



Scottish Housebuilders
Health and Safety Forum

CONFINED SPACES

Frontline Safety



Agenda



3-4	Defining a Confined Space	12	Toxic Vapours and Gases
5	Gas Risks in Confined Space	13	Brownfield Sites
6	Equipment and Monitoring	14-18	Best Practice
7-10	Atmospheric Hazards	19	A Complete Confined Space Kit
11	Exposure Limits		

Defining a Confined Space

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“confined space” means any place, including any chamber, tank, vat, silo, pit, trench, pipe, sewer, flue, well or other similar space in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk.

”

- Confined Spaces Regulations 1997, Health and Safety Executive

- Storage Tanks
- Ship Compartments
- Process Vessels
- Boilers
- Sewers
- Tunnels
- Underground Utility Vaults
- Pipelines
- Storm Drains
- Pits (open-topped)
- Degreasers (open-topped)
- Open-topped Water Tanks
- Ship Holds (open-topped)
- Excavations (open-topped)

Defining a Confined Space

Mulholland Contracts were required to excavate to a depth of 6 metres to facilitate directional drilling for a new storm system. Frontline Safety UK Ltd. was consulted early in the design to help plan and manage the risks associated with confined space hazards.

Sheet piling was used to support the excavation, and due to the depths involved, access and egress were via ladder only. The site had an extensive mining history; consequently, there was a risk of gases permeating through the soil and into the excavation.

A 4-gas (O₂, LEL, H₂S, CO) pumped unit was used by the 'top man' to monitor the atmosphere at all times whilst occupied. All personnel entering the excavation were trained in Confined Spaces and were issued with a personal 4-gas monitor and positive pressure escape hood. A counterbalance davit arm was deployed at the side of the excavation to assist with both fall arrest and emergency recovery.



GAS RISKS IN CONFINED SPACES

- ▶ Equipment and Monitoring
- ▶ Atmospheric Hazards
- ▶ Exposure Limits
- ▶ Toxic Vapours and Gases
- ▶ Brownfield Sites

Equipment and Monitoring

Protect

- Testing and Monitoring
- Ventilation
- Communications
- Lighting
- Barriers
- Other personal protective equipment
- Any required rescue and emergency equipment

Monitor and Ventilate

- Monitoring determines the air is safe, and ventilation keeps it that way
- The only way to pick up changes before they become life-threatening is to monitor them continuously
- Before entry, it is mandatory to determine that the confined space atmosphere is safe

Continue

- Atmospheric hazards in confined spaces form layers
- Crucial for gas to be checked at all levels

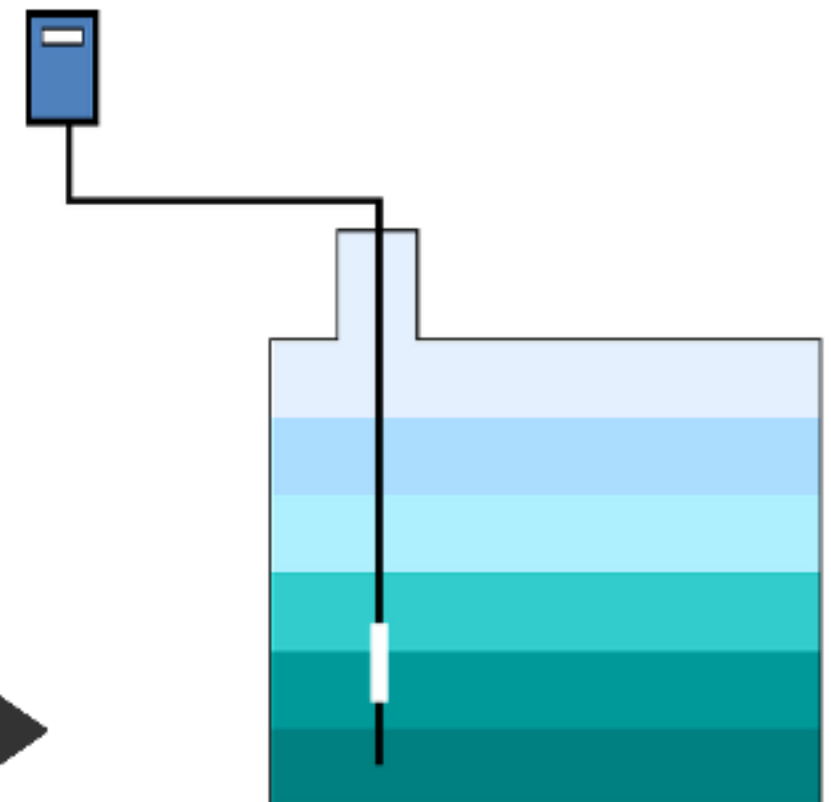
Atmospheric Hazards

H2S

O2

LEL

CO



H2S - Hydrogen Sulphide

- Produced by anaerobic sulfur-fixing bacteria
- Colourless
- Has a 'rotten egg' like odour at low concentrations
- Heavier than air
- Corrosive
- Flammable (LEL is 4.3%)
- Soluble in water
- Extremely toxic

H2S LEVELS	TOXIC EFFECTS
1.0 PPM	Ability to smell the gas
100 PPM	Rapid loss of smell
200-300 PPM	Eye inflammation, respiratory tract irritation after 1 hour, loss of consciousness
500-700 PPM	Death in 30min-1 hour
1000 PPM	Immediate respiratory arrest, loss of consciousness, followed by death

Associated with -

- Raw sewage
- Marine Seiments
- Pulp and paper industry
- Crude Oil
- Tanneries

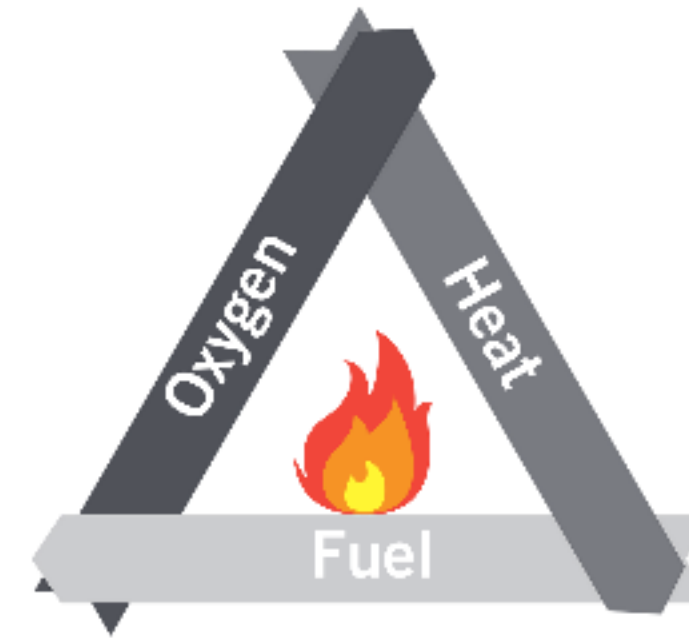
02 - Oxygen

- Enrichment or deficiency
- Too much - fire risk
- Too little - impaired coordination, respiratory impairments and even death.

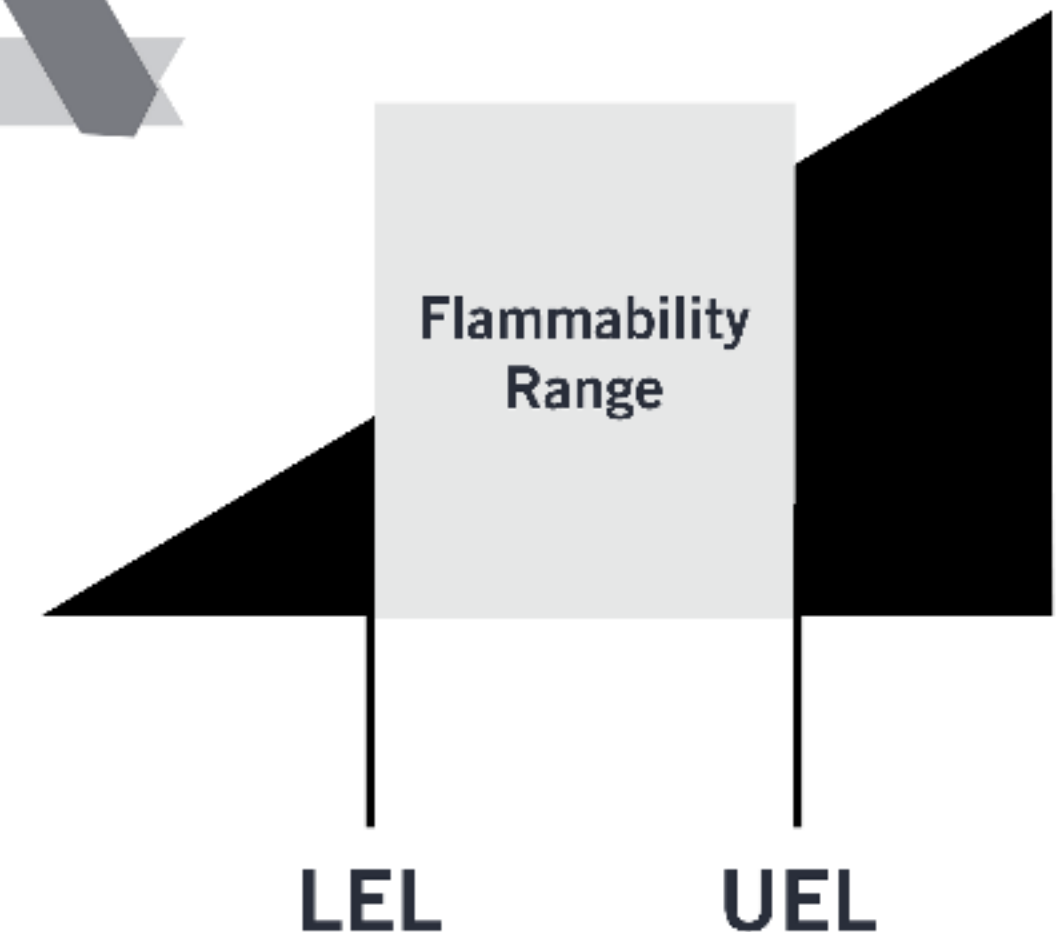
OXYGEN CONTENT (% BY VOL.)	EFFECTS AND SYMPTOMS (AT ATMOSPHERIC PRESSURE)
> 23.5%	Oxygen enriched, extreme fire hazard
20.9%	Oxygen concentration in normal air
19.5%	Minimum permissible oxygen level
15-19%	Decreased ability to work strenuously - may impair coordination and may cause early symptoms for persons of coronary, pulmonary or circulatory problems
10-12%	Respiration further increases in rate and depth - poor judgement, blue lips
8-10%	Mental failure, fainting, unconsciousness, ashen face, nausea, vomiting
<10%	50% fatality after 6 mins, coma in 40 seconds, convulsions, death

LEL - Combustible Gases

- Any flammable gas or vapour that exceeds 10% of its LEL is at risk. Any flammable gas or vapour that exceeds its UEL will be too rich to burn.
- Combustible Sensor Poisons
 - Silicones
 - H₂S
 - Phosphates and Phosphorus substances
 - Lead containing compounds
 - High concentrations of flammable gas



Concentrations within the Flammable range will burn or explode if a source of ignition is present.



CO - Carbon Monoxide

Produced as a by-product of incomplete combustion

- Associated with internal combustion of engine exhaust
 - Vehicles
 - Pumps
 - Compressors
 - Generators
- The leading cause of accidental poisoning and causes more accidental poisonings than any other chemical substance.
- Bonds to haemoglobin in red blood cells
- Contaminated cells can't transport O₂
- Chronic exposure at even low levels is harmful

Symptoms

- Headaches
- Fatigue
- Nausea and flu-like symptoms
- Loss of consciousness
- Brain damage
- Coma
- Death

Exposure Limits

Time Weighted Average (TWA)

- TWA is projected value.
- Time-weighted average (TWA) calculates a worker's daily exposure to hazardous substances such as dust, fumes, chemicals, gases, or vapours.
- It is averaged to an 8-hour workday or 40-hour week, along with the average exposure to the hazardous substance and the time spent in that area.
- The TWA reflects the maximum average exposure a worker can be subjected to without experiencing significant adverse health effects over the standardized eight-hour work period.
- The TWA is expressed in units of parts per million (ppm) or mg/m³.

TWA Calculation

EXPOSURE	CONCENTRATION	TWA
4 hours	100ppm	50ppm
8 hours	100ppm	100ppm
12 hours	100ppm	150ppm

Toxic Vapours and Gases

Where they come from

- Microbial action on materials in confined space
- Products or chemicals stored in a confined space
- Work is performed in a confined space
- Areas adjacent to confined space

How to Detect

- Colourimetric Tubes
- Electrochemical Sensors
- Photoionisation Detectors
- Non-Dispersive Infrared (NDIR)

Brownfield Sites

Dangers and Considerations

Dangers

- Heavy Metals
- Oils and Tars
- Chemical substances and preparations i.e solvents
- Gases
- Asbestos
- Radioactive Substances

Risk to Human Health

- Direct contact/ingestion
- Ground Gas
- Permeation into water supply pipework

Remediation Strategy

- Capping Layers
- Gas/Vapour protection measures
- Upgraded water supply pipes/over-dug service corridors





BEST PRACTICE

- ▶ Pumped Sampling
- ▶ Personal Monitoring
- ▶ Calibration and Bump Testing

Best Practice

Pumped Sampling

Prior

- Using a pumped gas detector
- Perform pre-entry checks on the confined space
- Check all levels of confined space before entry



Best Practice

Personal Monitoring

During

- A diffused standard 4 gas detector
- Worn on your lapel/around your breathing zone
- To be worn at all times to retrieve accurate gas readings



Best Practice

Monitor Servicing

Post

- Correct storage
- Crucial care before and after use and shifts
- Bump tests before each use
- Calibration and servicing every 6 months



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A COMPLETE CONFINED SPACE KIT

A pumped multi gas monitor for pre-entry checks of the confined space

A diffused multi gas monitor for personal gas monitoring

An escape set for emergency escape

Recovery winches for rescue

Fall protection harness for when working at height



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