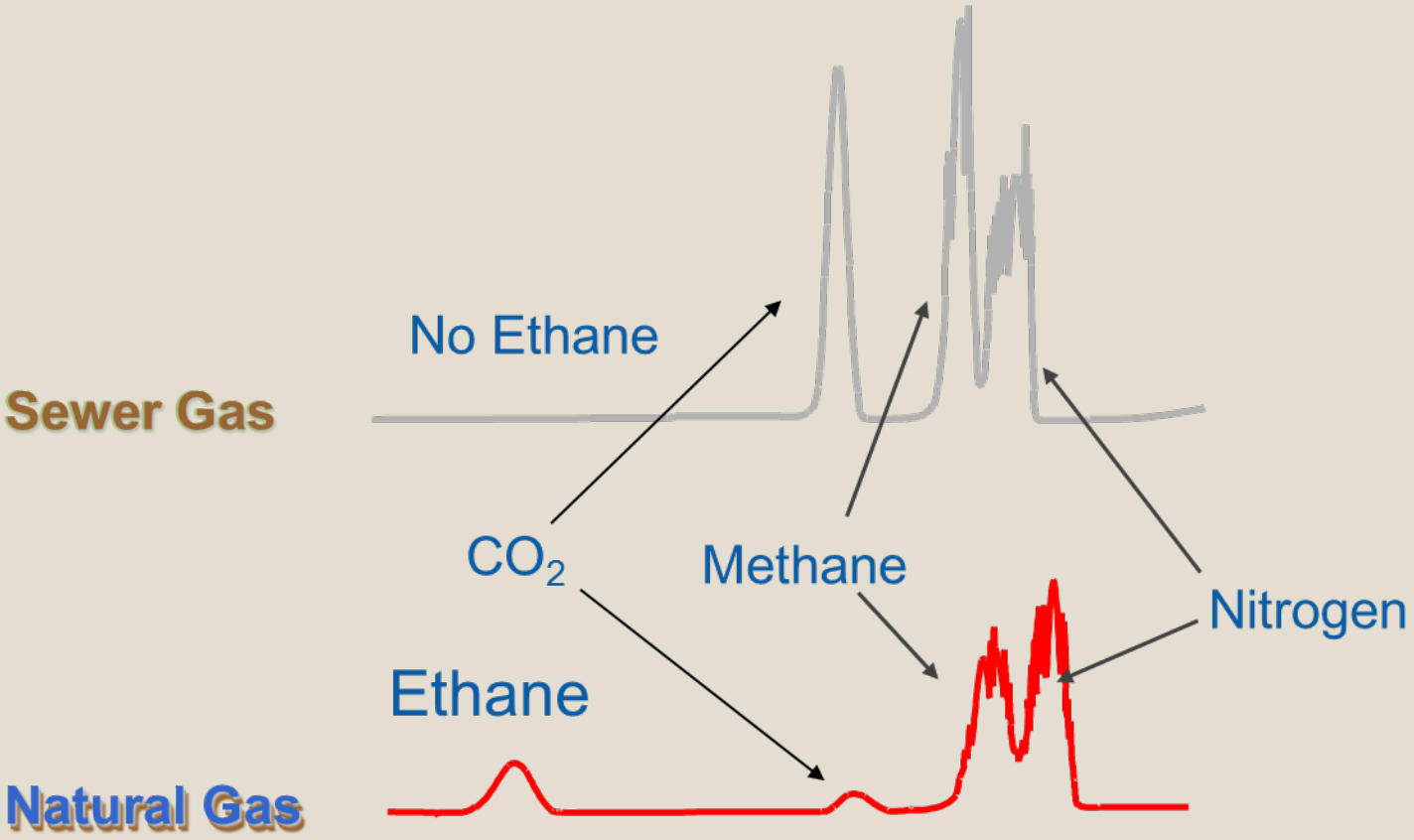
- Organic
- Made of Hydrogen and Carbon

Methane	CH_4	
Ethane	C_2H_6	
Propane	C_3H_8	
Butane	C_4H_{10}	

SEWER GAS

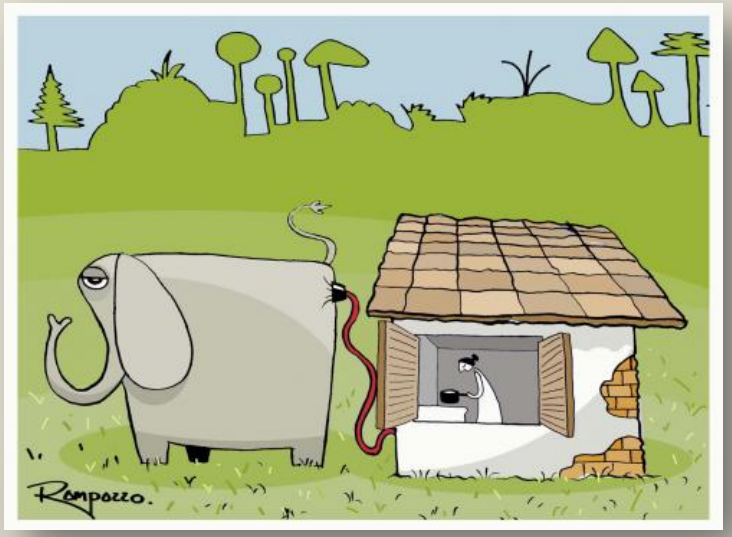
- Truth or fiction
- Will it collect and explode?
- Is it different than Natural Gas?

CHROMATOGRAPHIC ANALYSIS COMPARISON



PHYSICAL CHARACTERISTICS OF NATURAL GAS

- Natural Substance



- Flammable

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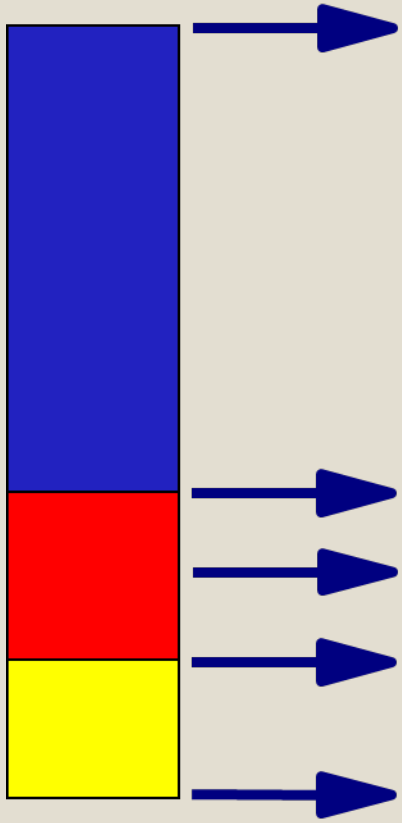
FLAMMABLE LIMITS

- LEL=Lower Explosive Limit
  - 5% Gas in Air
- UEL=Upper Explosive Limit
  - 15% Gas in Air
- FLAMMABLE RANGE
  - 5% Gas to 15% Gas

FLAMMABLE RANGE FOR NATURAL GAS



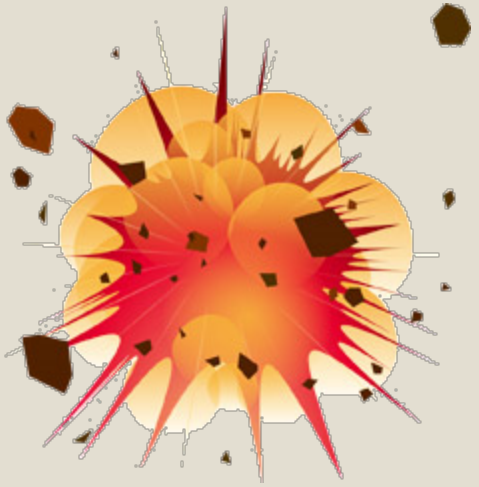
100% Gas

15.0% Gas (U.E.L.)

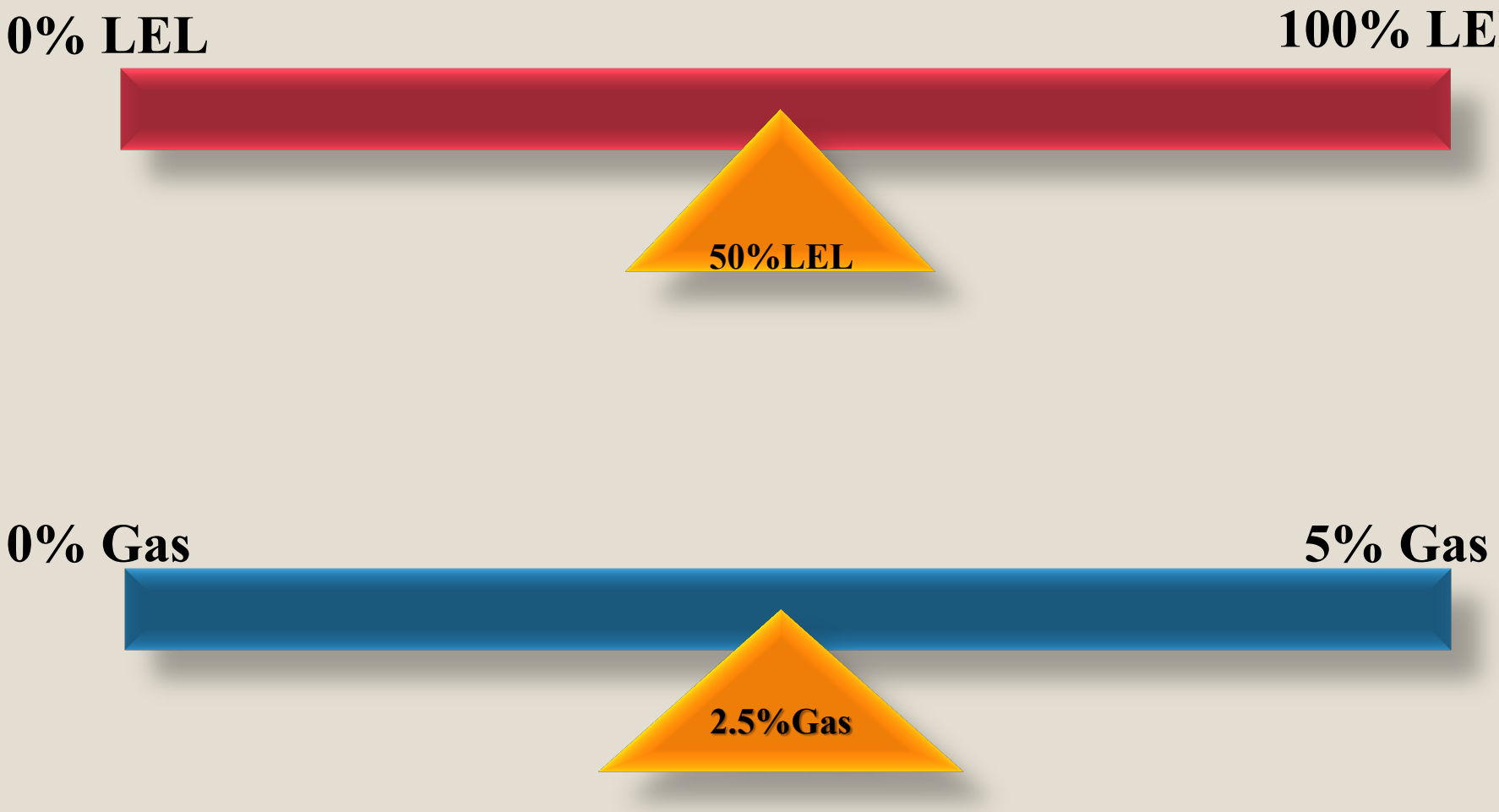
10% Gas (Optimum)

5.0% Gas (L.E.L.)

0% Gas



LEL Readings Compared to % Gas-Air



100% of the LEL is equal to 5% Gas in air

1% gas in air

You arrive and get a 20% LEL (1% Gas/Air reading) in the atmosphere, just as you enter the front door.

What would you do?

WHY IS THIS?

- The major cause of gas explosions is from gas migration, i.e. an outside leak migrating into the structure

FLAMMABLE

- Ignition Temperature generally accepted to be 1163 degrees F
- Very hot!
- Very available

POTENTIAL IGNITION SOURCES FOR NATURAL GAS

- Any Open flame
- Any spark
- Electrical switches
- Electrical motors
- Cars
- Static electricity
- Telephone
- Doorbell
- Etc.....

PROPANE

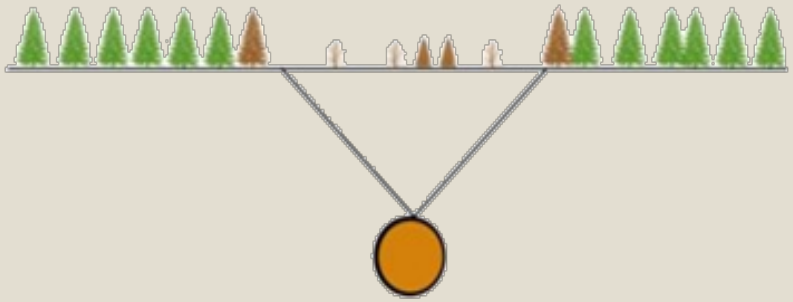
- LEL = 2.2 % gas in air
- UEL = 9.5 % gas in air
- Ignition temp = 932° F
- But the real problem is what?
  - Heavier than air

NON-TOXIC

- Will not kill you!
- However, displaces the available oxygen, and this will kill you

NATURAL GAS EFFECTS ON PLANTS

- Dries the soil out (drought effects)
- Reduces the oxygen content of the soil
- Changes the pH of the soil
- May change the color of the soil
- Reduces the plants vigor (trees)



EFFECTS OF NATURAL GAS ON SOIL AND VEGETATION

- Displaces soil atmosphere
- Drying effect
- Eliminates aerobic bacteria
- Reduces soil components
- Changes pH

Remember:

The biggest built-in safety factor of Natural Gas is that it is lighter than air; however…

IT WILL VENT TO THE ATMOSPHERE SOMEPLACE!

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SPECIFIC GRAVITY

- The blend takes on the characteristics of the largest component
- In natural gas the largest component is Methane
- Air is a standard at 1
- Number greater than 1 is heavier than air
- Number less than 1 is lighter than air

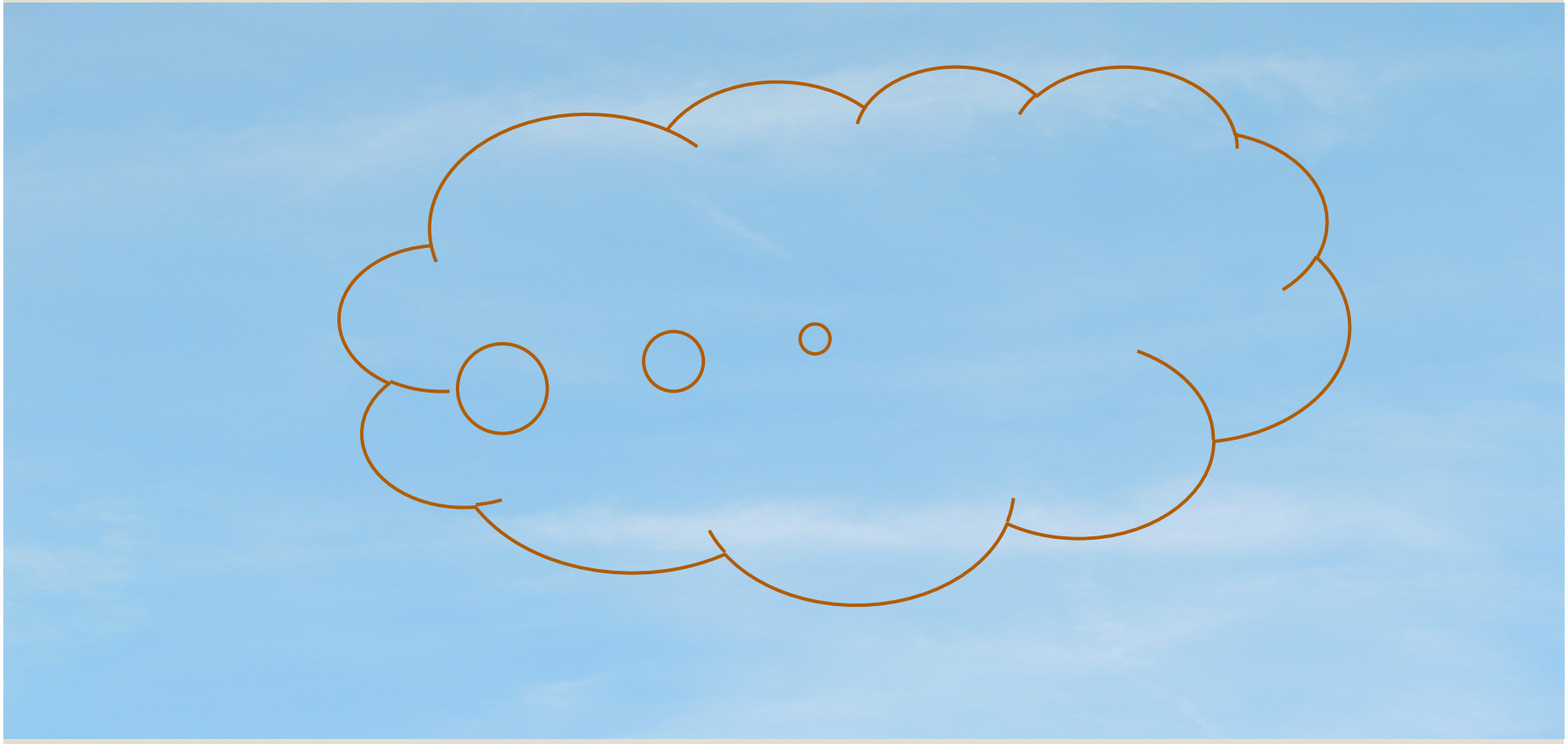
NATURAL GAS - .60 TO.70

- Depending on the blend

Propane - 1.52

PHYSICAL CHARACTERISTICS OF NATURAL GAS

- Tasteless, Odorless and Colorless



ODORIZATION REQUIREMENT

- Why Odorize?

SAFETY

To protect **LIFE** and **PROPERTY**!

Warning AGENT!

ODOR: PROBLEMS

- Age
- Colds
- Gender
- Fade
- Will not stay in the blend, nothing to attach to
- Adsorption into pipe wall, soil, water solubility, fade, and masking
- Too little added
- Odorizer broken

INSTRUMENTATION

- Instrumentation used shall consist of a:
  - gas inlet control valve
  - gas / air mixing chamber
  - a sample port for sniffing the gas / air mixture
  - a method to determine the relative concentration of the gas / air mixture

PHYSICAL PROPERTIES OF VARIOUS EXPLOSIVE LIQUIDS AND GASES

Material	Chemical Formula	Specific Gravity Air=1	Ignition Temp Deg. F in Air	Lower Expl. Limit (% gas)	Upper Expl. Limit (% gas)
Methane	CH_4	.55	1193	5.3	15.0
Natural Gas	Blend	.65	950-1200	5.0	15.0
Ethane	C_2H_6	1.04	993-1101	3.0	12.5
Propane	C_3H_8	1.56	932	2.2	9.5
Butane	C_4H_{10}	2.01	912-1056	1.9	8.5
Hexane	C_6H_{14}	3.0	437	1.1	7.5
Gasoline	Blend	3-4.0	632	1.4	7.6
Acetone	C_3H_6O	2.0	869	2.5	12.8
Benzene	C_6H_6	2.8	928	1.2	7.8
Carbon Monoxide	CO	1.0	1128	12.5	74.0
Hydrogen	H_2	.1	932	4.0	75.0
Hydrogen Sulfide	H_2S	1.2	500	4.0	44.0

REVIEW

- Natural Gas:
  - Flammable range: 5% to 15%
  - Ignition Temp: 950-1200 degrees F.
  - Specific Gravity: .65
  - Non-Toxic
  - Tasteless
  - Colorless
  - Odorless

LEAK SURVEY INSTRUMENTS

- Search Instruments
  - HFI
  - Infrared
  - Laser
- Confirmation Instruments
  - Catalytic
  - Chemical Adsorption

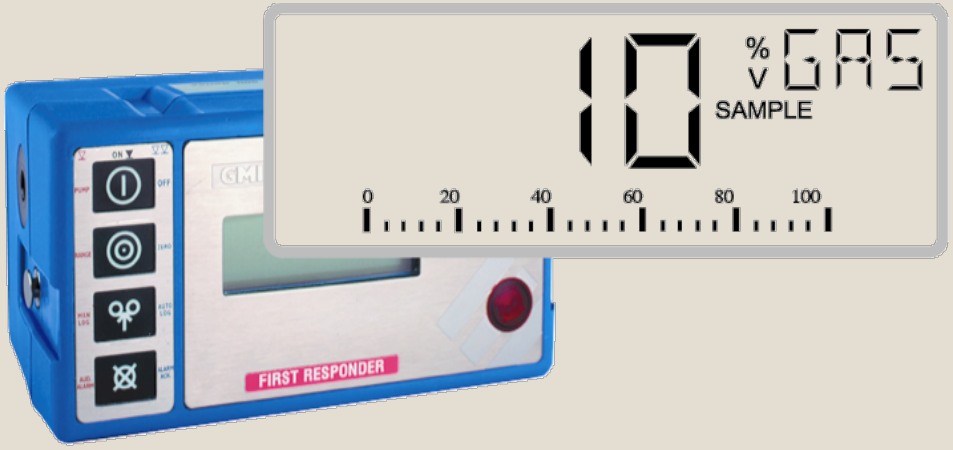
THE COMBUSTIBLE GAS INDICATOR

- CGI should be used to:
  - Classify an atmosphere
    - Inside a building or in a confined space
  - Classify underground leakage
    - Determine “Where is the gas?”
  - Pinpoint underground leakage
  - Determine “Where is the leak?”
- You must know:
  - How to properly use it
  - What readings might constitute a hazardous condition

"Your Decision Maker"

The Combustible Gas Indicator (CGI) is the most important tool that a gas company uses.

PUMP OPERATED CGI'S



MULTI – FUNCTION ERGONOMIC CGI'S

HYDROGEN FLAME IONIZATION

- What it will read
  - PPM (parts per million)
  - 1oz Vermouth in 8,000 gallon swimming pool of Gin
  - one penny in $10,000.00

PORTABLE HYDROGEN FLAME IONIZATION (HFI) INSTRUMENTS

- Search tool
- Visual and audible indication of gas concentrations in ppm
- Indications must be confirmed with a Combustible Gas Indicator (CGI)

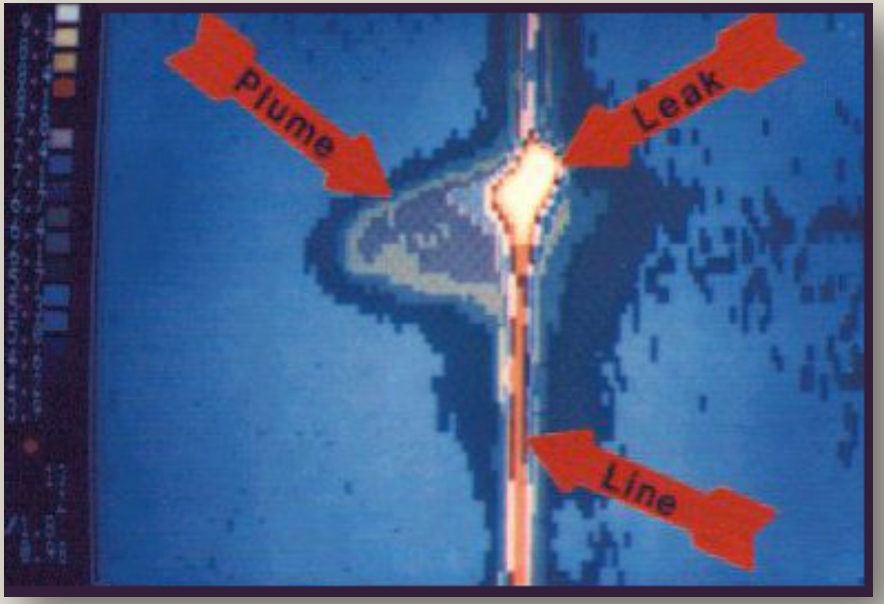
EVOLUTION

Mobile Leak Detection

MOBILE LEAK DETECTION EVOLUTION

INFRARED INSTRUMENTS

- Designed to see the heat signature of the area
- Ground displays one temp
- Leak displays another



SURFACE SAMPLING OPTICAL INFRARED LEAK DETECTORS

- Various models on the market today that can perform both search and pinpoint leaks.
- Selective to methane
- Can eliminate the false positives that you get with a standard FI unit that detects other hydrocarbons

LASER INSTRUMENTS

- When a leak is detected, a portion of the laser light will be absorbed in proportion to the concentration of methane along the measuring path

REMOTE METHANE LEAK DETECTOR (RMLD)

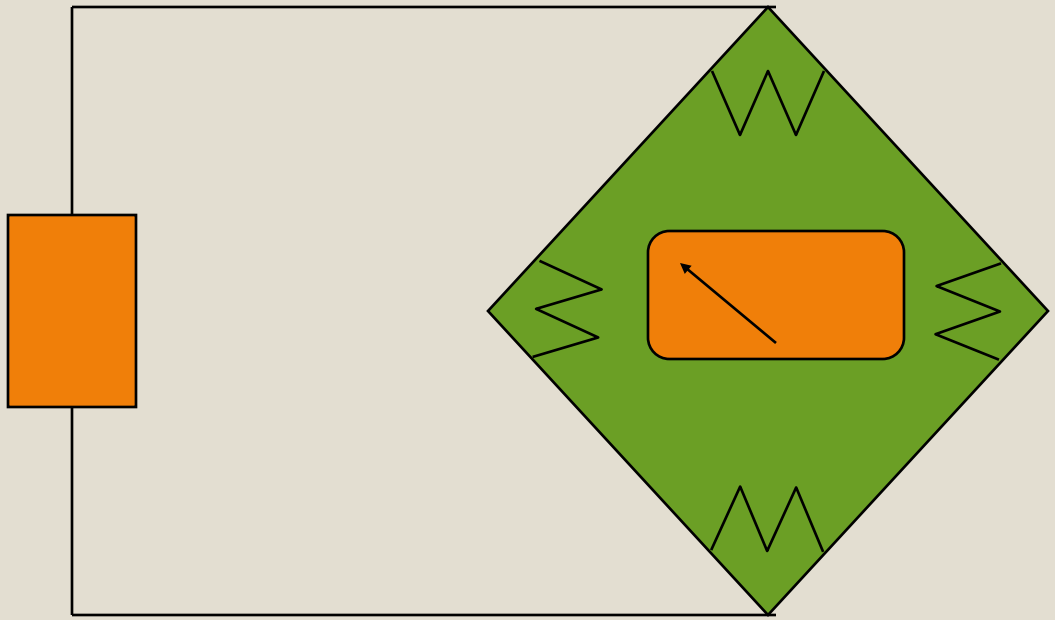
- Methane only
- Range 100 feet
- Bridge crossings, fenced yards, elevated pipes, etc.

DETECTS METHANE GAS AS IT VENTS TO THE ATMOSPHERE

CATALYTIC INSTRUMENTS

- Whetstone Bridge
  - Burns the gas
  - Measures increase in electrical resistance
  - Limitations:
    - Not specific to a single gas
    - Affected by voltage
    - Affected by contamination

WHETSTONE BRIDGE



LEAKAGE SURVEY

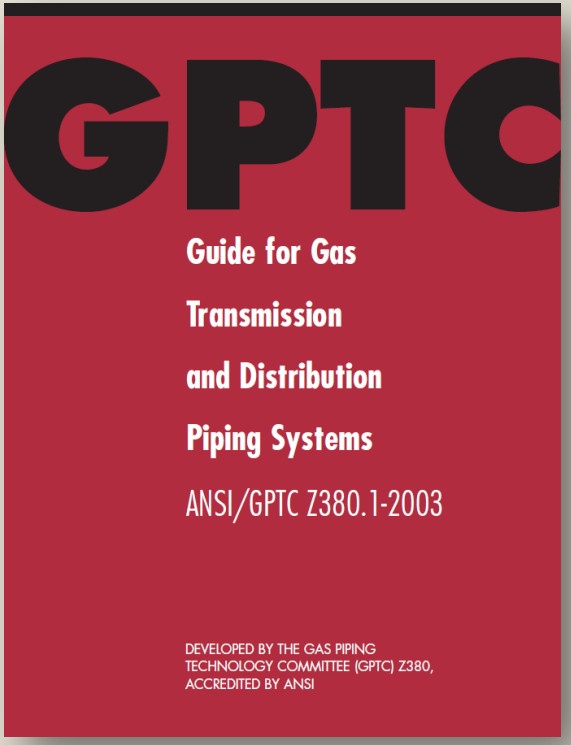
- Does the code say we have to fix leaks?
  - §192.711 and §192.717 - Transmission
  - §192.703 - All pipelines, including distribution
- Does the code tell us how to survey?
  - §192.706 – Transmission
  - §192.723 - Distribution

LEAKAGE SURVEY

- Does the code tell us we need to grade leaks?
  - No
- What does the code tell us????????
  - … The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions…
- So what do we do? Where can we get help?

GAS PIPING AND TECHNOLOGY COMMITTEE (GPTC)

- **GPTC Guide for Gas Transmission and Distribution Piping Systems - ANSI/GPTC Z380.1-2003**
  - Appendices:
    - G-192-11: GAS LEAKAGE CONTROL GUIDELINES FOR NATURAL GAS SYSTEMS (METHANE)
    - G11A: GAS LEAKAGE CONTROL GUIDELINES FOR PETROLEUM GAS SYSTEMS



GUIDE MATERIAL APPENDIX G-192-1 GAS LEAKAGE CONTROL GUIDELINES FOR NATURAL GAS SYSTEMS (METHANE)

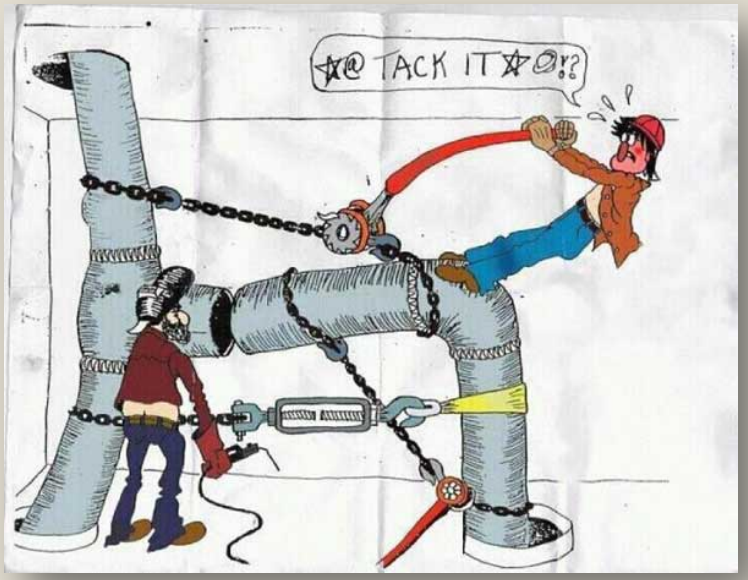
- General Discussion which includes physical properties of Natural Gas
- Definitions
- Leakage Detection
- Leakage Classification and Action Criteria
- Records

GPTC

- PAY ATTENTION!
  - Some states have additional requirements
  - Guide material may not be adequate under all conditions
  - Should not restrict operator from using other methods to comply
  - Does not ensure that operator is automatically in compliance

LEAKAGE DETECTION

- Qualification of personnel
- Reports from outside sources
- Odors or indications from foreign sources
- Surface gas detection survey
- Subsurface gas detection survey
- Vegetation survey
- Pressure drop test
- Bubble leak test



TRAINING

- Survey procedure:
  - Walking? Mobile? Bar hole? Combination?
- Product familiarity - critical
- Instrumentation
- Follow up inspections

INSTRUMENT MAINTENANCE

- "…in accordance with the manufacturer's recommended operating procedures."
  - Periodically checked while in use
  - Tested daily or prior to use
  - HFI at start-up and throughout the day

CALIBRATION OF INSTRUMENTS

- …in accordance with the manufacturer's recommended operating procedures.
  - After any repair
  - Regular schedule
  - Any time it does not appear to be working correctly

QUIZ

- What does LEL mean?

QUIZ

- Between what concentrations will Natural Gas ignite?

QUIZ

- Below ground leaks can be classified with an HFI or other Surface Sampling detector?

QUIZ

- Will 70% LEL ignite?

QUIZ

- Will 70% Gas ignite?

QUIZ

- Does Natural Gas Smell the same as sewer gas?

QUIZ

- A company does not need a survey program if it uses the GPTC guide material?

QUIZ

- Instrument calibration is not required? Is it?

QUIZ

- Can instrument maintenance be performed by any employee?

BONUS QUESTION

- True or false: when investigating an odor complaint, the first priority is to find and fix the leak.

QUESTIONS

MY CONTACT INFO

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