

Gas Risk Management

A Comprehensive Approach to Safety and Compliance

- **Types of Hazardous Gases**
- **Gas Sensor Technology**
- **Placement of Gas Sensors**

Types of Hazardous Gases

Hazardous Gases

■ Combustible Gases

- Explosion hazard
- Must maintain below lower explosive limit

■ Toxic Gases

- Hazardous to human health
- Employee exposure must be limited

■ Oxygen Displacing Gases

- Indirect human health hazard
- Deficiency of breathing oxygen

Combustible Gas



100% LEL Methane = 5% by volume



Combustible Gas



- The flammability of many gases lies in a very limited range
- The LEL differs depending upon the type of gas



Hydrogen Sulfide

H₂S in Air

1 ppm

10 ppm

20 ppm

100 ppm

500 ppm

1,000 ppm

Toxic Symptoms

Odor detected, irritation of respiratory tract

Allowable for 8 hours exposure (OSHA)

Protective equipment is necessary

Smell killed in 5 to 15 minutes. May burn eyes and throat; coughing

Respiratory disturbances in 2 to 15 minutes. Coughing, collapse & unconsciousness

Immediate unconsciousness. Brain damage may result unless rescued promptly. Death in 3 to 5 minutes.

OSHA limit = 10 ppm (TWA)

Carbon Monoxide

CO in Air

Toxic Symptoms

400 ppm	Headache within 1-2 hrs., widespread in 2.5 - 3.5 hrs.
500 ppm	Dizziness, nausea, convulsions within 45 min.
1,600 ppm	Headache, dizziness, nausea within 20 min. Death in 2 hours.
3,200 ppm	Headache, nausea within 5-10 min. Death within 30 min.
6,400 ppm	Headache, dizziness within 1-2 min. Death within 10-15 min.
12,800 ppm	Death within 1-3 minutes.

OSHA limit = 50 ppm (TWA)

Chlorine

Cl₂ in Air

3.5 ppm

15 ppm

30 ppm

40-60 ppm

1000 ppm

Toxic Symptoms

Minimum concentration detectable by odor

Causes throat irritation, smarting of eyes

Coughing, more severe throat irritation, general feeling of discomfort in the chest

Respiratory reflexes, coughing, burning of eyes, nausea, vomiting. Possible death within 30 minutes

Death within a few breaths

OSHA limit = 0.5 ppm (TWA)

Ammonia

NH₃ in Air

20 ppm

40 ppm

100 ppm

400 ppm

700 ppm

1700 ppm

5000 ppm

Toxic Symptoms

First perceptible odor

Slight eye irritation

Irritation of eyes and nasal passages

Severe irritation of throat, nose, upper respiratory tract

Severe eye irritation

Serious coughing, bronchial spasms, death within 30 min.

Serious edema, strangulation, asphyxia, death immediate

OSHA limit = 25 ppm (TWA)

Nitrogen Dioxide

NO₂ in Air

60 - 100 ppm

100 - 150 ppm

200 - 700 ppm

Toxic Symptoms

Immediate irritation of the nose and throat, coughing, nausea, choking, headache, shortness of breath and restlessness. Edema may develop within 6 - 24 hours after exposure

Exposure for 30 - 60 minutes can cause death

Death within minutes

OSHA limit = 3 ppm (TWA)

Nitric Oxide

NO in Air

Toxic Symptoms

50 ppm

Does not cause irritation nor is it easily noticed but can cause chronic respiratory problems and possibly edema

60 - 150 ppm

Irritation of throat, coughing, burning of chest

Can cause tightness / burning of chest 6 - 24 hours after exposure and possibly shortness of breath and sleeplessness. Air hunger will increase rapidly leading to loss of consciousness and then death.

200 - 700 ppm

Fatal after a few minutes

OSHA limit = 25 ppm (TWA)

Sulfur Dioxide

SO₂ in Air

3 - 5 ppm

8 - 12 ppm

150 ppm

500 ppm

Toxic Symptoms

Detectable by irritation

Throat irritation, coughing, constriction of the chest, tearing and smarting of eyes

Extreme irritation and can be tolerated only for a few minutes

Acutely irritating and causes a sense of suffocation

OSHA limit = 2 ppm (TWA)

Oxygen Deficiency

<u>Oxygen</u>	<u>Symptoms Developed</u>
20.9%	Normal oxygen concentration in air
15 - 19%	Decreased ability to work strenuously.
12 - 14%	Respiration increases in exertion, pulse up, impaired coordination, perception & judgment
8 - 10%	Mental failure, fainting, unconsciousness, blueness of lips, nausea & vomiting
6 - 8%	8 minutes, 100% fatal; 6 minutes, 50% fatal, 4 - 5 minutes, recovery with treatment
4 - 6%	Coma in 40 seconds, convulsions, respiration ceases, death

OSHA limit = Breathing Air below 19.5%

Gas Risk Management

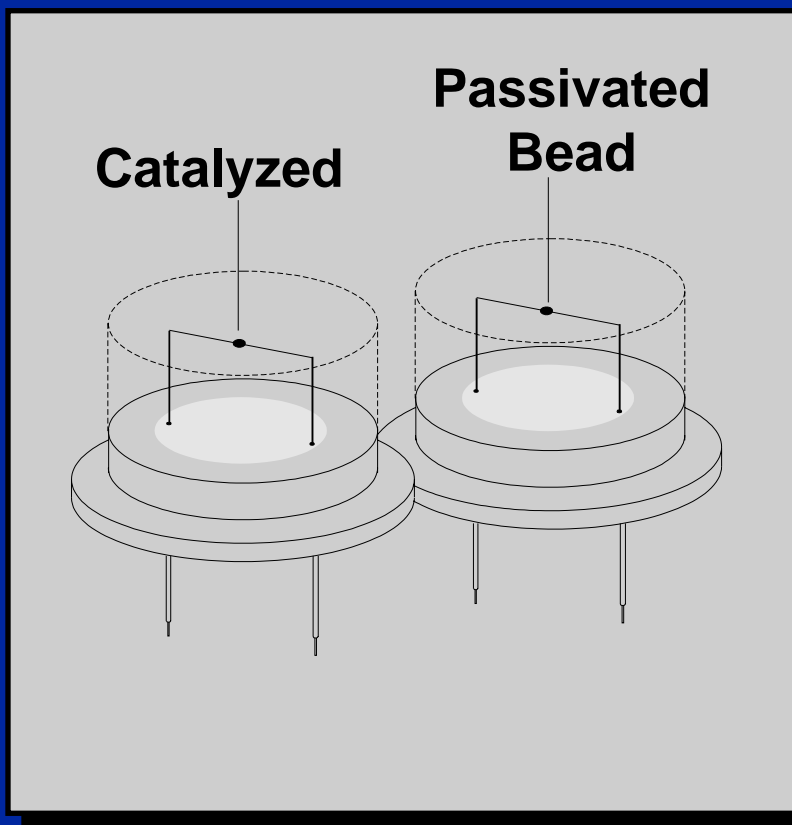
Gas Sensor Technology

Sensor Technology

- Catalytic Bead
- Electrochemical
- Semiconductor
- Infrared

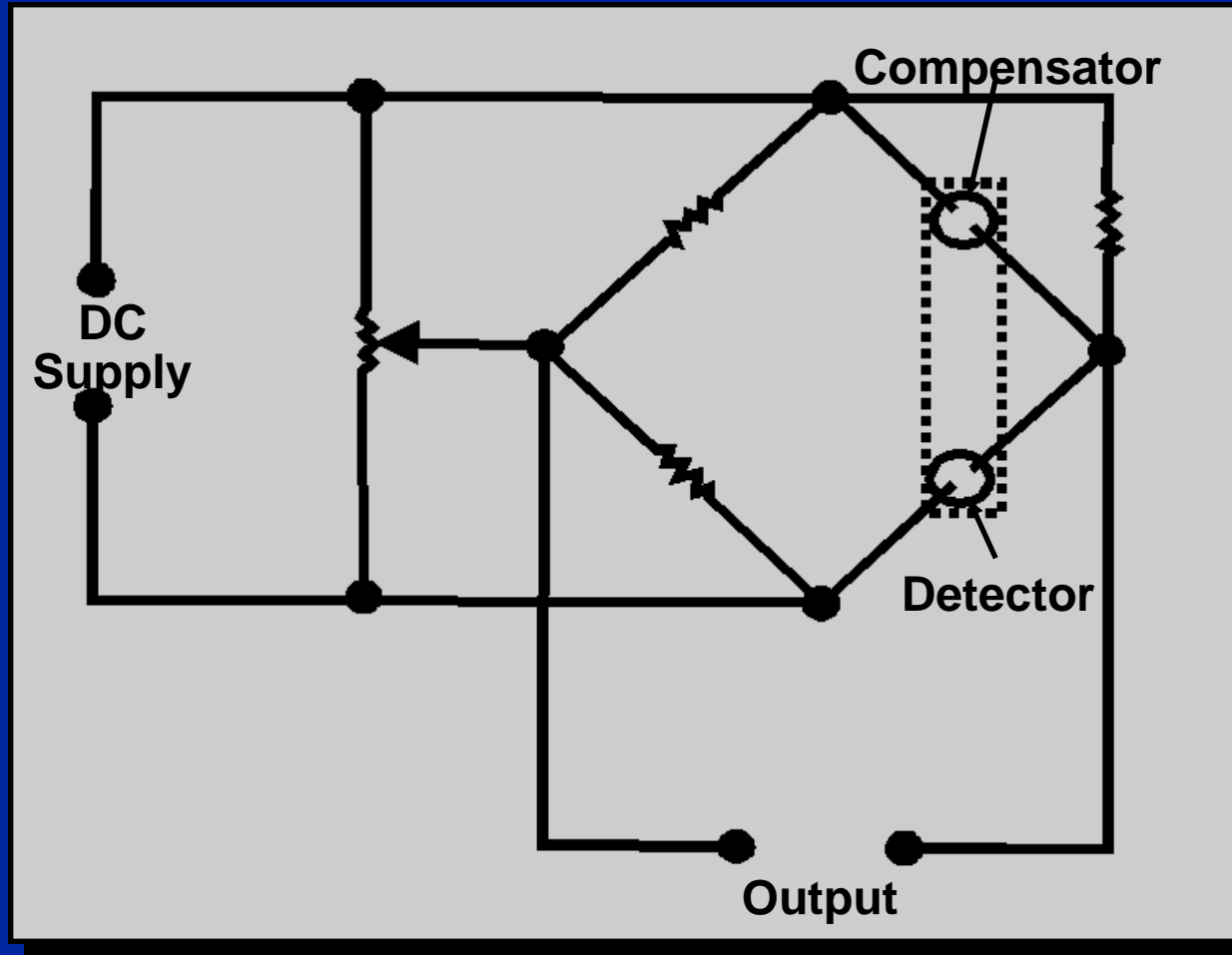
Catalytic Bead

- Wheatstone Bridge
- No Temperature or Humidity Effect
- Silicone Resistant
- 0-100% L.E.L. Scale



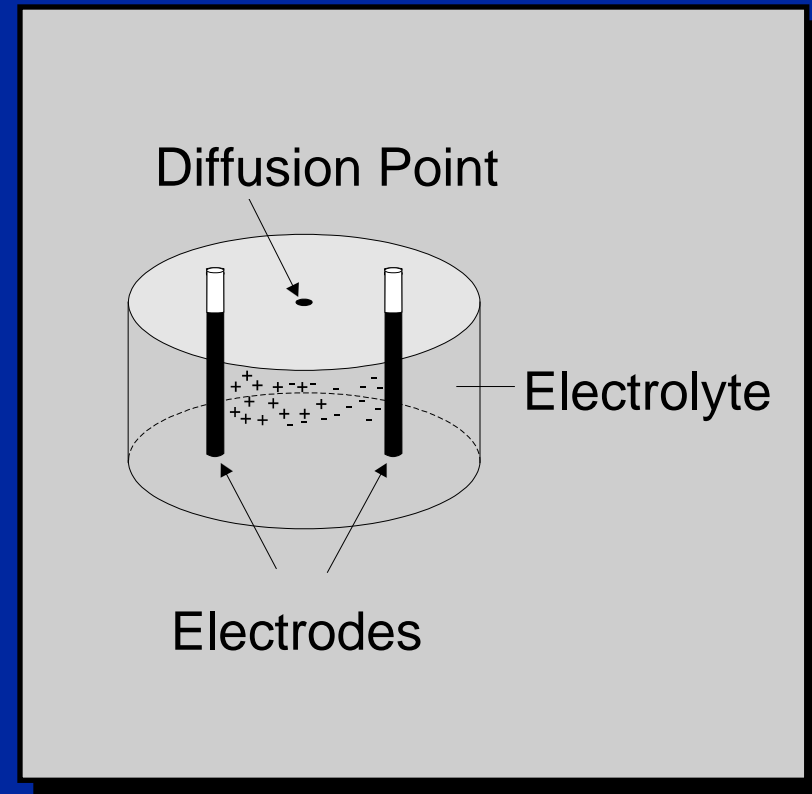
Catalytic Bead

Wheatstone Bridge



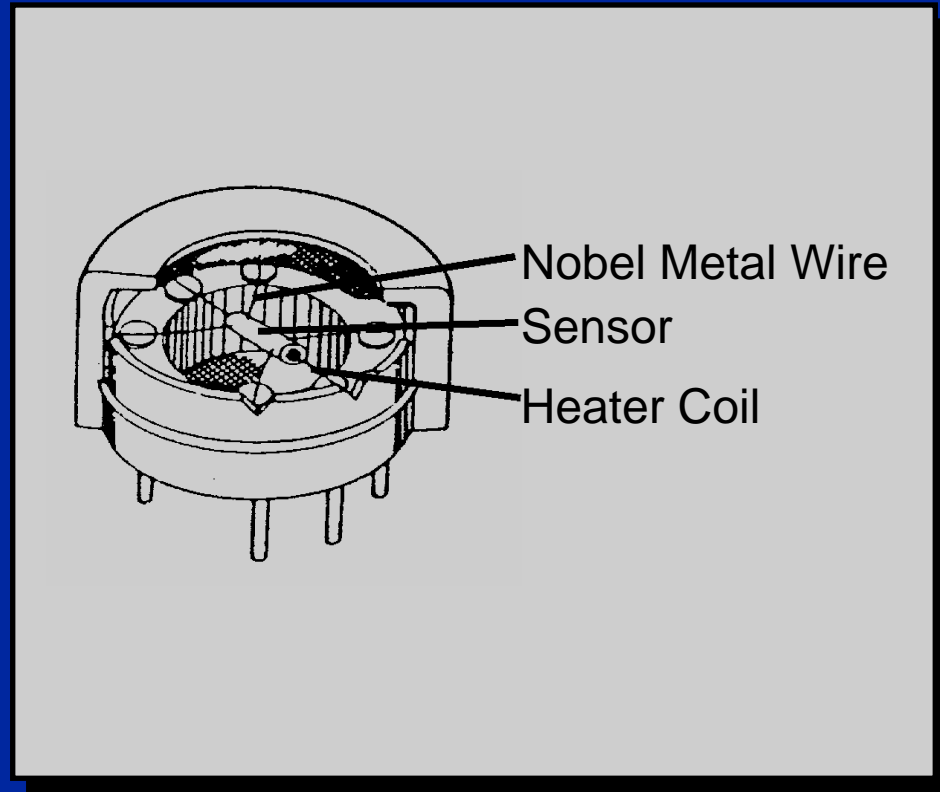
Electrochemical

- **Current Generating Electrolytic Reaction**
- **Specificity to Gas of Interest**
- **PPM for Toxics or Percent Volume for Oxygen**



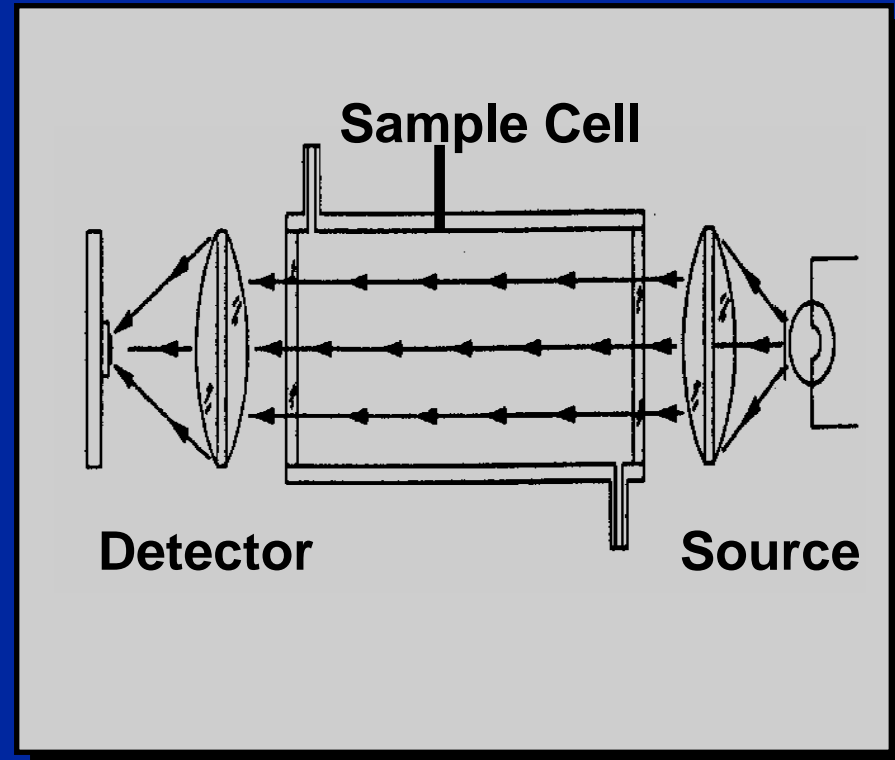
Semiconductor (Solid State)

- Long Life Sensor
- Semiconductor Resistive Film
- PPM Range
- High Sensitivity
- Non-Linear Response



Infrared

- Methane or Propane
- Carbon Dioxide
- Accurate
- Large Measurement Range
- Low Maintenance



Detection Techniques

Combustible

**Catalytic bead, Semiconductor,
Infrared**

Oxygen

Electrochemical

Toxic Gases

**Semiconductor, Electrochemical,
Infrared**

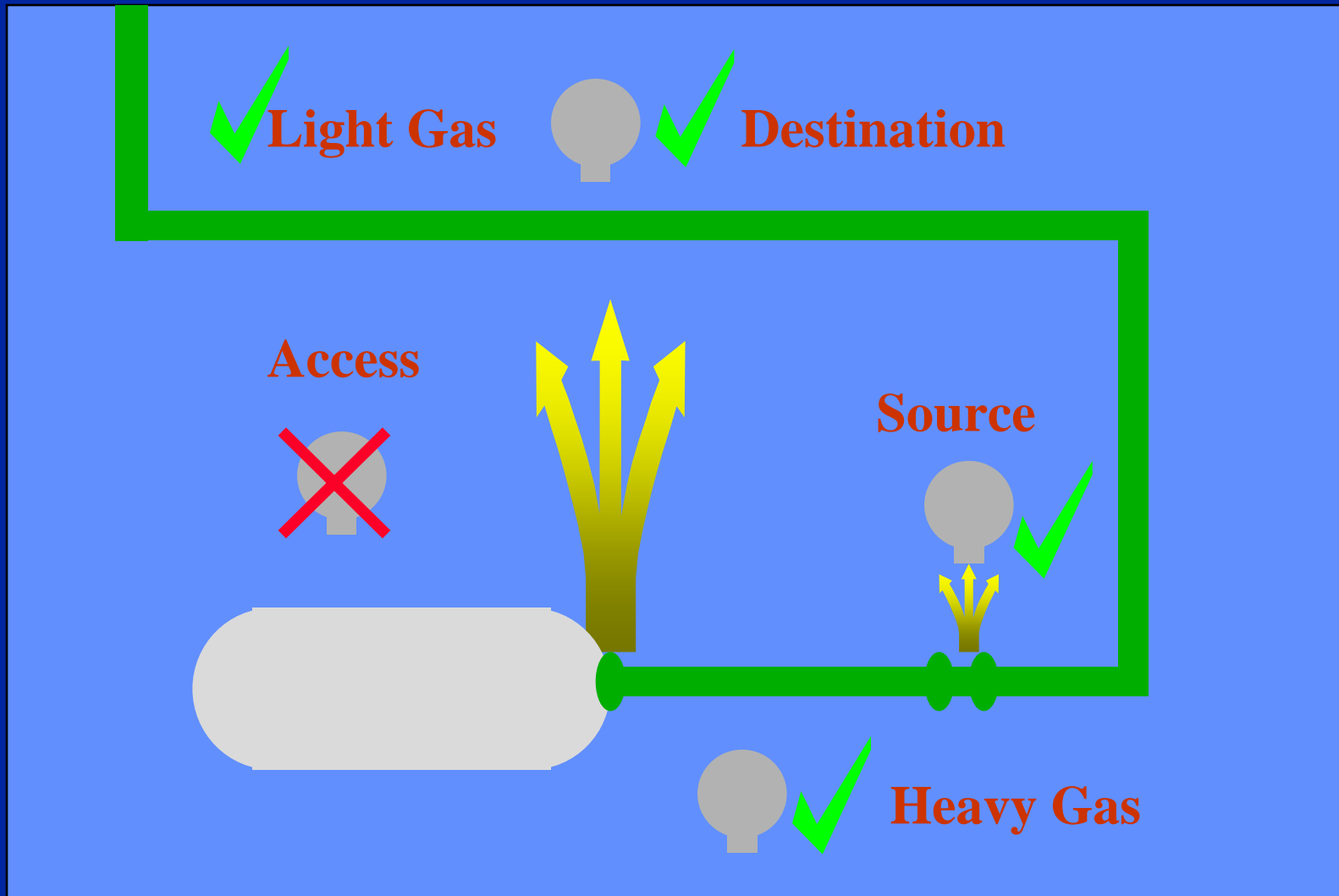
Gas Risk Management

Gas Sensor Placement

Gas Sensor Placement

- Place sensors close to possible gas source
- Place sensors in areas where gas might accumulate
- Place toxic gas and oxygen deficiency sensors in the “breathing zone”
- Consider accessibility and maintenance issues

Gas Sensor Placement



Gas Weight in Relation to Air

■ Ammonia	Lighter
■ Butane	Heavier
■ Carbon Dioxide	Heavier
■ Carbon Monoxide	Slightly Lighter
■ Methane	Lighter
■ Chlorine	Heavier
■ Ethane	Slightly Heavier
■ Ethylene	Slightly Lighter
■ Heptane	Heavier
■ Hydrogen	Lighter

Gas Weight in Relation to Air

■ Hydrogen Chloride	Heavier
■ Hydrogen Cyanide	Lighter
■ Hydrogen Sulfide	Heavier
■ Methyl Alcohol	Heavier
■ Nitric Oxide	Slightly Heavier
■ Nitrogen Dioxide	Heavier
■ Pentane	Heavier
■ Propane	Heavier
■ Sulfur Dioxide	Heavier
■ Toluene	Heavier

Sierra Monitor Corporation



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Your Highest Expectation is Ours