GAS LEAKAGE TRAINING

1-800-HEATH-US
www.heathus.com
CONSERVE RESOURCES

PRODUCTION WELL

COMPRESSOR

GATE STATION

TOWN BORDER STATION

REGULATOR STATION TO 60 PSI

SERVICE TAP

METER
REASONS FOR CONDUCTING LEAK SURVEY

- Public Safety
- Reduction of loss gas
- System Overview/Budget Funds where needed
- Reduce operating cost
- Public Image
- Federal & State Regs
- Leak Survey
  - 192.723
  - Periodic Leakage surveys w/ leak detector
  - Business Districts not to exceed 15 months
  - Outside business districts: 3 to 5 years
Survey Procedures

- Have a plan
  - How do you determine the area to be inspected?
  - How do you identify facilities to be inspected?
  - How do you record a completed area?

- Survey all the mains and services

- Bar Test all subsurface leak indications

- Check all available openings – venting locations – such as manholes, cracks, water boxes, drain pipes, cleanouts, electric meters and conduit, telephone and CATV boxes, etc.
Optimum Survey Triangle

- Venting
- Instrument
- Operator
<table>
<thead>
<tr>
<th>PARAFFIN SERIES</th>
<th>METHANE</th>
<th>ETHANE</th>
<th>PROPANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH4</td>
<td>H-H</td>
<td>H-H-H</td>
<td>C3H8</td>
</tr>
<tr>
<td>Gas, difficult to liquefy</td>
<td>Natural Gas</td>
<td>Gas, easily liquefied</td>
<td></td>
</tr>
</tbody>
</table>
## SAMPLE OF NATURAL GAS ANALYSIS

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Volume Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane (CH4)</td>
<td>91.50</td>
</tr>
<tr>
<td>Ethane (C2H6)</td>
<td>3.75</td>
</tr>
<tr>
<td>Propane (C3H8)</td>
<td>1.41</td>
</tr>
<tr>
<td>Butane (C4H10)</td>
<td>0.58</td>
</tr>
<tr>
<td>Hexane’s plus (C6H14+)</td>
<td>NIL</td>
</tr>
<tr>
<td>Pentane (C5H12)</td>
<td>0.15</td>
</tr>
<tr>
<td>Nitrogen (N2)</td>
<td>2.56</td>
</tr>
<tr>
<td>Carbon Dioxide (CO2)</td>
<td>0.05</td>
</tr>
<tr>
<td>Oxygen (O2)</td>
<td>NIL</td>
</tr>
<tr>
<td>Hydrogen (H2) &amp; Sulfide (H2S)</td>
<td>NIL</td>
</tr>
</tbody>
</table>

4/10/2015
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td>.55</td>
<td>1193</td>
<td>5.3</td>
<td>15.0</td>
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<tr>
<td>Natural Gas Blend</td>
<td>Blend</td>
<td>.65</td>
<td>950-1200</td>
<td>4.5</td>
<td>14.5</td>
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<tr>
<td>Ethane</td>
<td>C₂H₆</td>
<td>1.04</td>
<td>993-1101</td>
<td>3.0</td>
<td>12.5</td>
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<tr>
<td>Propane</td>
<td>C₃H₈</td>
<td>1.56</td>
<td>957-1090</td>
<td>2.2</td>
<td>9.5</td>
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<tr>
<td>Butane</td>
<td>C₄H₁₀</td>
<td>2.01</td>
<td>912-1056</td>
<td>1.9</td>
<td>8.5</td>
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<tr>
<td>Hexane</td>
<td>C₆H₁₄</td>
<td>3.0</td>
<td>437</td>
<td>1.1</td>
<td>7.5</td>
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<tr>
<td>Gasoline Blend</td>
<td>Blend</td>
<td>3-4.0</td>
<td>632</td>
<td>1.4</td>
<td>7.6</td>
</tr>
<tr>
<td>Acetone</td>
<td>C₃H₆O</td>
<td>2.0</td>
<td>869</td>
<td>2.5</td>
<td>12.8</td>
</tr>
<tr>
<td>Benzene</td>
<td>C₆H₆</td>
<td>2.8</td>
<td>928</td>
<td>1.2</td>
<td>7.8</td>
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<tr>
<td>Carbon Monoxide</td>
<td>CO</td>
<td>1.0</td>
<td>1128</td>
<td>12.5</td>
<td>74.0</td>
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<tr>
<td>Hydrogen</td>
<td>H₂</td>
<td>.1</td>
<td>932</td>
<td>4.0</td>
<td>75.0</td>
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<tr>
<td>Hydrogen Sulfide</td>
<td>H₂S</td>
<td>1.2</td>
<td>500</td>
<td>4.0</td>
<td>44.0</td>
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</tbody>
</table>
PHYSICAL PROPERTIES OF NATURAL GAS

- Lighter than air
- Odorless
- Hydrocarbon
- Primary component is methane
- Combustible
- Colorless
- Non-toxic
PHYSICAL PROPERTY – LIGHTER THAN AIR

Air Has a Specific Gravity of 1
Natural Gas Is Approximately .65
Natural gas is processed to remove impurities. Resulting in tasteless and odorless gas.

Odorant is added to natural gas to add scent. A Warning agent.

Usually mercaptans or sulfides.
MERCAPTAN / SULFIDE COMPONENTS

- **EM** Ethyl Mercaptan
- **DMS** Dimethyl Sulfide
- **IPM** ISO Propyl Mercaptan
- **MES** Methyl Ethyl Sulfide
- **NPM** Normal Propyl Mercaptan
- **TBM** Tertiary Butyl Mercaptan
- **SBM** Secondary Butyl Mercaptan
- **DES** Diethyl Sulfide
- **THT** Thiophane
- **EIS** Ethyl Isopropylnyl Sulfide
WHY ODORIZE?

- SAFETY
  - A warning device for the public – it is the customer’s leak detector and lifeline to safety

- COST REDUCTION FOR COMPANIES
  - Aids in the detection of leaks and avoids liability

- COMPLY WITH GOVERNMENT REGULATION
  - DOT 192.625 – Odorization of gas
A combustible gas in a distribution line must contain a natural odorant or be odorized so that at concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.
DETECTABLE AT 1/5 OF LEL!

- Explosive limits: 5% LEL to 15% UEL

- Must be able to smell odorant in no more than 1% of natural gas

  - Less than 1% is "good"

  - Greater than 1% is "bad"
To assure the proper concentration of odorant in accordance with this section, each operator must conduct periodic sampling of combustible gases using an instrument capable of determining the percentage of gas in air at which the odor becomes readily detectable.
PHYSICAL PROPERTY - COMBUSTIBLE – POTENTIAL SOURCES OF IGNITION

- Any open flame
- Electrical switches
- Electrical motors
- Automobiles
- Static electricity
- Telephone
- Doorbell
- Etc…
Sources of Combustible Vapors

- NATURAL GAS – Methane, Ethane
- GASOLINE - C5's and heavy HC's
- SOIL & LANDFILL - Methane, CO2
- GASES IN SEWER - Solvents, Alcohols
- SEWER GAS - Methane, CO2, H2S
Explosive Mix

1. Fuel
2. Oxygen
3. Heat (Ignition Source) 1100-1200 °F

Need all three ingredients for a burn or explosion.
PHYSICAL PROPERTY - NON-TOXIC: NATURAL GAS EFFECTS ON VEGETATION

- Displaces oxygen and moisture.
- Reduces the oxygen content of the soil.
- Dries the soil out (Drought Effect)
- Results in dead or dying (brown) vegetation.
- Natural gas does Not poison the soil.
- It reduces the soil’s ability to support plant growth.
VEGETATION DAMAGE
Normal air is 20.9% oxygen. Levels outside of 19.5% to 23.5% oxygen in air is unacceptable for human habitation.
POTENTIAL EFFECTS OF OXYGEN-DEFICIENT ATMOSPHERES

- 19.5% Minimum permissible oxygen level
- 15 – 19% Decreased ability to work strenuously. May impair coordination
- 12 – 14% Respiration increase in exertion
- 8 – 10% Mental failure, fainting
- 6 – 8% 8 minutes – 100% fatal
- 4 – 6% Coma in 40 seconds
GAS DISPERSION/MIGRATION

- Type of soil with regard to compactness and size of soil particles can influence the dispersion of gas. However, this will vary with gas pressure, surface cover and other factors.
FACTORS AFFECTING GAS MIGRATION

- Soil Type
- Soil Moisture
- Surface Cover
- Line Pressure
- Depth of Burial
- Leak Size and Age
- Change in Elevation = Slope
- Path of Least Resistance
Fig. 1—Natural gas leaking from a buried pipeline spreads up and away from the source of the leak in a path resembling the shape of an inverted cone.

Fig. 2—The path of leaking gas through clay soils is spread somewhat irregularly in shape and more nearly approximates a truncated inverted cone.
Major Causes of Gas Leakage

- Third Party Damage
- Corrosion
- Construction/Material Defect
- Improper Design
- Mechanical Failure
In the last 20 years, 50% of natural gas related incidents/explosions have been a direct result of “dig-ins” or outside damage!

This is the major reason why we should always promote the “Call Before You Dig.”
Our Main Job Is Not Finding And Fixing Leaks
Our Main Job Is PUBLIC SAFETY!
LEAK MANAGEMENT / DIMP

- Locate the leaks in the distribution system
- Evaluate the potential hazard
- Act appropriately to mitigate these hazards
- Keep records
- Self-assess to determine if more action is needed to protect life and property
THREE PHASES OF A LEAK DETECTION PROGRAM

- Detect
- Center / Pinpoint
- Repair
VENT LINES
WALKING / MOBILE SURVEY / PINPOINTING
FLAME IONIZATION INSTRUMENTS

- Use as search instrument
- Will pick up any hydrocarbon
- Detects in PPM
- It MUST be maintained properly
DAILY CARE AND MAINTENANCE

- Check hoses
- Change Filters as needed
- Clean probe with water
- Check batteries
- Use proper fuel - Certified Gas Only
- Do a tightness test
- Perform a “bump” (operational) test prior to using each day
- Check Calibration – once a week
### CONVERSION OF PPM – LEL - % GAS (METHANE)

<table>
<thead>
<tr>
<th>PPM</th>
<th>LEL</th>
<th>VOLUME GAS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0002</td>
<td>0.0001</td>
</tr>
<tr>
<td>10</td>
<td>0.02</td>
<td>0.001</td>
</tr>
<tr>
<td>50</td>
<td>0.1</td>
<td>0.005</td>
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<tr>
<td>500</td>
<td>1</td>
<td>0.05</td>
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<tr>
<td>1000</td>
<td>2</td>
<td>0.1</td>
</tr>
<tr>
<td>2500</td>
<td>5</td>
<td>0.25</td>
</tr>
<tr>
<td>5000</td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>10,000</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>50,000</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>100,000</td>
<td>-------</td>
<td>10</td>
</tr>
</tbody>
</table>
1 Part Per Million (PPM)

One penny in Ten Thousand Dollars
CALIBRATION

- Used to document that the instrument is working properly.
- A certified, known sample of gas is drawn into the sensor.
- The instrument is adjusted to read the known sample at the certified percentage level (Example: 100 PPM methane balanced with air)
- This test is than recorded and documented on a calibration sheet for each instrument.
COMBUSTIBLE GAS INDICATOR
(OUR MOST IMPORTANT TOOL)

CGI should be used to:

1. Classify An Atmosphere
   - Inside and in a confined space

2. Classify Underground Leakage - Center
   - Determine: where is the gas?

3. Pinpoint Underground Leakage
   - Determine: where is the leak?
Wheatstone Bridge

(unknown) y

A

B (adjust)

D

C

F

E
DIGITAL / WITH PUMP

will make finding gas leaks fast and
CGI DAILY OPERATIONAL TEST

- Check hoses/tubing for cracks, moisture, discoloration & dust
- Change filters as needed
- Check calibration – once a week or as required by company
- Check batteries
- Voltage Test
- Air Tightness Test
- Perform a daily operational check prior to use with a known sample of gas
ACCESSORIES USED WITH CGI

- CHARCOAL FILTER
- WATER TRAP
The CGI you will be using has two scales:

- 0 to 5% (0 to 100 LEL) and 0 to 100% Percent Gas
CONVERSION CHART FOR INSTRUMENTS THAT DISPLAY LEL AND YOU WANT TO CONVERT TO % GAS

<table>
<thead>
<tr>
<th>LEL</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 LEL</td>
<td>1 %</td>
</tr>
<tr>
<td>40 LEL</td>
<td>2%</td>
</tr>
<tr>
<td>60 LEL</td>
<td>3%</td>
</tr>
<tr>
<td>80 LEL</td>
<td>4%</td>
</tr>
<tr>
<td>100 LEL</td>
<td>5%</td>
</tr>
</tbody>
</table>
1. You are operating a CGI and you are checking for a natural gas leak. Your reading is 60%LEL – what percent would that be on the gas scale?

2. CGI is used to:
   - A. Confirm leak indication
   - B. Investigate inside leak complaints
   - C. Determine hazardous conditions
   - D. All of the above
3. When operating your CGI in the presence of petroleum vapors, what filter must be used to differentiate between natural gas and petroleum?

- A. Water Trap
- B. Inhibitor Filter
- C. Cotton Filter
- D. Charcoal Filter
CENTERING
Where Is The Gas?

PINPOINTING
Where Is The Leak?

The Leak Must Be Centered Before It Is Pinpointed!
CENTERING – WHERE IS THE GAS

- The Perimeter of the Leakage Area Must Be Identified
- The Test Holes Should Be The Same Depth
- The Probe Inserted The Same Depth
- Note The Stabilized Readings
- The Leakage Area Should Be “Zeroed Out” In All Four Directions
REMEMBER

- The Most Important Safety Characteristic Of Natural Gas is …
  “The Fact That It Is Lighter Than Air.”

- However, it will eventually Vent to Atmosphere, by taking the path of LEAST RESISTANCE.
Leaks are Difficult to Pinpoint When:

- Gas saturates a large area
- Water prevents taking CGI readings
- Multiple leaks are present
- Gas migrates away from leak
LOCATING THE LINE

• Maps
• Records
• System Experience
• Electronic Locators
• Other Utilities
PLACEMENT OF DRILL HOLES

- Where and how many?
- What size test holes?
- How deep?
- How far apart?
- How many?
PLACEMENT OF DRILL HOLES (cont’d)

• SAME (Saving Another Missed Excavation)

• Are reading stable or changing

• Bracketing the leak
BAR HOLE READINGS

• Sight: look across the top of the holes - the hole with the most fumes or the greatest amount of dust should be closest to the leak

• Feel: place the back of your hand over the hole – it is sometimes possible to feel which hole is venting the most gas

• Smell: If your nose can stand it, the gas which smells the closest to the original odor (need to know how your odorant smells) is normally closest to the leak.
BAR HOLE READS (cont’d)

• Aeration: to help in a more positive diagnosis the use of a soil purger maybe necessary.

• Aerator / purger sucks the gas and air from the individual bar holes and surrounding subsurface areas.
TESTING - USING A SOIL PURGER

- When to use it
- Application in pinpointing process
- How it works / Why it may not work
- Maximizing its effectiveness
- Use as a safety tool
The Four Dimensions Of Gas Leak Classification

1. **DISPERSION** = Where is the gas? Determining the perimeter.
2. **LOCATION** = The leakage area as compared to the surroundings.
3. **PROPORTION** = The amount of gas as shown on the CGI.
4. **EVALUATION** = The operator and his/her judgment…

**ONLY YOU CAN MAKE THE CALL!**
Leak Classifications

- Type 1 – Leak most severe needs immediate attention
- Type 2 – Leak non-hazardous needs scheduled repair
- Type 3 – Leak non-hazardous and can be expected to stay non-hazardous
FIRST PRIORITY WHEN FINDING A GRADE 1 LEAK

Protect life and property by making safe.
MAKESAFE
(Actions To Consider)

- Time Is Critical. Remember, Public Safety First!
- Implementation Of The Emergency Plan
- Calling For Additional Help
- Notification of Police & Fire Departments
- Evacuating Premises
- Blocking Off The Area
- Stopping The Flow Of Gas
MAKE SAFE
(Actions To Consider)

- Elimination of Ignition Sources
- Venting An Area

Remember!
Your job is **Public Safety**
And not finding and fixing the leak!
Leak Classifications

- Not every leak detected is a Grade 1 leak.
- It is up to the technician or the operating personnel on the scene to make the call.
- Use good judgment and common sense.
It sometimes does not matter if you do your job perfectly….you may be judged by your paperwork.

Paperwork involving leakage, odor complaints, service, construction and other pertinent documents must be completed - NEATLY, THROUGHLY AND ACCURATELY!

When filling out your paperwork, look at it and think….”If I had to testify about this document in front of a judge or jury, would this document help or hurt me?”
END