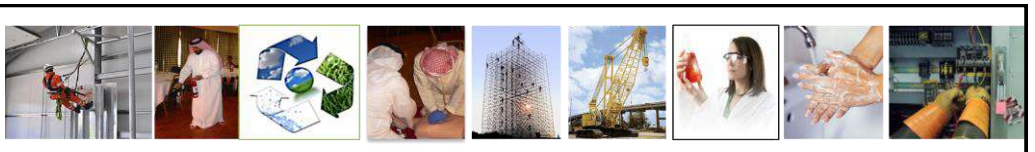
NCMT

CONFINED SPACE

COURSE MATERIAL

Mussafah 39, Abu Dhabi, UAE | Tel.: +97126721777 | Fax: +97126725511

Email: training@ncmt.ae | Web: www.ncmt.ae



Training is not a goal, it is part of the solution to a sustained and improved performar

Confined Space Hazards & Controls

Website: www.ncmt.ae

Administration

- Course Duration- 4hrs
- Emergency / Fire safety arrangements
- Breaks
- Telephones/Mobiles on Silent Mode
- Participation
- Introductions

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What you will Learn

- What are Hazards, Risks and Controls
- What is a Confined Space
- Hazards of Confined Spaces
- Basic Entry Requirements

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HAZARDS

What is a Hazard?

A hazard is Source, situation or act with a **potential** for harm in terms of:

human injury or ill health, damage to workplace environment, damage to property, reputation or combination of these.

RISK

What is Risk?

Risk is a combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s).

RISK = Probability x Severity

What is a Hazard? What is Risk?

Hazard

A hazard is anything with the **POTENTIAL TO HARM** people, assets, the environment or the company's reputation.

Risk

Is the ***likelihood*** that **ACTUAL** harm or loss will occur and it also takes into account the **consequences** of the occurrence.

Which comes first?

1.From **Activities** we get

2.**Hazards**, from hazards we get

3. **Risk** of harm occurring, therefore we need

4. **Controls** to reduce the risk

Control of Hazards

To control Hazards we implement 2 strategies. It is known as the hierarchy of controls based on **ESEAP**:

- Eliminate
- Substitute
- Engineering

} **Safe Place Strategy**

- Administrative
- PPE

} **Safe Person Strategy**

Eliminate the Hazard

You would not want to carry out activities which included naked flame when the risk of flammable vapours are present.

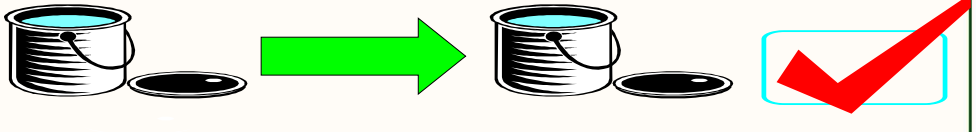
A small spark can lead to this

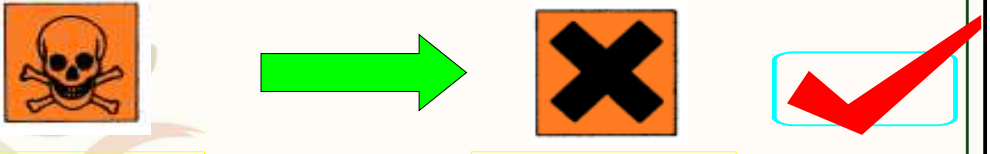
Removal = Elimination

Substitute/Reduce the Risk

Flashpoint = 1º Celsius

Flashpoint = 25º Celsius





Toxic

Harmful

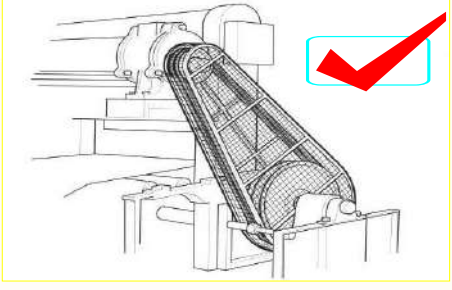
Engineering (Isolate the Hazards)

Can the hazard be isolated or enclosed ?
e.g. Switch off or remove the electrical breaker.

Engineering Controls

Control the hazards through technical device

e.g. Guard on moving parts



Administrative Controls

We need to supervise activities to ensure:

Compliance with procedures and the PTW & signage is being complied with no exceptions

Prohibition

Mandatory

Warning

Safe Condition

PPE

The last resort action for controlling hazards and risk

Why is it considered the last resort?

Confined Space "CS"

General Requirements

All employees required to enter confined or enclosed spaces must be instructed in:

- **nature of the hazards**
- **necessary precautions to be taken**
- **use of protective and emergency equipment**

The employer must comply with any specific regulations that apply to work in dangerous or potentially dangerous areas.

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What is a Confined Space?

Confined space ... as per OSHAD

An enclosed space (enclosed or partially) which:

- Is at atmospheric pressure during occupancy. And / or
- Is not intended or designed primarily as a place of work .And / or
- May have limited or restricted means for entry or exit . And/ or

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What is a Confined Space?

- May have an atmosphere which contains potentially harmful levels of contaminants , or
- May not have a safe oxygen level; or
- May cause engulfment

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What is a Confined Space?

Confined space include but are not limited to:

- Storage tanks, process vessels, boilers, pressure vessel, silos and other tank-like compartments.
- Open-topped spaces such as pits
- Pipes, sewers , ducts …..
- Any shipboard spaces entered through a small hatchway or access point, such as car go tanks, oil tanks, ……

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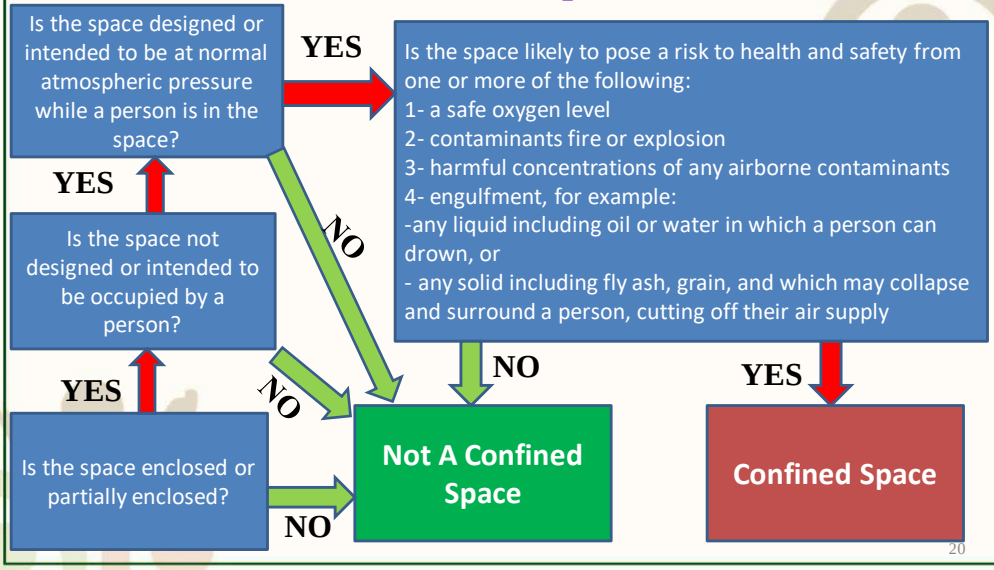
How to determine whether a space is a confined space



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Typical Confined Spaces

- Boilers & Furnaces
- Pipelines
- Pits
- Process Vessel
- Silo & Storage Tanks
- Sewer & Manholes
- Trenches & Excavations

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Boilers & Furnaces

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Pipelines

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Pits

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Process Vessel

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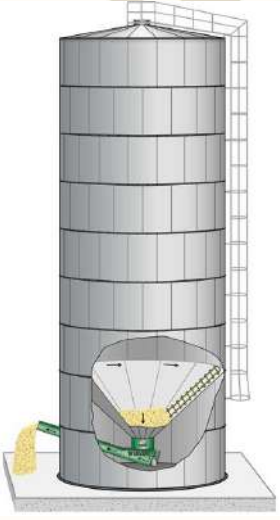
Silo & Storage Tanks



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Silo & Storage Tanks

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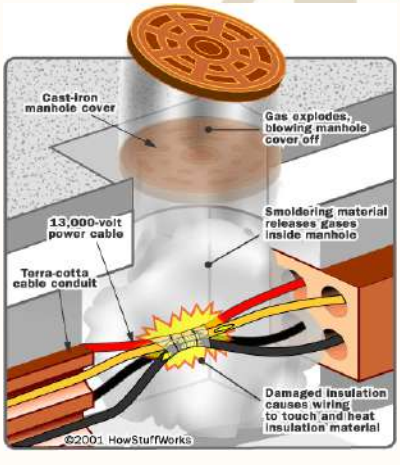
Sewer & Manholes



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Trenches & Excavations

In general practice, all trench excavations over 4 feet in depth should be considered confined spaces until a competent person has ruled out all of the potential hazards associated with them.

Hazards of Confined Spaces

Hazards Associated with CS

- ✓ **Restricted entry or exit**
- ✓ **Atmospheric**
- ✓ **Engulfment or Entrapment**

Other Hazards

- ✓ **Uncontrolled introduction of substances**
- ✓ **Biological hazards**
- ✓ **Mechanical**
- ✓ **Electrical**
- ✓ **Skin contact with hazardous substances**
- ✓ **Noise**
- ✓ **Manual tasks**
- ✓ **Radiation**
- ✓ **Environmental hazards**
- ✓ **Hazards outside the confined space**
- ✓ **Additional physiological and psychological demands**

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Entry Point Hazards

- ✓ Small Openings make entry and rescue difficult
- ✓ Sharp edges can tear protective clothing or air lines
- ✓ Temporary ladders and vent gear can make even large openings difficult to transit
- ✓ Vertical entry points are fall hazards

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Atmospheric Hazards

- ✓ Oxygen Deficient Atmospheres
- ✓ Oxygen Enriched Atmospheres
- ✓ Flammable Atmospheres
- ✓ Harmful airborne contaminants

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Oxygen Deficient Atmospheres

Air normally contains **21%** oxygen by volume.

Oxygen levels of **19.5% — 23.5%** by volume are considered to be safe.

Some situations can cause the level of oxygen to dramatically decrease, leading to an oxygen-deficient atmosphere and possible asphyxiation.

This may occur, for example, if oxygen in the atmosphere is:

- displaced by gases produced during biological processes, for example, methane in a sewer.
- displaced during purging of a confined space with an inert gas to remove flammable or toxic fumes.
- depleted inside metal tanks and vessels through surface oxidation (rust).
- consumed during combustion of flammable substances.
- absorbed or reacts with grains, wood chips, soil or chemicals in sealed silos.

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Oxygen Deficient Atmospheres

19.5 %	Minimum acceptable oxygen level.
15 - 19%	Decreased ability to work strenuously. Impair co -ordination. Early symptoms.
12-14%	Respiration increases. Poor judgement.
10-12%	Respiration increases. Lips blue.
8-10%	Mental failure. Fainting. Nausea Unconsciousness. Vomiting.
6-8%	8 minutes - fatal, 6 minutes - 50% fatal 4-5 minutes - possible recovery.
4-6%	Coma in 40 seconds. Death

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Oxygen Enriched Atmospheres

Too much oxygen can increase the risk of fire or explosion. Oxygen-enriched atmospheres may occur if:

- chemical reactions cause the production of oxygen, for example certain reactions with hydrogen peroxide.
- there is a leak of oxygen from an oxygen tank or fitting while using oxy-acetylene equipment.

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Oxygen Enriched Atmospheres

- Oxygen Level Above 23.5%.
- Causes Flammable and Combustible Materials to Burn Violently When Ignited.
- Hair, Clothing, Materials, Etc.
- Oil Soaked Clothing and Materials.
- Never Use Pure Oxygen to Ventilate.
- Never Store or Place Compressed Tanks in a Confined Space.

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OXYGEN ENRICHMENT

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OXYGEN ENRICHMENT

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Flammable Atmospheres

Required Factors:

- Oxygen
- Flammable Gas, Vapor or Dust
- Ignition Source
  - Welding
  - Electric Tools
  - Sparks
  - Smoking

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Combustibles

Flammable Gases

- Methane
- Hydrogen
- Acetylene
- Propane
- Ammonia
- Benzene
- Carbon Disulfide
- Ethane
- Isobutane
- Methyl Chloride
- Naphthalene
- Styrene
- Toluene

Flammable Vapors

- Gasoline fumes
- Fumes/vapors of:
  - Flammable Liquids
  - Chemicals
  - Chemical reactions
  - Absorbed materials

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Lower Explosive Limit

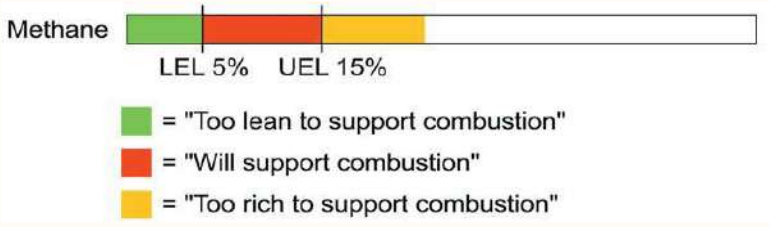
The Lower Explosive Limit (LEL) refers to the lowest concentration of a gas in the atmosphere that will result in a flammable mixture. For example, the LEL of methane is 5% by volume. This means that if there is less than five percent by volume of methane in air, the mixture is too lean (weak) to support combustion.

Upper Explosive Limits

The Upper Explosive Limit (UEL) refers to the highest concentration of a gas in the atmosphere, which results in a flammable mixture. For example the UEL of methane in air is 15% by volume. This means that if there is more than 15% by volume of methane in air, then the mixture is too rich (concentrated) to support combustion.

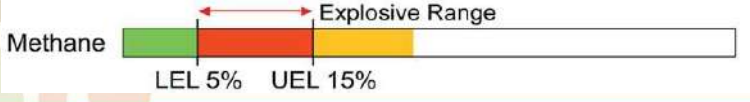
Flammable Atmospheres

A rich gas mixture would typically occur in a confined area such as an oil storage tank where the methane cannot disperse. From the table shown, we can see that concentrations of methane in air between 5 and 15% are combustible.



Explosive Range

The region between the Lower Explosive Limit and the Upper Explosive Limit is known as the Flammable or Explosive Range.

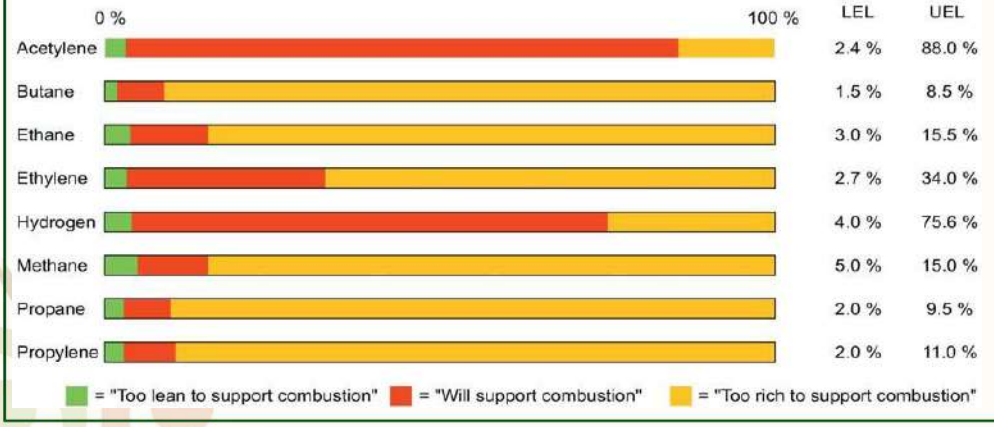


Flammable Atmospheres

Common Gases

The LEL and UEL of some common gases are shown in the table.

The AGT is responsible for recording the percentage of LEL for the gas being tested.



Harmful airborne contaminants

Source	Examples
Substance stored in the confined space or its by-product(s)	•build-up of hydrogen sulphide in sewers and pits • release of toxic substances e.g. H2S in tanks of decomposing organic material, especially when the material is disturbed
Work performed in the confined space	•use of paints, adhesives, solvents or cleaning solutions • welding or brazing with metals capable of producing toxic fumes • exhaust fumes from engines used in the confined space • painting or moulding glass-reinforced plastics
Release of airborne contaminants	•when sludge, slurry or other deposits are disturbed or when scale is removed

Harmful airborne contaminants

Source	Examples
Manufacturing process	•residues left in tanks, vessels etc., or remaining on internal surfaces can evaporate into a gas or vapour
Entry and accumulation of gases and liquids from adjacent plant, installations, services or processes	•the contamination of underground confined spaces by substances from plant in the vicinity of the confined space • carbon monoxide from the exhaust of LPG-powered forklifts operating in, or in the vicinity of, the confined space
Entry of natural contaminants e.g. groundwater and gases into the confined space from the surrounding land or soil	•acid groundwater acting on limestone with the potential to produce dangerous accumulations of carbon dioxide • methane released from groundwater and from decay of organic matter

Harmful airborne contaminants

Workplace Exposure Limit (WEL)

The occupational exposure limits for many toxic and hazardous substances are controlled by a Workplace Exposure Limit (WEL), which is defined as 'the approved exposure limit for any hazardous substance in relation to a specified reference period, when calculated by an approved method.'

The limits for each substance are given in parts per million (ppm) and milligram per meter-cubed for:

- Long Term Exposure Limits (LTELs), for an 8 hour reference period, and
- Short Term Exposure Limits (STELs), for 15 minute reference period

Harmful airborne contaminants

Hydrogen Sulphide

- Decomposition of materials. Human waste.
- Rotten egg odour at low concentrations.
- Possibly no warning at high concentrations.

PPM	Effect	Time
1 ppm	Permissible Exposure Level	8 Hours
5 ppm	Permissible Exposure Level	15 mint.
50 - 100	Mild Irritation - eyes, throat	1 Hour
200 - 300	Significant Irritation	1 Hour
500 -700	Unconsciousness,	Death1/2 - 1 Hour
>1000	Unconsciousness,	Death Minutes

https://www.oshad.ae/ar/adehsms/Documents/AD%20EHSMS%20RF%20-%20Standards%20and%20Guideline%20Values%20-%20v2.0.pdf

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Harmful airborne contaminants

Carbon Monoxide CO

- Odourless, Colourless Gas.
- Combustion By-Product.
- Quickly collapse at high concentrations.

PPM	Effect	Time
25	Permissible Exposure Level	8 Hours
200	Slight headache, discomfort	
600	Headache, discomfort	1 Hour
1000-2000	Confusion, nausea, headache	2 Hours
1000-2000	Tendency to stagger	1 1/2 Hours
1000-2000	Slight heart palpitation	30 Min.
2000-2500	Unconsciousness	30 Min.

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Engulfment or Entrapment

Engulfment means to be swallowed up in or be immersed by material, which may result in asphyxiation.

Examples of materials that may pose a risk of engulfment include plastics, sand, liquids, fertiliser, grain, coal, coal products, fly ash, animal feed and sewage.

Stored materials such as sand and grain can form a crust or bridge when a container is emptied from below, leaving the top layer in place.

Workers walking on the bridge or working below the bridge on the floor of the container may be engulfed if a bridge collapses

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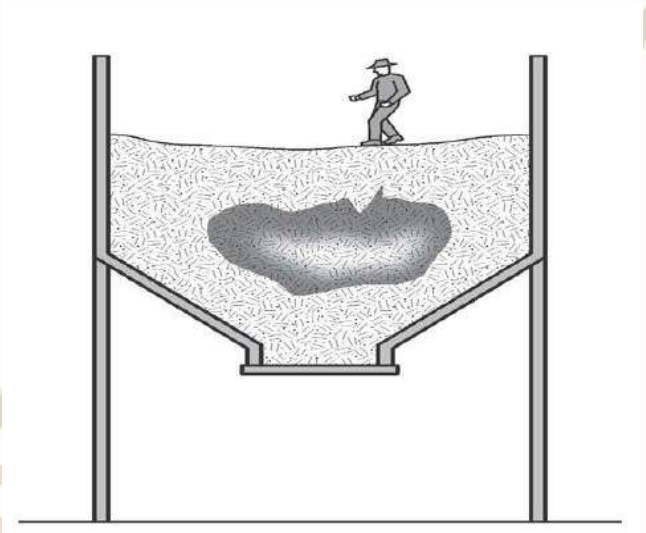
Engulfment or Entrapment



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Uncontrolled introduction of substances

- The uncontrolled introduction of substances such as steam, water or other liquids, gases or solids may result in drowning, being overcome by fumes or other harm depending on the nature of the substance.
- Vehicles and forklifts operating close to the opening of the confined space can cause a build-up of exhaust gases, including carbon monoxide, in the space.

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Biological hazards

Contact with micro-organisms, such as viruses, bacteria or fungi, may result in infectious diseases, dermatitis or lung conditions such as hypersensitivity pneumonitis.

Sewers, grain silos and manure pits are examples of confined spaces where biological hazards may be present.

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Mechanical Hazards

Some confined spaces have unguarded mechanical equipment such as:

- **Paddles**
- **Blades**
- **Shafts**
- **Chain or belt drives**

Hazards of: **entanglement, crushing, cutting, and shearing of parts of a person's body.**

All equipment must be Locked and Tagged before entry

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Electrical Hazards

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Electrical Hazards

Electric Shock or Burn is a possible hazard in Confined Spaces

Hazard Sources include:

- **Broken lighting**
- **Electrical sensing devices**
- **Limit switches**
- **Level indicating devices**
- **Hazards from equipment taken inside**

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Skin contact with hazardous substances

The nature of a confined space could give rise to an increased likelihood of skin contact with surface contaminants.

Skin contact with hazardous substances may result in immediate **health effects** such as burns, irritation or allergic dermatitis, or longer-term systemic effects.

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Noise Hazards

Noise generated in a confined space from the use of plant, the work method or process may be amplified due to reflections off hard surfaces.

Exposure to hazardous noise may result in:

Hearing loss, tinnitus and other non-auditory health effects.

Hazardous noise may also prevent workers hearing warning signals and distract workers from their work.

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Manual tasks

Hazards arising from manual tasks may be exacerbated by physical constraints associated with working in a confined space.

Additional hazards may arise from the use of personal protective equipment that restricts movement, grip and mobility.

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Radiation

The health effects associated with radiation depend on the type of radiation involved.

Sources of radiation include:

radioactive sources, x-rays, lasers, welding flash, radio frequency and microwaves.

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Environmental hazards

Environmental hazards associated with work in a confined space may cause or contribute to harm. Examples of environmental hazards include:

- heat or cold stress arising from the work, process or conditions
- slips, trips and falls arising from slippery surfaces or obstacles
- inadequate lighting.

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Physical Configuration Hazards

The use and shape of a space can create hazardous conditions

- **Use of Ladders & Scaffolding**
- **Wet or slippery surfaces**
- **Uneven bottoms**
- **Bends in tunnels**
- **Narrow areas that can entrap workers**
- **Poor lighting**

Use retrieval & fall protection when possible

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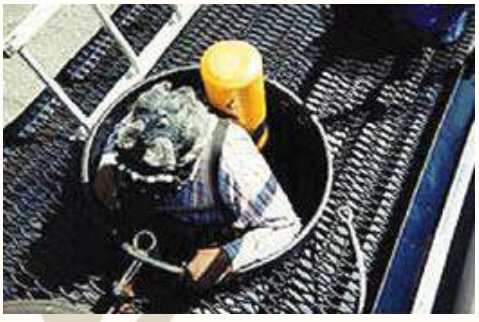
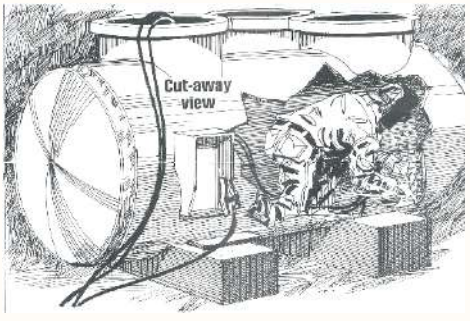
Physical Configuration Hazards





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Hazards outside the confined space

- Where the confined space has a vertical opening, there is a risk that people could fall in.
- Traffic hazards are a concern where confined space entrances or exits are located on footpaths or roads. There is the potential for workers entering or exiting the space to be struck and injured by vehicle traffic.
- Work done outside the space, but near openings to it, can contaminate the atmosphere inside the space. There may also be potential for fire or explosion where hot work is done in areas next to confined spaces that contain flammable atmospheres.

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Additional physiological and psychological demands

Working in a confined space may impose additional physiological and psychological demands over and above those encountered in a normal working environment.

Consideration should be given to a worker's:

- physical ability
- ability to work in a restrictive space (for example claustrophobia)
- ability to wear the personal protective equipment required to do the work (for example respirators).

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HOW TO ASSESS THE RISKS

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HOW TO ASSESS THE RISKS

To determine the risks requiring control the following factors should be considered:

- the **atmosphere** in the confined space,
- the risk of **engulfment** of a person
- all proposed work activities, particularly those that may cause a change to the conditions in the confined space.
- the number of persons occupying the space
- the soundness and security of the overall structure and the need for lighting and visibility
- the identity and nature of the substances **last contained** in the CS.
- any risk control measures needed to bring the CS to **atmospheric pressure**

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HOW TO ASSESS THE RISKS

Continue Factors when assessing the risk:

- the number of persons required outside the space:
  - to maintain equipment essential for the task being undertaken within the confined space
  - to provide continuous communication with the persons within the confined space, and
  - to properly initiate emergency response procedures
- risks associated with other hazards, such as noise or electricity
- arrangements for emergency response, for example first aid and resuscitation

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HOW TO ASSESS THE RISKS

Continue Factors when assessing the risk:

- the physiological and psychological demands of the task and the competency of persons involved.
- the adequate instruction of persons in any required procedure, particularly those that are unusual or non-typical, including the use and limitations of any personal protective equipment and other equipment to be used.
- the availability and adequacy of appropriate personal protective equipment and emergency equipment for all persons likely to enter the confined space.

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HOW TO ASSESS THE RISKS

Continue Factors when assessing the risk :

- the need for additional risk control measures, including:
  - o prohibiting hot work in adjacent areas.
  - o prohibiting smoking and naked flames within the CS and adjacent areas
  - o avoiding contamination of breathing air from operations or sources outside the CS , for example, from the exhaust of an internal combustion engine
  - o prohibiting movement of equipment in adjacent areas, for example forklifts
  - o prohibiting spark-generating equipment, clothing and footwear
- whether purging or cleaning in the confined space is necessary.
- whether hot work is necessary.
- conditions that could impede entry and exit or the conduct of the tasks in the confined space, for example, plant layout, dimensions, manual handling and ergonomic aspects of the task activity.

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How to identify 'Atmospheric Hazards' ?

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Air Monitoring




Test the Atmosphere

In this order:

- **Check for Oxygen Content:**
  - At least 19.5% and less than 23.5%
- **Check for Combustibles:**
  - Less than 5% of the LEL
- **Check for potentially harmful contaminants "Toxic Gasses":**
  - Most commonly carbon monoxide (PEL <25 ppm)
  - Or any other hazardous materials as determined by the use of the space.

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TWA & STEL

TWA:

Time Weighted Average concentration of airborne contaminant over an entire 8hr working day, for a 5 day (40hrs) working week.

STEL:

Short-term Exposure Limit is the concentration of airborne contaminant, averaged over a period of 15 minutes that should not be exceeded at any time during a work-day even if the eight-hour TWA average is within the TWA exposure standard. Exposure at the STEL should not be longer than 15 minutes and should not be repeated more than 4 times a day. There should be at least 60 minutes between successive exposures at the STEL.

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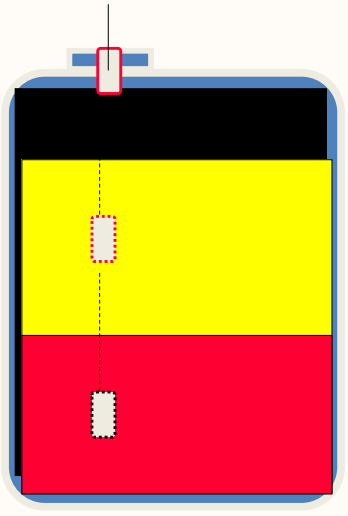
Gas Checking System

Always test the air at various levels to be sure that the entire space is safe.

Good air near the opening does NOT mean there is good air at the bottom!



Good Air

Poor Air

Deadly Air

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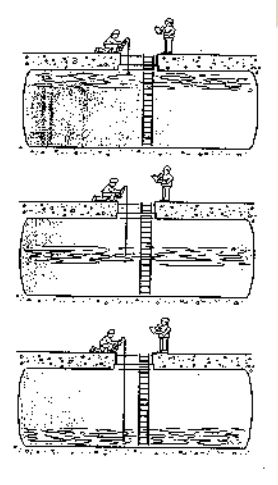
Air Monitoring and Ventilation

- **Before and during entry**

Methane	0.55
Ammonia	0.59
Carbon Monoxide	0.96
Nitrogen	0.97
AIR	**1.0**
Hydrogen Sulfide	1.2
Carbon Dioxide	1.5
Gasoline	3-4
Jet Fuel	4.7

Lighter than air gases

Heavier than air gases



Testing The Atmosphere

Verify presence of safe work atmosphere.

- Calibrate Air Monitoring Equipment before use
- Test all areas of a confined space
  - Top, Middle, Bottom
  - Check for Explosive & Toxic Gases
  - Check Oxygen level
- Record all readings

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Atmosphere Testing Shall Be Performed

- Prior to every entry when the space is vacant;
- After a 10 minute ventilation period (if ventilation is necessary);
- At least hourly for permit-required confined spaces.
- More frequently, if conditions or suspicions warrant.
- Change in conditions.
- Work break more than one hour

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HOW TO CONTROL THE RISKS ?

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The hierarchy of control

- Eliminate the need to enter a confined space
- Minimise the risks
- Entry permits
- Isolation
- Atmosphere
- Communication and safety monitoring
- Entry and exit procedures
- Signs and barricades
- Information, instruction and training
- Maintenance of control measures

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Eliminate the need to enter a confined space

Work could be carried out from outside the confined space by:

- installing fixed or temporary cleaning devices for example spray balls using high-pressure hoses inserted through an access hatch to clean the inside of a tank
- using remote cameras or a mirror attached to a probe for internal inspection of vessels.
- using remotely operated rotating flail devices, vibrators or air purgers to clear blockages in silos.
- using a hook, long-handled clasp or magnet on a string to retrieve an object dropped into a confined space.

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Minimise the risks

The **identified hazards** will help determine what controls are needed to minimize any risk associated with work in the confined space.

The following matters must be considered:

- **The nature of the space**

— whether the number, size and location of entrances and exits are adequate to enable the rapid exit and rescue of workers

— the temperature of the space so that it will not cause heat stress

— adequate lighting, if there is poor visibility.

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Minimise the risks

- **The concentration of oxygen or airborne contaminants**
  - a safe level of O2 and any airborne contaminants are maintained by ventilating prior to and/or during entry.
  - any changes that may occur to oxygen or airborne contaminants are determined by testing the atmosphere
  - where the atmospheric conditions cannot be maintained at a safe level, appropriate respiratory protective equipment must be provided.

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Minimise the risks

- **The work and work method**
  - minimize the release of harmful airborne
  - reduce the time spent in the space or the number of people that have to enter the space
  - eliminate the risk of engulfment.
- **Emergency procedures**

Effective arrangements for raising the alarm and carrying out rescue operations in an emergency are essential

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Entry permits

A confined space entry permit provides a formal check to ensure all elements of a safe system of work are in place before people are allowed to enter the confined space. It also provides a means of communication between site management, supervisors and those carrying out the work and ensures that the person conducting the business or undertaking has checked and authorized the entry to the confined space and it is safe to proceed.

85

Entry Permit Requirements

- Date, Location, and Name of Confined Space.
- Purpose of Entry and Known Hazards.
- Duration of Entry Permit Time.
- Authorized Entrants, Attendants, Supervisors.
- Air Testing Results - Signature of Tester.
- Protective Measures to Be Taken.
  - Ventilation, Isolation, Flushing
  - Lockout / Tagout, Purging

86

Entry Permit Requirements

- Written Permit Signed by Supervisor.
- Verifies Pre-entry Precautions Have Been Taken and the Space Is Safe to Enter.
- Posted at Entry to Confined Space.
- Requires Termination of Permit When Task Is Completed or When New Conditions Exist.
- Name and Phone Numbers of Rescue and Emergency Services.

87

Entry Permit Requirements

- Communication Procedures.
- Additional permits, such as for hot work, that have been issued authorizing work in the permit space.
- Special Equipment and Procedures.
- Personal Protective Equipment.
- Alarm Procedures.
- Rescue Equipment.
- Respirators.

88

Entry Permit Requirements

Conduct Briefing

- Entire crew must attend
  - Attendants, entrants, entry supervisor
- Review hazards of entry and work
- Review PPE
- Review procedure for contacting rescue
  - Verify rescue available
- Complete permit

89

Entry Permit Requirements

When the Job is Done

- Remove all personnel, tools, and debris from the space. Sign off the log.
- Close the space.
- Cancel the permit.
- Review the job with the host employer

(hazards, problems, other employers, etc.)

90

Isolation

All potentially hazardous services should be isolated prior to any person entering the confined space to prevent:

- the introduction of contaminants or conditions through piping, ducts, vents, drains, conveyors, service pipes and fire protection equipment
- the activation or energizing of machinery in the confined space

91

Isolation

Continue to prevent:

- the activation of plant or services outside the confined space that could adversely affect the space (for example heating or refrigerating methods)
- the release of any stored or potential energy in plant
- the inadvertent use of electrical equipment.

If liquids, gases or vapours could enter the confined space the pipe work should be physically isolated.

92

How to Isolate

- Locking and Tagging Out Electrical Sources.
- Blanking and Bleeding Pneumatic and Hydraulic Lines.
- Disconnecting Mechanical Drives and Shafts.
- Securing Mechanical Parts.

93

How to Isolation

- Blanking Sewer and Water Flow.
- Disconnection or spading
  - As close to the confined space as possible.
- Locking and Tagging Out Shutoff Valves.
- Close valves
  - Double block & bleed, or
  - Blank flange

94

Atmosphere

A safe atmosphere must be ensured, so far as is reasonably practicable, during work in a confined space.

A safe atmosphere in a confined space is one that:

- has a safe oxygen level
- is free of air borne contaminants or any airborne contaminants are in concentrations below their allowable exposure standard (if any)
- any flammable gas or vapour in the atmosphere is at concentrations below 5% of its LEL.

A safe atmosphere can be achieved within the confined space using methods such as cleaning, purging and ventilation.

95

Atmosphere

Purging

Purging is done using an inert gas, such as nitrogen, to clear flammable gases or vapours before work in the confined space begins.

After purging, the confined space should be adequately ventilated with sufficient fresh air to ensure that the inert gas is removed.

Atmospheric testing should be carried out before entry to check that the ventilation has been effective.

96

Atmosphere

Ventilation

Ventilation of a confined space with fresh air, by natural, forced or mechanical means, may be necessary to establish and maintain a safe atmosphere and temperature for as long as anyone is in the confined space.

If the confined space has sufficient openings then natural ventilation may be adequate, but in most cases mechanical ventilation is likely to be needed.

97

Atmosphere

Ventilation

- **Use mechanical ventilation**
  - Fans
  - Air hoses
- **Ventilate at the rate of at least four (4) volumes per hour**
  - Larger spaces require more ventilation
- **Make sure air supply is not contaminated**
  - Ventilation air supply must be from fresh air uncontaminated with flammables, toxins, etc.

98

Atmosphere

Ventilation

Where mechanical ventilation equipment is likely to be necessary to maintain acceptable contaminant levels in a confined space, the equipment should:

- be monitored to ensure continuous operation while the confined space is occupied
- have the controls (including any remote power supply) clearly identified, tagged and protected to guard against unauthorised interference.

99

- **Two common types of mechanical ventilation include**
  - Local Exhaust Ventilation (LEV)
  - General Ventilation.
- **Local Exhaust Ventilation (LEV)**

  Local exhaust ventilation captures contaminants at their point of origin and removes them. This type of ventilation method is ideal for flammable and toxic materials produced at a single point (e.g., hot-work and work involving cleaning solvents). When using this type of ventilation system, keep the exhaust intake close to your work. Do not use this type of ventilation system for contaminants that are widely dispersed or for confined spaces that make ventilation difficult.

100

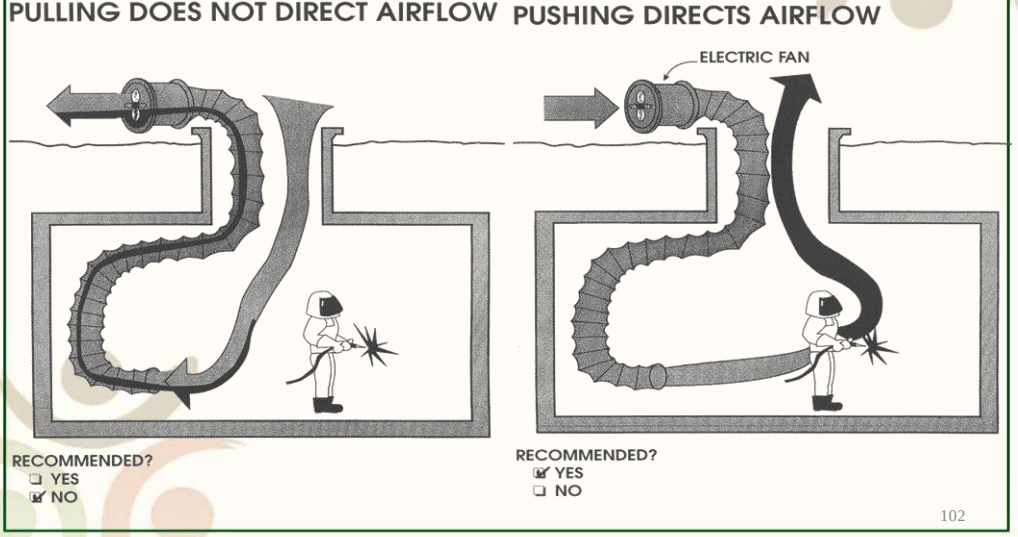
Ventilate the Space

General Ventilation.

General ventilation flushes the atmosphere by supplying and exhausting large volumes of air. Because this system does not reduce the amount of contaminants released, it is not recommended for highly toxic atmospheres. General ventilation is ideal for providing oxygen and controlling low concentrations of materials that are not highly toxic. When using this type of ventilation system during hot-work, monitor the atmosphere continuously and wear a SCBA, as necessary.

101

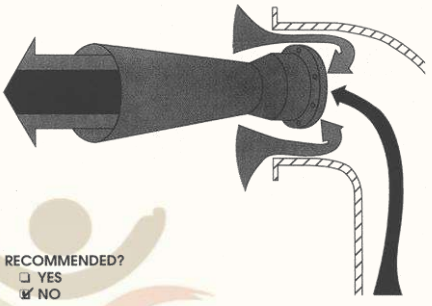
Pulling Versus Pushing (General Ventilation)



102

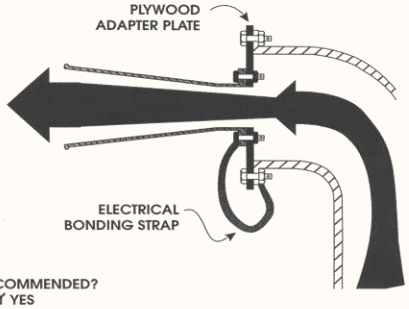
Improper Installation of Air Movers Also can be Source

PROBLEM:
EDUCTOR POORLY
PLACED IN VESSEL AIR OUTLET



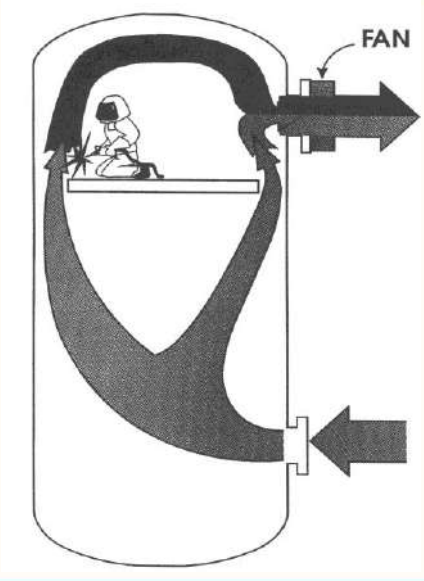
RECOMMENDED?
❑ YES
☑ NO

SOLUTION:



RECOMMENDED?
☑ YES
❑ NO

Effective Use of Ventilation Techniques



Atmosphere

Respiratory protective equipment

The respiratory protective equipment should be provided and worn in situations where there is no exposure standard for a substance, or where the substance is present in an unknown concentration.

Respiratory protective equipment refers to a range of breathing equipment, including air-supplied and self-contained breathing apparatus.

Communication and safety monitoring

A communication system is needed to enable communication between people inside and outside the confined space and to summon help in an emergency.

Depending on the conditions in the confined space, communication can be achieved by voice, radio, hand signals or other suitable methods.

Before a worker enters a confined space, **a standby person** must be assigned to continuously monitor the wellbeing of those inside the space, if practicable observe the work being carried out and initiate appropriate emergency procedures when necessary

Communication and safety monitoring

CS Stand by person / Attendant –Responsibilities

- Remain outside the permit space during entry operations unless relieved by another authorized attendant;
- Perform non-entry rescues when specified by the employer's rescue procedure;
- Know existing and potential hazards, including information on the mode of exposure, signs or symptoms, consequences and physiological effects;

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Communication and safety monitoring

CS Stand by person / Attendant –Responsibilities

- Maintain communication with and keep an accurate account of those workers entering the permit space;
- Order evacuation of the permit space when:
  - A prohibited condition exists;
  - A worker shows signs of physiological effects of hazard exposure;
  - An emergency outside the confined space exists; and
  - The attendant cannot effectively and safely perform required duties.

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Communication and safety monitoring

CS Stand by person / Attendant –Responsibilities

- Summon rescue and other services during an emergency;
- Ensure that unauthorized people stay away from permit spaces or exit immediately if they have entered the permit space;
- Inform authorized entrants and the entry supervisor if any unauthorized person enters the permit space; and
- Perform no other duties that interfere with the attendant's primary duties.

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Entrant

The employee who will physically enter the confined space to perform the work.

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Entrant Responsibilities

- Know space hazards, including information on the means of exposure such as inhalation or dermal absorption, signs of symptoms and consequences of the exposure;
- Use appropriate personal protective equipment properly;
- Maintain communication with attendants as necessary to enable them to monitor the entrant's status and alert the entrant to evacuate when necessary;

111

Entrant Responsibilities

- Exit from the CS as soon as possible when:
  - Ordered by the authorized person;
  - He or she recognizes the warning signs or symptoms of exposure;
  - A prohibited condition exists; or
  - An automatic alarm is activated.
- Alert the attendant when a prohibited condition exists or when warning signs or symptoms of exposure exist.

112

Entry Supervisor

This must be a team leader or foreman who:

- Know space hazards including information on the mode of exposure, signs or symptoms and consequences;
- Verify emergency plans and specified entry conditions such as permits, tests, procedures and equipment before allowing entry;

113

Entry Supervisor

- Terminate entry and cancel permits when entry operations are completed or if a new condition exists;
- Verify that rescue services are available and that the means for summoning them are operable;
- Take appropriate measures to remove unauthorized entrants; and
- Ensure that entry operations remain consistent with the entry permit and that acceptable entry conditions are maintained.

114

Entry and exit procedures

For the entire period the confined space entry permit is valid, procedures should be in place to indicate when any worker is in the confined space, for example by using tags, a system of signing in and out on the entry permit, or having a standby person record who is in the confined space.

115

Signs and barricades

Signs must be erected to prevent entry of persons not involved in the work.
Signs must be placed at each entrance to the confined space.
Signs must be in place while the confined space is accessible, including when preparing to work in the space, during work in the space and when packing up on completion of the work.
Signposting alone should not be relied on to prevent unauthorised entry to a potential confined space.
Security devices, for example locks and fixed barriers, should be installed.

116

Information, instruction and training

Workers and their supervisors must have the skills and knowledge to understand the hazards associated with working in the confined space, the contents of any confined space entry permit, and the control measures implemented for their protection.

117

Maintenance of control measures

Proper maintenance of control measures is an integral part of any safe system of work. Maintenance may involve visual checks, inspections, testing of equipment, preventative maintenance and remedial work.

Equipment that should be regularly inspected includes:

- atmospheric testing and sampling equipment
- personal protective equipment including respirators
- ventilation equipment
- safety harness and lines
- emergency rescue equipment.

118

EMERGENCY PROCEDURES

- An employer must establish first aid and rescue procedures to be followed in an emergency.

  First aid and rescue procedures must be initiated from outside the confined space as soon as practicable in an emergency.
- Also He must ensure that openings for entry and exit are of a sufficient size to allow emergency access; openings are not obstructed; and any plant, equipment and personal protective equipment provided for first aid or emergency rescue are maintained in good working order.

119

EMERGENCY PROCEDURES

- First aid and rescue procedures must be rehearsed with relevant workers.
- Rescue should be performed from outside the CS, if possible. Workers performing rescue must be adequately trained. Rescuers must be provided with and wear appropriate respiratory protective equipment if they enter a CS in an emergency.
- If a person inside a CS has been overcome by lack of oxygen or airborne contaminants, it should always be assumed that entry for rescue is unsafe unless air-supplied respiratory protective equipment is used.
- Potential problems with the size of entrances and exits must be addressed when developing emergency and rescue procedures.

120

Rescue Team

Employers should ensure that responders are capable of responding to an emergency in a timely manner.

Employers must provide rescue service personnel with personal protective and rescue equipment, including respirators, and training in how to use it.

Rescue service personnel also must receive the authorized entrants training and be trained to perform assigned rescue duties.

121

Rescue Team

All rescuers must be trained in first aid and CPR. At a minimum, one rescue team member must be currently certified in first aid and CPR.

Employers must ensure that practice rescue exercises are performed yearly and that rescue services are provided access to confined spaces so they can practice rescue operations.

Rescuers also must be informed of the hazards of the confined space.

122

123

Harnesses and retrieval lines

- Authorized entrants who enter a permit space must wear a chest or full body harness with a retrieval line attached to the center of their backs near shoulder level or above their heads.
- **Wristlets** may be used if the employer can demonstrate that the use of a chest or full body harness is not feasible or creates a greater hazard.
- Also, the employer **must ensure** that the other end of the retrieval line is attached to a mechanical device or a fixed point outside the confined space.
- A mechanical device must be available to retrieve someone from vertical type permit spaces more than 5 feet (1.524 meters) deep.

124

SDS

If an injured entrant is exposed to a substance for which a Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that SDS or other written information must be made available to the medical facility personnel treating the exposed entrant.

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Summary

Each Confined Space has different hazards. Hazards can also change with time and usage.

Controlling Confined Space Hazards

- Post signs to warn of the dangers.
- Use barriers to prevent uncontrolled access
- Develop and use a written space entry program.
- Conduct air monitoring and tests to identify and evaluate hazards.
- Define acceptable entry conditions.

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Controlling Confined Space Hazards cont…

- Monitor entry conditions
- Eliminate or control the space's atmospheric hazards
- Lockout all internal hazards prior to entry
- Keep Entrants under effective surveillance by one or more of the following methods:
  - Line of sight (not always possible);
  - Voice contact (allowing for distance and ambient noise);
  - Intrinsically safe radio with agreed periodicity of contact;
  - Pre-arranged signals on air-klaxons, whistles, etc;
  - Pre-arranged lifeline signals.
- Be equipped with a suitable communication device (e.g. radio,) to summon assistance rapidly if required.

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Controlling Confined Space Hazards

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CONFINED SPACE ENTRY LOG

COMPANY: DATE:

Srl. No.	Name	Time In	Time Out	Time In	Time Out	Time In	Time Out

Name of Attendant: _____

Signature: _____

Contact No.: _____

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Any Questions ??

Thank you for your time!

NCMT

Mussafah 39, Abu Dhabi, UAE | Tel.: +97126721777 | Fax: +97126725511

Email: training@ncmt.ae | Web: www.ncmt.ae