

FUNDAMENTALS OF NATURAL GAS SAFETY

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INTRODUCTION

Natural Gas: A combustible mixture of methane and higher hydrocarbons used chiefly as fuel and raw material.

To safely produce natural gas and natural gas products, a basic understanding of the hazards of the material itself and the processes required to bring it to market is essential. Let's start out with the hazards of natural gas as it is in its raw field gas state:

1. Flammable/Explosive
2. Hazardous Impurities
 - a. Hydrogen Sulfide
 - b. Benzene
 - c. CO₂
 - d. Liquid, Petroleum Gases (LPG's)

Flammable/Explosive

Raw field gas can have a lower explosive limit less than 0.5% in air and an upper explosive limit in excess of 40% in air. This is different from pure methane, which is the major component of commercial natural gas.

Differences in raw field gas and methane are:

	<u>Raw Field Gas</u>	<u>Methane</u>
Vapor Density	1.0 to 2.1	0.6
Vapor Pressure	30 psi @ 60°F To 765 psi @ 100°F	NA
Solubility in Water	Negligible	Slight
Appearance	Colorless Gas/ Can Produce Vapor Cloud Resembling Fog	Colorless
Odor	None to Light Hydrocarbon Odor	None
Boiling Point	Varies with Mix	-258°F
Lower Explosive Limit	0.4%	3.6-5%
Upper Explosive Limit	40%	15%

Because of the densities of raw field gas components, it can settle and form explosive mixture at ground level.

The colder the air temperature, the greater the probability of this occurring. Should leaks occur or line depressuring become necessary, extreme caution should be exercised before entering the area. Use of a L.E.L. meter is recommended to determine if gas has settled in the area. Gas concentrations in excess of 10% L.E.L. should stop entry and all activity in the area.

Methane is lighter than air and rarely settles to the surface unless strong winds influence its ability to rise. It is still an advisable step to check all work areas with a L.E.L. meter prior to starting work.

Hazardous Impurities

A. *Hydrogen Sulfide (H₂S)*: Gas containing this chemical is often called "sour gas" because of its characteristic rotten egg odor. This gas is an extremely fast-acting toxic substance. The NIOSH 8 hour exposure level is 10 ppm. A maximum allowable short-term exposure level, (STEL), of 50 ppm for 15 minutes is allowable, if no other exposure occurs. The reason for no other exposure if you are exposed at the STEL level is that the effects are cumulative. The toxic effect will destroy your ability to detect the odor at concentrations above 100 ppm. At concentrations above 800 ppm to 1,000 ppm, a one-breath exposure can cause unconsciousness and death unless rescue is immediate, followed by correct medical procedures. It is estimated that 50% of all hydrogen sulfide deaths are rescuers trying to make a rescue without proper respiratory protection. Never enter an atmosphere that is immediately dangerous to life or health without positive pressure air-supplied respiratory protection.

B. *Benzene (C₂H₂)*: Benzene is a liquid that may be present in small amounts in raw and pipeline quality natural gas. It rarely is found in quantities that would add to the flammability or explosive characteristics of the total mix. Its primary hazard is that of a long-term health hazard. OSHA has determined that exposures in excess of the threshold limit value (T.L.V.) of 1 ppm in the work place are hazardous. Extensive safety precautions described in 29cfr 1910.1028, (Benzene), are all required by OSHA if the "Action Level" air-borne concentration of Benzene in the workplace exceeds 0.5 ppm based on an 8 hour time weighted average. Long-term exposure may cause liver, kidney, and brain damage, as well as leukemia.

C. *Carbon Dioxide (CO₂)*: Inhalation exposures over 5,000 ppm (0.5% in air) can produce overexposure symptoms such as rapid breathing, rapid heart rate, headache, sweating, shortness of breath, mental depression, visual disturbances, shaking, unconsciousness, and death. Concentrations of 50,000 ppm (5% in air) are considered immediately dangerous to life and death. The hazard of the CO₂ at 5% in air is compounded by its displacing the oxygen content in air. This gas is heavier than air and can accumulate in closed spaces and low places. This gas is colorless and odorless. A relatively small leak of almost pure CO₂ at an extraction plant can cause an extremely hazardous situation at indoor equipment and compressor locations.

D. *Liquefied Petroleum Gases (LPG)*: Other chemicals entrained in raw natural gas are referred to as natural gas liquids. Butane, N-Butane, Propane, ISO-Butane, ISO-Pentane, and Ethane, as well as natural gasoline can be present in raw field gas. These chemicals all have vapor densities heavier than air. Leaks or intentional blow-down can create explosive mixtures at ground level. Fires at or near LPG facilities, storage tanks, and transport containers are extremely hazardous. Should the equipment or tankage be exposed to enough heat to weaken the metal of the equipment or tankage to the point of failure, the resulting release can be catastrophic. The energy released from the expanding LPG as it vaporizes and ignites is monumental. These specific failures are referred to as a B.L.E.V.E. (Boiling Liquid Expanding Vapor Explosion). Equipment pieces, tank ends, etc., can be propelled up to several thousand feet and trailed by an extremely large fireball. Unless specific equipment training and large amounts of water are available and can be delivered correctly on the involved equipment, evacuation should begin immediately.

To produce pipeline-grade natural gas from raw field gas, certain processing must take place.

- I. Dehydration
- II. H₂S removal
- III. CO₂ Removal
- IV. Liquid extraction

If you work with, in, or in close proximity to any of these processing facilities, you should become familiar with the following:

- I. Hazards
- II. Operations' Procedures
- III. Emergency Procedures
- IV. What Personal Protective Equipment is Required for Working In or Near These Facilities

At this point in time, technology is expanding our envelope of knowledge faster and faster. New equipment,

techniques, procedures, and applications are being developed with ever increasing speed.

To keep up with new technology and maintain a safe work environment, four areas must be addressed:

I. Knowledge

- A. Basic knowledge of natural gas industry association standards API, AGA, NPRA.
- B. In-depth knowledge of operations policies, procedures, and equipment.
- C. Remain technically up to date.
 1. Operational changes.
 2. Equipment changes and how they influence operations.

D. Governmental regulations

1. Federal
 - a. OSHA
 - b. EPA
 - c. DOT
2. State
 - a. TNRCC
 - b. RRC
3. Local city and county regulations

II. Ability

- A. Mental ability and skills to learn.
- B. Physically able to perform tasks requiring strength, agility, etc., to match tasks.
- C. Ability to think through what the results of your actions will be.

III. Accountability

- A. Management Commitment
 1. Time
 2. Money
 3. Resources

To build, man, and operate safely.

B. Supervision

1. Knowledgeable and well trained in all aspects of his or her job.
2. Has management backing.
3. Is aware of the responsibility for his or her, as well as employees' actions.
4. Can communicate well with his superiors and employees.
5. Sets good example for employees.
6. Give employees time to complete job safely.

- C. Employee
 - 1. Well trained
 - 2. Understands his or her job and accepts responsibility for getting it done.

IV. Attitude

The individual's attitude about working safely is the key to working safely in any industry.

- A. Do it right every time.
- B. If you don't know, ask. Special emphasis to new employees.
- C. Use the correct tools and equipment to do the job.
- D. Work as a team—communicate.

- E. You are your brother's, or sister's keeper. Yes, even contractors.

- 1. Help those who need assistance.
- 2. Help correct improper actions of others.
- 3. Create an atmosphere of looking out for each other.

- F. Housekeeping: Keeping your area clean, organized, and safe. It's your home away from home — keep it clean, neat, and orderly.

- G. Last but not least, common sense and courtesy to others.

- 1. Fellow employees
- 2. Customers
- 3. Contractors
- 4. Public officials
- 5. Land owners