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PERFORM WORK IN CONFINED SPACE OPERATION



LEANERS GUIDE

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Prepared By: **Sivakolunthu Venkatesan**

Approved By: **Rosli Pitchay**

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For Enquiries and feedback please email admin@efg.com.sg





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INTRODUCTION

Learners will be taught on the practical approach in using various tools, tactics, tips and know-how, contextualised to the needs of different sectors, including building and engineering construction services. Learners will also acquire a deeper skill set as they learn how to match these skills to different situations and have the knowledge and expertise at their disposal.

Perform Work in Confined Space Operation is one of the skills that comes under all process sectors for competency level 1.



COURSE OVERVIEW

Competency Elements (CE) and Underpinning Knowledge (UK)

Performance Statement		Assessment Method
CE 1	CE1. Identify duties and responsibilities of all personnel involved in confined space work under the WSH Legislations and Code of Practice	W/O A, PP
CE2	CE2. Identify confined space hazards	W/O A, PP
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CE4	CE4. Comply with Permit-to-Work system and safe work procedures when working in confined space	W/O A, PP
CE5	CE5. Participate in an Emergency for confined space	W/O A, PP
W/OA: Written/Oral Assessment ; PP: Practical Performance		
Underpinning Knowledge		Assessment Method
UK1	<ul style="list-style-type: none"> Legal requirements on confined space as stipulated by the WSH Act, WSH (Confined Space) Regulations; WSH (Construction) Regulations, WSH (Shipbuilding & Ship-repairing) Regulations; WSH (General Provision) and Code of Practice for Confined Spaces (SS 568:2011) Penalties for non-compliance under WSH Act Roles, responsibilities and activities of an entrant and attendant Roles and responsibilities of supervisor, confined space safety assessor, rescue personnel and authorized manager Types of confined space and work carried out in confined space Types of personal protective equipment and their functions Types of respiratory protection equipment and their uses Types of safety/warning signs 	W/O A, PP
UK2	<ul style="list-style-type: none"> Types of atmospheric hazards and their consequences Types of physical and biological hazards and their consequences Risks when working in a confined space, severity of consequences and likelihood Symptoms of persons exposed to typical atmospheric hazard Methods to prevent and control confined space hazards 	W/O A, PP
UK3	<ul style="list-style-type: none"> Types of common gas detection instruments and their uses Limitations of gas detection instruments Common mistakes when using gas detection instruments Basic precautions when using gas detection instruments 	W/O A, PP
UK4	<ul style="list-style-type: none"> Permit-to-Work System for confined space Key information on a permit-to-work Safe work procedures for working in a confined space 	W/O A, PP
UK5	<ul style="list-style-type: none"> Identify hazardous conditions which require evacuation Elements of an Emergency Response Plan Elements of a Rescue Operation plan Self-rescue procedures Alarms and communications Rescue and respiratory protection equipment for use for rescue in confined space with hazardous conditions Rescue equipment for confined space operations Entry and non-entry rescue methods Retrieval techniques for injured personnel Use retrieval devices Select, Use and check personnel protective equipment used in rescue operation 	W/O A, PP
W/OA: Written/Oral Assessment ; PP: Practical Performance		
Assessment Instruments		Duration
W/OA: Written Assessment PP: Practical Performance		2.0 hour
Total Assessment time per candidate		2.0 hour



CE 1: Identify duties and responsibilities of all personnel involved in confined space work under the WSH Legislations and Codes of Practice

1.1 Introduction

This section focuses on the knowing your responsibilities as a confined space entrant and attendant under the WSH Legislations and Codes of Practice and discharging it responsibly which include the use of personal protective equipment and respiratory protection provided for the works in confined space. It also covers the roles and responsibilities of the entrants, attendants and various stakeholders involved in confined space works. Entrants must know the different types of confined space and the works that are carried out in these spaces. Equally important is to know the underlying reasons of using PPE, following safety signs, instructions and safe work procedures.

1.2 Legal Requirements on confined spaces as stipulated by the WSH Act. WSH (confined space) Regulations; WSH (Construction) Regulations; WSH (Ship Building & Ship Repairing) Regulations; WSH (General Provision) and Code of Practice for Confined Spaces (SS 568:2011

Legislation Requirements

- Workplace Safety and Health (WSH) General provisions
- Workplace Safety and Health (WSH) Construction regulations
- WSH (Confined Space) Regulations
- SS568:2011 – Code Of Practice Confined Spaces (CP 84: 2000 - Confined Space Entry Procedure)
- WSH (Shipbuilding & Ship Repairing) Regulation
- WSH (Risk management) Regulation

Workplace Health and Safety Act

What is the Workplace Safety and Health Act?

- It is a framework to cultivate good safety habits and practices at the workplace. Every person at the workplace, from the top management to the worker, must take reasonably practicable steps to ensure the safety and health of every workplace and worker

Objective of Workplace Safety and Health Act (WSHA)

- § Manage workplace safety and health proactively.
- § Everyone to observe safety and health.
- § Aimed at reducing deaths at workplaces.

Three Guiding Principles :

1. Reduce risks at source.
2. Industries to take greater ownership.
3. Higher penalties for poor safety management.

Penalties for Non-Compliance

The Workplace Safety and Health Act states a general maximum penalty for offences.

Offender Category	Maximum Fine (1st conviction*)	Maximum Fine (2nd and subsequent convictions**)	Maximum Imprisonment	Conditions
Individual persons	\$200,000	\$400,000	2 years	Either or both
Corporate Body	\$500,000	\$ 1 million	Either or both	
Persons at work who misused or failed to use protective equipment provided	\$1,000	\$2,000		

* 1st conviction for an offence that causes the death of another person.

** 2nd & subsequent conviction of same offence that causes the death of another person

WSH (Confined space) Regulations 2009

WSH (Confined Space) Regulations 2009 is effective from 1st November 2009

“hazardous atmosphere” means an atmosphere where —

- (a) the level of oxygen in the atmosphere is not within the range of 19.5% to 23.5% by volume;
- (b) the level of flammable gas or vapour in the atmosphere is 10% or more of its lower explosive limit; or
- (c) the levels of toxic substances in the atmosphere exceed the permissible exposure levels as specified in the First Schedule to the Workplace Safety and Health General Provisions) Regulations (Rg 1);

Record of confined spaces in factory

Where a fixed and stationary confined space is sited in a factory, it shall be the duty of the occupier of the factory to —

- (a) make a record of the description and location of the confined space; and
- (b) inform persons who are liable to be exposed to the hazards of the confined space, of the existence and hazards of the confined space

Access to and egress from confined space

The duty of the occupier of a workplace to take, so far as is reasonably practicable, measures to ensure that the means of entry into and egress from any confined space in the workplace are safe and without risks to the health of every person entering or leaving the same.



Opening of entrance cover of confined space

It shall be the duty of the responsible person of a person entering or working in a confined space which contains any substance under pressure greater than atmospheric pressure to ensure that —

- (a) the entrance cover of the confined space is not removed unless the confined space is depressurized and rendered safe for opening; and
- (b) when such entrance cover is removed, the opening to the confined space is barricaded or guarded by railings or other effective means, to prevent any person or object from falling into the confined space.

Lighting in confined space

It shall be the duty of the responsible person of a person entering or working in a confined space to ensure that there is sufficient and suitable lighting for such entry into or work in the confined space.

Ventilation in confined space

It shall be the duty of the responsible person of a person entering or working in a confined space to ensure that the ventilation in the confined space complies with this regulation.

Adequate and effective ventilation shall be maintained in the confined space for the purposes of entry into and work in the confined space.

The air supply for the ventilation shall be —

- (a) from a source free from contaminants; and
- (b) directed to the area where a person is or will be present in the confined space.

Where exhaust ventilation is used, the exhaust air from the ventilation system shall be exhausted to a location outside the confined space where it does not present a hazard to any person.

Implementation of confined space entry permits

Before any person enters or works in a confined space, it shall be the duty of his responsible person to —

- (a) appoint a person whom the responsible person reasonably believes is competent to carry out the duties of an authorized manager, as an authorized manager for the confined space;
- (b) appoint a person whom the responsible person reasonably believes is competent to carry out the duties of a confined space safety assessor, as a confined space safety assessor for the confined space; and
- (c) ensure that a confined space entry permit has been issued in respect of the entry into or work in the confined space which specifies —



- (i) the description and location of the confined space;
- (ii) the purpose of entry into the confined space;
- (iii) the results of the gas testing of the atmosphere of the confined space; and
- (iv) its period of validity.

No entry into or work in confined space without evaluation and confined space entry permit

No person shall enter or work in a confined space unless

- (a) evaluation that it is necessary for such person to enter or work in the confined space; and
- (b) a confined space entry permit has been issued

Shall not apply if the person entering or working in the confined space —

- (a) is wearing a suitable breathing apparatus;
- (b) has been authorized to enter by the authorized manager
- (c) where reasonably practicable, is wearing a safety harness with a rope securely attached and there is a confined space

Application for confined space entry permits

An application for a confined space entry permit shall —

- (a) be made by the supervisor;
- (b) form and manner as may be required
- (c) state the measures which will be taken
- (d) be addressed to the authorized manager and submitted to the confined space safety assessor for the confined space.

Evaluation of confined space entry permits

On receipt of the application for a confined space entry permit, the confined space safety assessor shall test the atmosphere of the confined space prior to entry by any person into the confined space.

Issue of confined space entry permit

- (a) oxygen **range of 19.5% to 23.5% by volume**;
- (b) flammable gas or vapors less than **10% of its LEL**
- (c) toxic substances do not exceed the **permissible exposure levels (PEL)**
- (d) adequately ventilated;
- (e) prevent any ingress of dangerous gases, vapors' or any other dangerous substances into the confined space;
- (f) all reasonably practicable measures taken to ensure the safety and health of persons

The authorized manager issues a confined space entry permit, it shall be his duty to retain a copy of the permit.



Posting of confined space entry permit

- (a) Be clearly post a copy of the permit at the entrance of confined space or where the work to be conducted; and
- (b) Ensure that the copy of the permit is not removed until —
 - (i) the date of expiry of the permit;
 - (ii) the revocation of the permit; or
 - (iii) the person entering or working in the confined space has achieved his purpose of entry

Monitoring to ensure safety and health of worker during entry into or work in confined space

It is duty of the responsible person and the authorized manager to ensure that all measures necessary to ensure his safety and health are taken and in place at all times during his entry into, stay or work in the confined space.

It is also the duty of the responsible person to inform the authorized manager when the person entering or working in the confined space has left the confined space after achieving the purpose of the entry or completing the work, as the case may be.

Periodic testing of atmosphere

It is the duty of the responsible person to ensure that —

- (a) the atmosphere in the confined space is tested by a confined space safety assessor at such intervals necessary;
- (b) 2 or more persons present in the confined space, at least one of them continuously monitors the atmosphere in the confined space with a suitable gas detector; and
- (c) if a hazardous atmosphere in a confined space is detected
 - (i) all persons shall vacate immediately;
 - (ii) an evaluation to determine how the hazardous atmosphere developed;
 - (iii) no person re-enters until a new confined space entry permit

It is the duty of the confined space safety assessor to record the results of the tests

It is the duty of the responsible person that the records kept for not less than 2 years

Duty to report incompatible work

It is the duty of **any person** who is aware of any work being carried is incompatible with any other work being carried out, to immediately report to his supervisor, the workplace safety and health officer, the workplace safety and health coordinator or the authorized manager for the confined space.

“incompatible work” any work carried out in the confined space and which is likely to pose a risk to the safety and health of persons present in the confined space.



Review and revocation of confined space entry permit

It is duty of the authorized manager to review and assess the need for entry into or work in the confined space on a daily basis and revoke the permit if he thinks fit to do so.

The authorized manager:

- (a) may revoke a confined space entry permit in respect of a confined space if he is satisfied that —
 - (i) the entry or work in the confined space has been completed; or
 - (ii) the entry or work in the confined space cannot be continued for a significant period of time; and
- (b) shall, in the circumstances described in regulation 16(1)(c), revoke the relevant confined space entry permit. *{testing @ intervals; continuous monitoring of gas using personal detector ; in emergency vacate}*

Warning sign

It is the duty of the occupier to clearly post a notice at the entrance to the confined space to warn persons of the hazards of the confined space unless —

- (a) a copy of the confined space entry permit in respect of the confined space is posted there in accordance with regulation 14(a); or
- (b) there is no entrance which persons may use to enter the confined space.

Display of name or Identification badge

It is the duty of a person entering to display his name and identification badge at the entrance

It is the duty of his responsible person to ensure that he does the same.

Training of workers and supervisors

It is the duty of the responsible person before such entry or work, that the person has first received adequate safety and health training.

Any person conducts oversight or supervisory work in a confined space, it is the duty of his responsible person to ensure that the person has first received adequate safety and health training

Appointment and duties of confined space attendant

It is the duty of the responsible person to appoint a confined space attendant before such entry or work.

It is the duty of the confined space attendant to remain outside the confined space in order to —

- (a) monitor persons
- (b) maintain regular contact
- (c) alert the persons appointed to carry out rescue work in the event of an emergency.



Rescue Operation

It is duty of the responsible person

- (a) establish a written rescue plan
- (b) appoint persons to carry out rescue work
- (c) sufficient supply of suitable breathing apparatus, safety harness and ropes, suitable rescue equipment and suitable reviving apparatus which are —
 - (i) kept readily available;
 - (ii) properly maintained; and
 - (iii) thoroughly examined by a competent person at least once a month or at such other intervals as the Commissioner may require..

WSH(Construction) Regulations 2007

If you an Employer or Principal or Contractor

- To ensure workers has received adequate safety & health training
- Familiarize with hazards associated
- Implement Permit-To-Work System for work involving entry into a confined space

Any person who carries such work without permit can be Fine - \$20,000/-Max

If you are a Supervisor

- clearly post the permit at the work area
- permit not removed unit expiry or revoked or upon completion
- to monitor

Duty to report incompatible work

- Any person aware of incompatible work with any high risk construction work, to immediately report to supervisor, WSH officer/coordinator or project manager
- Work carried out at or in the vicinity likely to pose a risk to safety & health shall be treated as incompatible work
- Project Manager may immediately cease or revoke permit
- Work carried out at or in the vicinity likely to pose a risk to safety, health & welfare of persons at work

SS568:2011 (CP 84)

All of confined spaces should be clearly identified, documented and labeled at the premises

Warning Signs should be displayed at or near access point in signs in compliance with SS217.

Openings of confined space will have to be authorized in writing by responsible person.





He is also responsible for eliminate unsafe condition before removal of cover, guard opening to prevent fall of person, display warning signs and prevent falling object

Lighting shall be adequate & suitable provided.

- access & passage > 50 lux
- portable handheld AC 50v or DC 110v

Procedures for entry

- written procedures
- entry permit
- display of name or number tags
- period testing of atmosphere
- use of retrieval system
- confined space vacated for significant period

Ventilation

- suitable & adequate
- forced ventilation - cannot removed or meddle
- internal combustion engine - exhaust emission cannot enter confined space

Training

- workers & supervisors
- rescue personnel

Attendant

- appointment
- duties

Rescue operation

- rescue operation plan
- rescue equipment
- conducting drill
- SDS

1.3 Penalties for non-compliances under WSH Act

Fine **not exceeding \$20,000** or imprisonment for a term not exceeding 2 years or to both;

Any person who contravenes shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$20,000. {Permit implementation & No work without evaluation}

Any person who contravenes shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$1,000 and, in the case of a second or subsequent conviction, to a fine not exceeding \$5,000. {Display name tag & C.S attendant appointment}



1.4 Roles, responsibilities and activities of an entrant and attendant

All person to be aware of Confined space hazards and understand the hazards associated with that confined space which is used for work, it includes;

- Lack of Oxygen
- Toxic gases
- Flammable gas
- Mechanical hazards
- Chemical hazards
- Engulfment's

Duties of Authorized Entrants

- Be fully informed about all hazards
- To assure that the space has been adequately ventilated, isolated, emptied, or otherwise made safe for entry.
- To follow all safety rules and procedures that apply to the job.
- To be familiar with the work to be performed and the procedures that apply to the job.
- To properly use of all equipment for testing and monitoring, personal protection, communication, lighting, entry and exit
- To immediately exit a space whenever:
 - Is given an order to evacuate.
 - Discover any prohibited condition.
 - Recognizes warning signs or symptoms of exposure to danger.

Duties of Confined space attendant

"Attendant" means an individual stationed outside one or more permit spaces who **monitors the authorized entrants** and who performs all attendant's duties assigned in the employer's permit space program

- Warn the **unauthorized person's** entry into confined space.
- Continuously maintain an accurate count of entrants in the confined space and ensures a means to accurately identify the authorized entrants
 - Maintain Log **IN & OUT** sheet of entrants
 - Records atmospheric reading in the gas test certificate
- To remain outside the confined space during the entry operations until relieved by another attendant
- Maintain communication with entrants as often as necessary to monitor entrant status and alert entrants of the need to evacuate:
 - Communication may be through:
 - Walkie – Talkie
 - Visual contact with entrants



- Use sounding system (tapping on the wall or roof)
- Signs using the life line pulling (1-time ; 2-times; 3-times)
- Aware of emergency point, emergency equipments basic functionality that are close to Confined space such as:
 - Power point that supplies power to the confined space
 - Emergency shower, emergency alerting point (fire point, equipments such as welding machine, compressor switch off points)
- Assist rescue team on all available rescue equipment.
- For no reason, he is not allowed to enter the confined space to rescue
- Initiate the rescue and emergency.
- Aware of rescue and emergency procedure
- Understand the responsibility after the Job is completed.
- 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.)

1.5 Roles and responsibilities of supervisor, confined space safety assessor, rescue personnel and authorized manager

Duties of Supervisor

- To assure adequate protection is provided to the entrants by verifying adequate lockout/tag out and that all hazards are securely isolated.
- To support the attendant's authority in controlling access to a confined space.
- To verify that all personnel have exited prior to closing the space.
- To assure that all personnel involved are aware of the hazards associated with the space.
- To assure that rescue services are available prior to entry

Duties of Confined Space Safety Assessor

The person is responsible for testing and monitoring of the confined space to ensure safe for entry. The assessor must be adequately trained and competent in his work.

Duties of Rescue Personnel

"Rescue Person" is an individual or a team who have successfully undergone rescue training and authorized to conduct rescue operation in case of any emergency.

Duties of Authorized Manager





To review and assess the need for entry into or work in the confined space on a daily basis and revoke the permit if he thinks fit to do so.

Authorize confined space permit after evaluating all possible risk involved.





Revoke permit if he feel the confined space not safe.

Retain one approved permit copy for his records.






1.6 Types of confined space and work carried out in confined space

Types of confined space	
Excavations	
	
Giant sized pipelines	
Tunnels	



Trenches	
Columns	
Towers	
Exchangers	









Reactors	
Silos	
Underground seawater line	
Sewers	
Manholes	




1.7 Types of Personal Protective Equipment and their functions

When using PPE,

- Assess & determine hazards
- Select correct type of PPE
- Proper use
- Proper fit
- Training on use, limitation, care, maintenance, useful life and disposal

Type of PPE	Functions		
Hard hats/helmets	A hard hat is required when there is danger of head injury. It is important to wear a safety helmet which complies with applicable codes or international standards.	<ul style="list-style-type: none"> Change liner every year Change whenever damage is found. Do not modify helmet from manufacturing specification 	 
Safety Foot Wear	Special foot protection may be worn to protect against slippery surfaces, electricity, falling objects, chemicals, or sparks. Safety shoes are required to comply with applicable codes or international standards.	<ul style="list-style-type: none"> Steel Toed shoes - boots Rubber or Chemical resistant boots Petroleum – oil resistant boots. 	
Hearing Protection	To prevent excess noise from entering the ears. Prolonged exposure without protection can cause NID	<ul style="list-style-type: none"> Plugs Muffs Custom fit 	 

<p>Eye protection</p>	<p>Eye protection is required in all confined spaces. If eye-irritating chemicals, vapors or dusts are present, it is necessary to wear a pair of appropriate safety goggles. It is critical to use eye and face protection equipment which complies with applicable codes or international standards.</p>	<ul style="list-style-type: none"> • Glasses with side shields • Goggles dusty, chemicals 	
<p>Hand Protection</p>	<p>Gloves and protective clothing made of a suitable resistant material are to be worn to protect the hands from exposure to potential injuries. Specialty gloves may be required to protect against heat, cold, or when handling slippery material or tools.</p>	<ul style="list-style-type: none"> • Leather Glove • Chemical Glove • Rubber Glove • Cotton Glove • PVC Glove 	
<p>Fall Protection</p>	<p>Safety Harness It is critical for safety harnesses to be worn when there is a potential of falling from height. When wearing it, exercise care that such equipment would not introduce a hazard or unnecessarily hinder free movement within a confined space. It is important to give careful consideration to the possible hazards/rescue arrangements during the selection of the type of safety harness. The safety harness is required to comply with applicable codes or international standards</p>	<ul style="list-style-type: none"> • Fall Arrest • Fall Restraint • Safety harness 	

<p>Special Clothing</p>	<p>All persons entering a confined space shall wear full-suit work clothing. It is important for the clothing materials worn to provide appropriate protection against toxic or irritating substances. If the hazards are heat or cold, protection from over-exposure to these hazards should be worn. It is necessary for such clothing to comply with applicable codes or international standards.</p>	<ul style="list-style-type: none"> • Aprons • Coveralls • High Vis-Vests • Welding • Anti static clothing 	  
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1.8 Types of respiratory protection equipment and their uses



Training is required by WSHA for anyone who wears a respirator. Training will enable you to have the knowledge on how to protect your health. If you don't know how to use a respirator properly, you can get a false sense of protection.

Fit Testing:

- Respirators must fit properly to prevent leaks around the edges.
- Fit-testing must be done before first wearing a respirator.
- Beards are not allowed when wearing a respirator.
- In fit-testing, you first try on several types and sizes of respirators.
- After a comfortable respirator is selected, we conduct the actual fit-test.
- It is important to conduct qualitative or quantitative fit testing for all wearers of filtering respiratory protection devices to ensure that the facial seal is good. It is also crucial that fit testing is always performed by the manufacturer or their authorized partner.



<p>Air Purifying (Cartridge) Respirator</p> 	<ul style="list-style-type: none"> • These types of breathing apparatus usually consist of a full face mask connected to an air purifying filter canister. • The canisters contain an absorbent material selected for the specific toxic gas which it removes from the inhaled air. • It is important to realize that these types of BA have serious limitations. • Chemical cartridge respirators may be considered on a limited, carefully selected basis. • Limited shelf life on the canisters could result in poor efficiency of the absorbent. • Cannot be used in an oxygen deficiency atmosphere. • When breathing, a negative pressure is created within the nose / mouth cup. This may allow entry of harmful gasses via a leak around the seal. • No indication of how much absorbent is remaining or the point of saturation
<p>Air supply Respirator (Self Contained Breathing Apparatus)</p> <div data-bbox="260 1182 638 1473"> <p>PERSONAL PROTECTIVE EQUIPMENT FOR CONFINED SPACE WORK</p> <p>Self Contained Breathing Apparatus (SCBA)</p> <p><u>Advantages</u></p> <ul style="list-style-type: none"> • Highest form of protection • Can be used anywhere at any adverse condition • Allows unrestricted mobility while working  </div> <p>(Airline Respirator)</p> 	<ul style="list-style-type: none"> • Highest form of protection • Can be used anywhere at any adverse condition • Allows unrestricted mobility while working • Classified as always Rescue equipment. • As rescue unit it can be used for the limited time (30 min., 45 min.; 60 min. at the maximum.) • For better mobility SCBA can act as work line units, connected to compressed air cylinders • Air-line sets are used when required to work for long time in an Oxygen deficient or toxic gas environment • An airline respirator is recommended when entry with a normal SCBA is physically restricted and/or the work duration is longer than the service time of the SCBA. • Breathing air from an airline respirator normally comes from a trolley-mounted cylinder(s) positioned in safe zones in close proximity to the user, from a compressor or a combination of both. The breathing air is then supplied to the user by the breathing hose which is normally connected to a lightweight harness to provide the user with an uninterrupted air supply. • When compared to the more conventional SCBA, this arrangement provides greater freedom of movement and less fatigue to the user.

<p>Dust mask</p> 	<ul style="list-style-type: none"> Dust mask helps to protect health from dust particles.
<p>Hood & Mask Type ESCAPE Sets</p> 	<ul style="list-style-type: none"> Used for escape only Available in 5, 10, 15 minute sets

1.9 Types of Safety/Warning Signs

<p>Prohibition</p>	
<p>Warning / Danger</p>	

<p>Mandatory</p>	
<p>Information Safety / Emergency</p>	

CE 2: Identify confined space hazards

2.1 Introduction

This section focuses on identifying hazards associated to with works in of confined space which includes identification of the different types of hazards. Understand the use of PPE when working in of confined space. Know how to prevent confined space hazards by following the preventive and control measures introduced. Able to identify, evaluate the severity and likelihood and control hazards identified in of confined space.

2.2 Types of atmospheric hazards and their consequences

Hazards can be defined as the source or situation with potential for harm in terms of sick, health, property damage, environment damage or a combination of these.

Atmospheric Hazard



Atmospheric Hazards and their consequences

Hazards	Detailed description	
Oxygen enrichment & Oxygen deficiency	<ul style="list-style-type: none"> • Oxygen content normal fresh air level is 20.9% Vol • To entry in confined space Safe level is from 19.5% to 23.5% Vol. • Less than 19.5% is Oxygen deficient environment or Lack of oxygen • Greater than 23.5% is Oxygen enrichment that dangerous for person • For Sustain life minimum of oxygen require 18% Vol 	<ul style="list-style-type: none"> • Displacement by other gases (e.g. N₂, CO₂ for purging) • Consumption by combustion processes (e.g. welding or cutting processes) • Decomposition of organic material (bacterial effect) • Oxidation of metal structures (corrosion) • Chemical reaction (decomposition and fermentation) • Concrete casting • Oxygen enriched atmosphere start fires easily • Oxygen creates explosive atmosphere , increases rate of chemical reaction • Clothing and hair can easily catch fire an O² enriched atmosphere • People can be very seriously burn, which can often be fatal case • Oxygen creates explosive atmosphere , increases rate of chemical reaction • Oxygen enrichment atmosphere smoking is very dangerous, should be strictly prohibited



<p>Flammable gases and vapours</p>	<ul style="list-style-type: none"> • Flammable substances in a confined space can cause fire and explosions in the presence of an ignition source • Flammable gases or vapor are ignitable only if their concentrations are within the flammable range. The boundaries of this range are set by two specific levels known as the <ul style="list-style-type: none"> ➤ Lower Explosive Limit (LEL) ➤ Upper Explosive Limit (UEL) <p>Flammable sources include</p> <ul style="list-style-type: none"> • Residual gases or vapors e.g. petroleum vapors • Leaks from gas cylinders or pipelines. e.g. acetylene, liquefied petroleum or natural gas • Underground marsh gas (methane) • Vapors evaporated from solvents e.g. toluene, xylene 	<p>Containers of fuels such as gasoline and propane should not be taken into a confined space as fuel can easily burn or explode. Here are some other common substances that can cause explosions or fires in confined spaces:</p> <ul style="list-style-type: none"> • Acetylene gas from leaking welding equipment • Methane gas and hydrogen sulfide gas produced by rotting organic wastes in sewers or tanks • Hydrogen gas produced by contact between aluminum or galvanized metals and corrosive liquids • Grain dusts, coal dust • Solvents such as acetone, ethanol, toluene, turpentine, and xylene, which may have been introduced into the space through spills or by improper use or disposal
<p>Toxic gases, vapours, fumes</p>	<p>Means any substance in the form of gas, vapors, dust, fume, fiber or mist which may cause irritation injury, illness, disease or any harmful effect to a person through ingestion, inhalation or contact to a person through ingestion, inhalation or contact with body surface and includes any substance specified in the First Schedule</p> <p>Air contamination inside a confined space occurs when hazardous substances inside the space become airborne. Depending on the type of contaminants, the effects can be irritation, asphyxiation, or systemic poisoning even at low concentration</p> <p>Hydrogen Sulphide (H₂S)</p> <ul style="list-style-type: none"> • colorless gas with a strong smell of rotten eggs, • Higher concentrations sense of smell disappears • Hydrogen sulphide is highly toxic, combustible gas and heavier than air • Irritating to eyes and respiratory tract • Cause poisoning, coma and 	<p>Substances already present</p> <ul style="list-style-type: none"> • Residual petroleum vapors in storage tanks • Contents not adequately purged • Substances introduced during work processes • Cleaning chemicals/solvents (e.g. acetone, trichloroethylene) • Paint fumes (e.g. toluene, xylene) • Substances agitated and released during entry • Levels should not exceed Permissible Exposure <ul style="list-style-type: none"> ➤ Levels (PEL) stipulated in the WSH (General Provisions) Regulations

	<p>death at high concentration</p> <ul style="list-style-type: none"> • Poison person by building up in blood stream • Causes asphyxiation • Hydrogen supplied is a rapidly acting systemic poison which At high concentrations paralyses the respiratory function and causes asphyxiation. • When breathes In for prolonged periods at low concentrations it dulls the sense of its characteristic rotten-egg odor . • At high concentrations the sense of smell is readily deadened, so odour cannot be used as early warning sign <p>Carbon Monoxide</p> <ul style="list-style-type: none"> • Carbon Monoxide is a colorless and odorless gas • Combustible gas and lighter than air • The permissible Exposure Level(PEL) for Carbon Monoxide is <25 ppm by air volume • Exhaust of internal combustion engine like petrol or diesel driven machines • By product of combustion – fount in most industry <p>Effect in human:-</p> <ul style="list-style-type: none"> ➤ Enter bloodstream through the lungs <p>The Carbon Monoxide gas is a chemical asphyxiate. It binds strongly to red blood cells preventing the flow of oxygen to the brain. In the absence of oxygen, the brain cells die leading to unconsciousness and even death</p>	
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Prevention of Atmospheric Hazards

- Don't enter in confined space without checking the oxygen level is adequate
- Don't do welding, brazing and burning in a poorly ventilated confined space
- Always ventilate confined space
- Feel weak or difficulty in breathing, get out immediately
- Continuous or frequent testing is necessary in confined space
- Special precaution should be taken if confined space suspect other chemical reaction or flammability
- Before entry into confined space, test oxygen level
- Any leak must be dealt with by people who have been adequately trained and who have the proper equipment
- In oxygen enriched condition the best fire fighting media are water or extinguishers containing dry chemical powder or carbon dioxide
- Apparatus used for distribution and utilization of oxygen must be properly installed and identified
- Any vessel which is connected to a gas source other than air containing 20.9% oxygen must be disconnected and blanked
- Use forced ventilation to dilute the flammable gas
- Don't bring any ignition source or smoking within 5 meters of any confined space
- Don't carry out any hot work such as welding and cutting etc, unless the confined space is has been tested free of flammable gas or vapors
- Any unusual smell, leave the space immediately
- Provide adequate ventilation
- Never place diesel or petrol driven pump, compressors, generators, blowers or exhaust fans inside a confined space
- Use forced ventilation
- Monitor and maintain the concentration of toxic gases are below the PEL
- Leave at once if feel unwell like headache
- Never park any car, compressors, generators machine near the confined space manhole

2.3 Types of physical and biological hazards and their consequences

Physical and Biological Hazards



Hazards	Detailed description	
Electrical	<ul style="list-style-type: none"> Direct contact with electricity can caused electrocution, resulting in DEATH. Faulty Electrical equipment or cable left on the ground can cause fire and explosion The presence of water or wet ground and wet body can lead to electrical shock or short circuit 	<p>Electrical equipment's should be inspected before use</p> <ul style="list-style-type: none"> All cable coil and hang up over head Don't use Electrical equipment on wet ground or when your body is wet Use earth leakage circuit breakers (ELCB), properly grounded using double insulated tools Proper lock out and tag out procedures in place Use low voltage electric equipment LEW to certify safe for use ALL electrical equipment's
Mechanical hazards	<p>Moving parts or rotating parts of equipment is dangerous. Before entry, identify any moving or rotating parts in equipment (such as conveyors, motor, mixers, augers etc.)</p> <p>Cut, crushed, amputation or stuck by moving or rotating parts.</p>	<ul style="list-style-type: none"> Fixed proper Physical Guards on rotating parts to prevent accidental contact Don't adjust machine while working on it Isolation of all energy sources, example; power supply to the CS, following Lock out & tag out procedure (LO/TO) All pipeline leading to the CS to be Blind and bleed, securing valves with LO/TO preventing unauthorized or accidental use De- energize and lock out, or if lockout is not practicable then tag out, or both lock out and tag out of machinery, mixers, agitators or other equipment containing moving parts in the confined space. A lock out and tag out is attached to switch or valve to prevent accidental operation and automatically activation It shall only be removed by an authorized person



Falling from height/ hit by falling objects	<ul style="list-style-type: none"> In a confined space persons may fall from heights when their working on elevated grounds. In a confined space there may be the danger of being struck by falling objects such as Excavation collapse, tools or equipment, particularly if access ports or workstations are located above workers. If workers might be exposed to the hazard of falling objects, safe work procedures must be put in place to prevent this. 	<p>If the hazard cannot be eliminated and there is a danger of falling from a height;</p> <ul style="list-style-type: none"> A written Fall Protection Plan in place A fall protection system such as guardrails or a safety harness and lifeline may be required. Safety harness with 2 lanyards Warning sign displayed Only permitted workers to working at height on safe working platform with proper access and egress Do not store any material at the edge of opening or platform All tools to be kept in a toolbox All objects or materials to be securely and stored properly
Slip trip and falls	The confined space you are about to enter may have a pipe line, support, hatchway that is difficult to squeeze through, and ladders for ascending or descending. You are therefore at risk of slips, trips, and fall hazards. The flooring of tanks or other wet environments or the rungs of a ladder may be very slippery.	
Noise and vibrations	An enclosed environment can amplify noise. Noise produced in confined spaces can be particularly harmful because of reflection off walls. Noise levels from a source inside a small confined space can be up to 10 times greater than the same source placed outdoors.	Excessive noise can damage hearing. It can affect workers' ability to hear alarms, warning shouts, communication or orders to evacuate in an emergency. To prevent hearing damage, adequate & proper hearing protection must be worn e.g. ear plug or ear muff
Heat or temperature extremes	<ul style="list-style-type: none"> Confined space is closed area, one of hazard is Heat or Temperature like work inside boiler, vessels, tank & pits pipe line can heated by sun or hot work activity High temperature can cause "heat stroke" which could result in death heat cramps, exhaustion, stroke Heat cramps sign painful muscle spasms and usually in the limb Heat exhaustion sing Fatigue, nausea, headache and giddiness pulse rate & blood pressure low Thermal hazard sign is skin appear red & usually and dry, body temperature rises more than 40⁰ C 	<ul style="list-style-type: none"> Provide more ventilation fan or other cooling system. allow enough time for cooling of confined spaces that have been steam-cleaned. <p>Heat Stroke</p> <ul style="list-style-type: none"> Move to shady area Loosen or remove clothing Apply cool water on skin and fan him Place ice pack under armpits and groin area Drink water Unwell, inform Supervisor Wear loose fitting and light clothes Work under shade
Engulfment and drowning	Engulfment and suffocation in a loose material that is stored in a hopper or grain silo is another hazard that can be encountered in a confined space. A condition called bridging can occur in tanks and silos. Bridging occurs when grain, coal, sawdust, etc. clings to the side of a vessel that is being emptied. The	<ul style="list-style-type: none"> Liquids, sludge, fine solids, and other material may not be completely removed from confined spaces and may present an engulfment or drowning hazard. E.g. insulation work, process material Use of inspection ports and dipsticks



	<p>bridging material becomes unstable and may collapse at any time, engulfing workers standing on or below the material</p> <p>The risk of drowning in a vessel or tank that contain liquid and other type of process material, If contents not fully drained or dry, it may pose a risk of drowning. Workers have drowned in small pools of liquid. Workers who have fallen face-down into a small pool of water have drowned.</p>	<ul style="list-style-type: none"> • Appropriate safety harness and lifeline • Engulfment due to uncontrolled movement of liquids and solids so Check and inspect before enter in confined spaces
Lighting or Poor visibility	<p>Confined space is an enclosed area with generally no lighting within. You need install temporary lighting or use portable lighting. Light must be AC 50 or DC 110 Use flame-proofed lighting Stand by emergency lighting system</p> <p>Poor lighting can lead to risk of an accident and difficulty to see the way or when a worker in distress and identifying other potential hazard in confined space</p>	
Ergonomics Hazard	<p>Poor or Wrong work posture can result in Ergonomics issues. Confined space openings are generally small and not well-located. This can make entry and exit difficult and can interfere during emergency rescue Ergonomic issue:</p> <ul style="list-style-type: none"> • Muscular strains • Back injury • Repetitive Stress Injury (RSI) 	<ul style="list-style-type: none"> • Work at right height • Seek assistance when required • Avoid repetition of activities • Stretch out muscle often than normal.
Biological hazard,	<p>A biological hazard, also known as a biohazard, is an organism or a by-product from an organism that is harmful or potentially harmful to other living things, primarily human beings</p> <p>Common types of biological hazards include viruses, un classified waste, or toxins that were created by a particular organism or microorganism.</p> <p>Different class of biological hazards:</p> <ul style="list-style-type: none"> • Level 1 • Level 2 • Level 3 • Level 4 <p><u>LEVEL 1 :</u> It mainly consists of bacteria and other microorganisms, which pose little risk in</p>	

	<p>the case of exposure and can be warded off through the simple use of gloves or a mask.</p> <p>They can generally be disposed of in their own separate trash container without worry and are easily decontaminated</p> <p>LEVEL 2 : It consist of viruses and bacteria that can have a limited detrimental effect on humans, for example they may cause a disease such as salmonella poisoning, hepatitis, measles, Lyme disease and more.</p> <p>People working in the presence of these biological hazards will usually exercise a substantial amount of care in their handling and disposal with proper hand, eye and body protection.</p> <p>LEVEL 3 : Bacteria and viruses that can cause severe to fatal disease in humans, but for which vaccines or other treatments exist.</p> <p>LEVEL 4 : Viruses and bacteria that cause severe to fatal disease in humans, and for which vaccines or other treatments are not available.</p> <ul style="list-style-type: none"> • Anthrax • Lyme disease • Ebola 	
Asbestos Hazards	<p>The use of asbestos in buildings has been banned by the National Environment Agency since 1989</p> <p>Asbestos has in the past been widely used in a variety of building materials including floor tiles, ceiling tiles, asbestos-cement pipes or sheets, refuse chutes and fire-resistant structures. It may also be present in pipe lagging or heat insulation materials and in cladding or sprayed-on materials located on beams and between walls</p> <p>Asbestos fibres enter the body by inhalation of airborne dust or by ingestion, and can become embedded in the tissues of the respiratory or digestive systems. Exposure to asbestos dust can cause numerous disabling or fatal diseases. Inhaling or ingesting fibres from contaminated clothing or skin can also result in such diseases. Among these diseases are asbestosis (scarring and fibrosis of the lung tissues), lung cancer,</p>	<ul style="list-style-type: none"> • Identification and notification • Medical examinations • Engineering and work practice controls <ul style="list-style-type: none"> • Preparation And Demarcation Of Asbestos Work Area • Isolation • Safe Work Procedures • Wet Methods • Personal Protective Equipment • Washing / Changing Facilities • Housekeeping

	<p>mesothelioma - a cancer of the thin membrane lining of the chest and abdomen, and gastrointestinal cancer. The symptoms of these diseases generally do not appear for 20 or more years after initial exposure</p>	<ul style="list-style-type: none"> • Waste Disposal • Transportation Of Asbestos Waste
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2.4 Risks when working in a confined space, severity of consequences and likelihood

Doing a risk assessment allows us identify the hazards at the workplace and implement effective risk control measures before they escalate into accidents and injuries



3 main process:

- 1. Hazard Identification
- 2. Risk Evaluation
- 3. Risk Control

Hazard Identification

Hazard Identification involves identifying the hazards associated with the activity of each process and type of potential accidents or incidents

For confined space:

Atmospheric Hazard

- oxygen deficiency
- flammable gases and vapours
- toxic gases, vapours, fumes
- solvent vapours such as alcohols; ketones; toluene; xylene; benzene
- H₂S gases
- Carbon monoxide gases
- Dust and fibres
- Welding and flame cutting



Physical and Biological Hazards

- Chemical hazards
- Mechanical hazards
- Electrical hazards
- Ergonomic hazards
- Welding and cutting related hazards
- Engulfment hazards
- Noise and vibration hazards
- Thermal hazards
- Radiation hazards
- Working at heights
- Heat exposure such as heat stress, heat rash, heat collapse, heat cramps, heat exhaustion and heat stroke
- Other physical hazards (examples, pressure, lighting)

Risk Evaluation

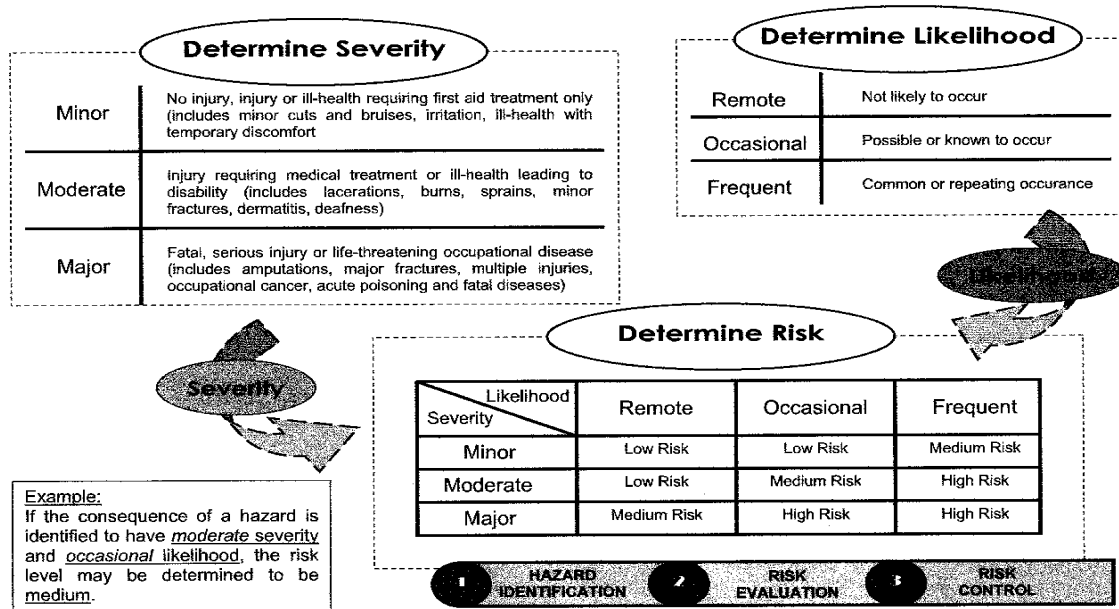
Risk evaluation is the process of estimating the risk levels for the hazards and their acceptability

Two factors that govern risk:

- SEVERITY (Consequence of the hazards)
- LIKELIHOOD (Probability of the incident happening)



Risk Evaluation Map

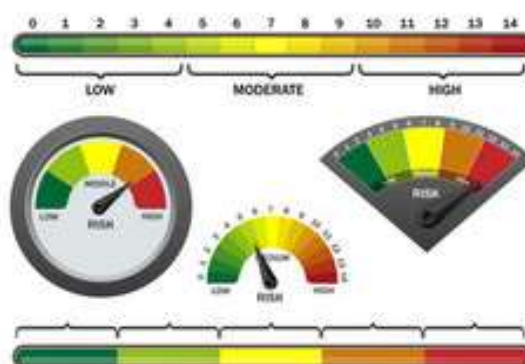


Risk Control

		Consequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	5 Almost certain	Moderate 5	High 10	Extreme 15	Extreme 20	Extreme 25
	4 Likely	Moderate 4	High 8	High 12	Extreme 16	Extreme 20
	3 Possible	Low 3	Moderate 6	High 9	High 12	Extreme 15
	2 Unlikely	Low 2	Moderate 4	Moderate 6	High 8	High 10
	1 Rare	Low 1	Low 2	Low 3	Moderate 4	Moderate 5

Formulate the control measures according to the Hierarchy of Controls and to analyze and evaluate residual risks

Risk Level	Acceptability of Risk
Low	Acceptable
Medium	Moderately Acceptable
High	Not Acceptable



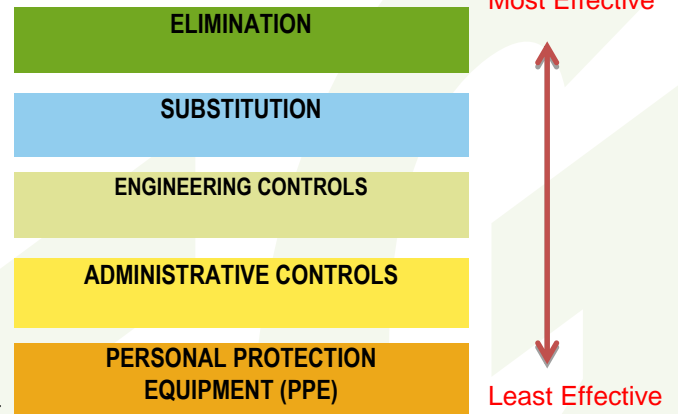
2.5 Symptoms of persons exposed to typical atmospheric hazards

Refer to 2.2

2.6 Methods to prevent and control confined space hazards

Hierarchy of Controls:

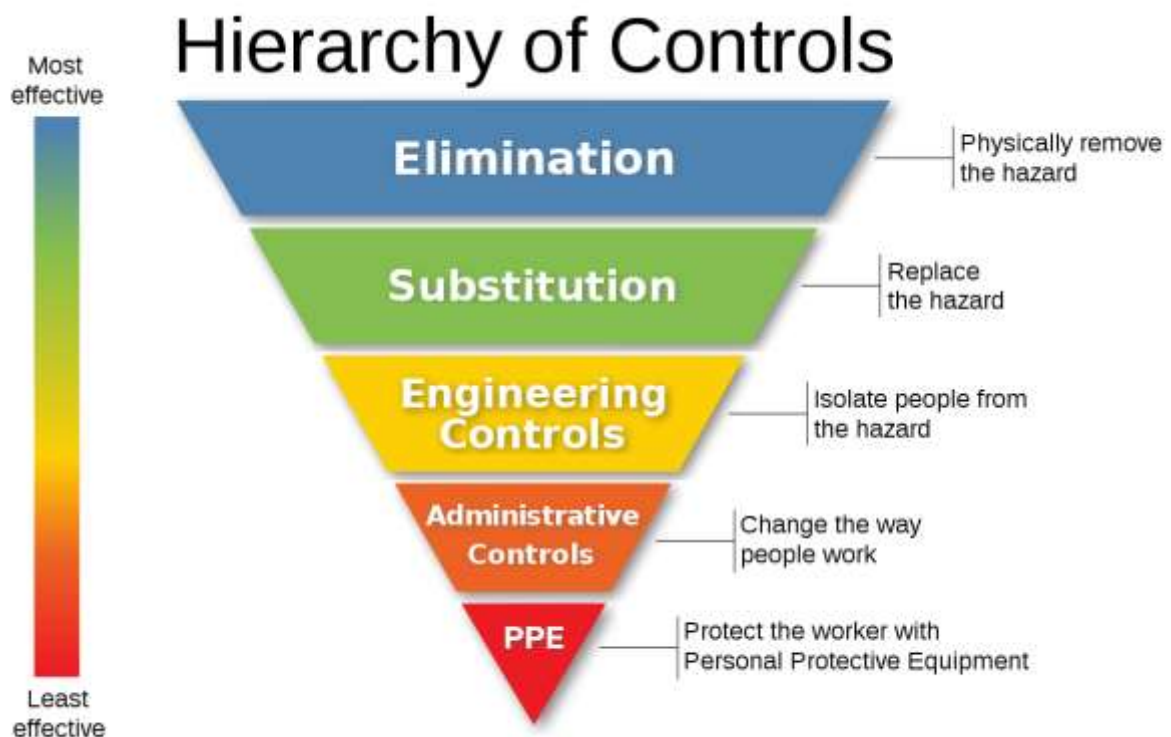
1. Elimination,
2. Substitution,
3. Engineering Controls,
4. Administrative Controls and
5. Use of Personal Protective Equipment.



Elimination of the hazard should take first priority while personal protective equipment should be the last line of defense. Following is an example of the possible control measures applicable.

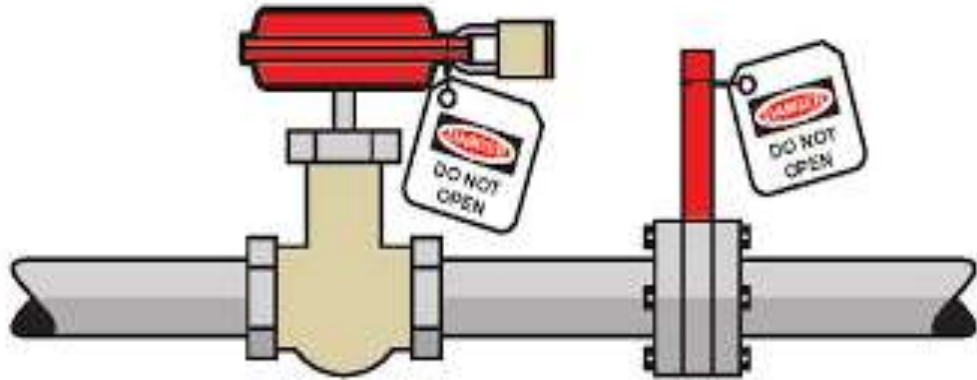
a) Conduct risk Assessment

Prior to commencement of confined space work, a risk assessment must be carried out to identify the hazards associated with the work.



b) Implement Isolation process

Adopt LOTO process to isolate potential energy
Before entry, valves and pumps to all pipes leading to confined spaces must be locked and tagged to prevent the entry of hazardous materials.



c) Periodic Gas Check

- ☐ A competent person must test and certify the atmosphere of confined spaces
- ☐ While a person is inside the space, continuous or regular gas testing should be conducted to ensure that the space remains safe.



d) Calibration of Gas Meters

Gas monitoring devices are regularly maintained
Every day before work self-functional test to be done

NOTE: A functional test is a brief exposure of the gas monitor to a known gas for the purpose of verifying sensor and alarm operation.

A full calibration by 3rd party or by authorized person
Calibrations must be carried out by trained personnel, and records kept.



e) Use non-sparking tools

Avoid sparking tools (metallic tools) while working inside confined space.

No NAKED flames to be used to start-up welding torches or for any purpose

Note: USE non sparking rubber tools to open or to hammer metals inside the confined space.



f) Entry Permit

Before entering a confined space, a permit must be issued

Note: Entry permit means only to enter (for any work needs cold or hot work permit)

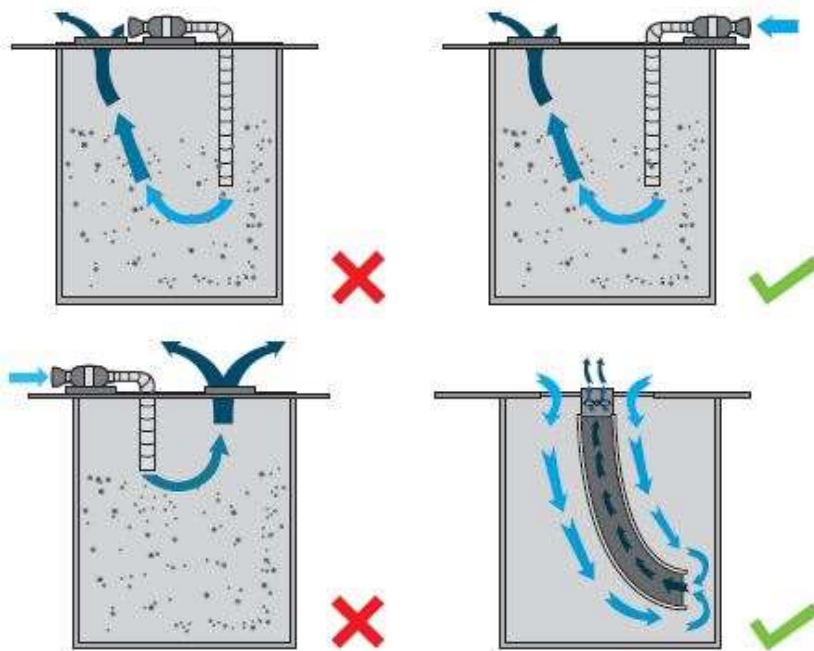


g) Ventilation

Suitable and adequate ventilation should be provided at all times to provide fresh air and/or to dilute and remove any contaminants to a safe level.

It is recommended that a combination of FORCED or supplied and EXHAUST ventilation be used to ensure adequate ventilation of the space.

Forced or supplied ventilation introduces fresh air into the space typically through the use of a fan or blower while exhaust ventilation removes contaminants from the space by drawing air out using an extractor.



h) Appoint confined space attendant

A standby person (Attendant) should be stationed outside the confined space to keep a look out and render help in the event of an emergency.



i) Safety Appliances

When entering a confined space:

- A safety harness and lifeline should always be worn at all times. This will facilitate retrieval during an emergency.
- Suitable respirators should be worn where toxic gases or vapors are known to be present.
- Air supplied respirators must be used if the space is likely to be deficient in oxygen or contain unknown or high concentrations of air contaminants.



j) Rescue Plan and Equipment

Establish written rescue operation plan on-site

Equipment such as retrieval devices and breathing and reviving apparatus should be readily available for emergency use.

The severity of accidents can be reduced

- » with timely alerts from attendants outside the space
- » having well-trained and fully equipped rescuers



k) Training

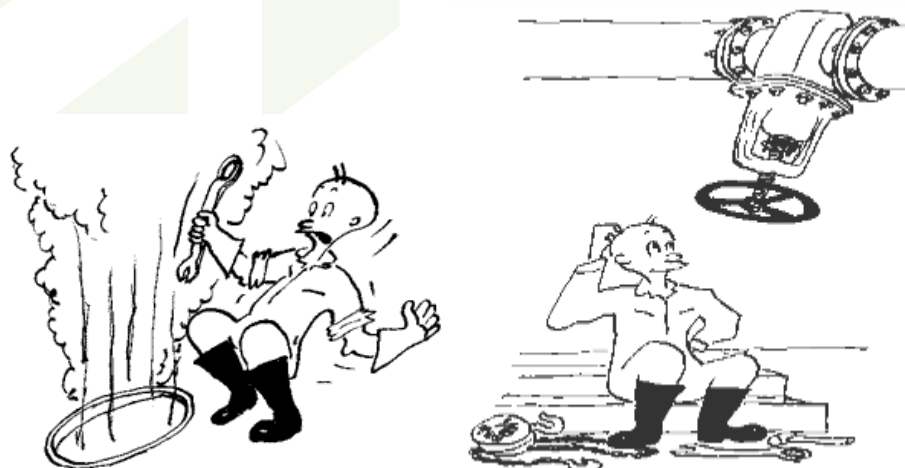
Training should be provided to all persons involved in

- General hazards associated with confined space
- Safety and health precautions
- Entry permit system and safe work procedures
- Emergency response



l) Other Safety Measures

- Never be placed Diesel-driven and petrol-driven engines inside a confined space.
- Host employers should ensure that contractors are competent.
- Procedures for emergency response must be established and communicated to all personnel on-site.






CE 3: Use Gas detection Instruments for atmospheric monitoring

3.1 Introduction

This section focuses on the different types of gas detection instruments and their uses. It also covers its limitations and common mistakes people when using such detection instruments. Persons using such devices must also know the basic precautions when handling such instruments.

3.2 Types of Common Gas Detectors and their Uses

Types	Uses
<p>Multi – gas detector</p> 	<ul style="list-style-type: none"> It is recommended that for confined space entry testing, whenever possible, use an Ex approved electronic gas detection instrument that is capable of detecting OX/EX/TOX simultaneously. Using either diffusion or active sampling via manual or electrical pump will warn the users when concentration levels in the confined space are unsafe.
<p>Single gas detector(H₂S, CO, O₂, LEL, SO₂, NH₃ etc)</p> 	<ul style="list-style-type: none"> Able to detect only one/ single gas Not suitable for gas detection or monitoring
<p>Detector tube</p> 	<ul style="list-style-type: none"> Only suitable for gas detection Not suitable for continuous gas monitoring

3.3 Limitations of Gas Detection Instruments

Multi-gas portable detector has its own limitations:

- LEL sensor can operate only in 11% of oxygen atmosphere
- All these sensor cannot work in inert gas condition.

Catalytic Gas Detection Pros & Cons

Advantages

- Relatively low cost
- Accurate and linear over sensor detection range relative to calibration gas
- Broad band sensor
- Long history, proven technology



Limitations

- Unable to identify type of gas detected
- Requires sufficient O₂ to support operating principle
- High power consumption
- Not fail safe
 - Poisoned by: sulfurs, silicones, Phosphors & leads
 - Inhibited by: chlorinated & fluorinated hydrocarbons
- Combustible gas readings may not reflect the true concentration of a combustible gas hazard.

Combustible gas detection instruments using catalytic sensor are usually not designed to detect the presence of combustible materials such as fiber or dusts

Presence of other gases in the space is different from that which the instrument is calibrated to, it may adversely influence the results of the gas testing

Important to note that some combustible gases and vapours are also toxic in nature and by using a % LEL measuring instrument, it may not be sufficient to determine the health hazard effects of these substances in the ppm range

Technology	Metal oxide semiconductor	Electrochemical	Pellistor	Infrared	eNose (sensor arrays)
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3.4 Common Mistakes when using gas detection instruments

- using gas detection instrumentation that is not calibrated
- using gas detection instrumentation that is incorrect calibrated
- using the wrong calibration gas,
- not knowing how to calibrate a gas detector
- not knowing how to read values on the unit
- not paying attention to the expiration dates,
- using improper cabling
- not following product specifications.

3.5 Basic Precautions when using Gas Detection Devices

- Reading measured from gas detector are random sample of the atmosphere.
- Do not switch off the detector when you are inside the confined space
- Do not change battery while working inside the confined space
- Before starting detector, the detector does self-test, do not measure till the detector is ready for use
- Remember there is always RESPONSE TIME for the detector, take reading only when sufficient time is given to the sensor to detect the gas
- All sampling tube to be dry and there should not be any water droplets inside the sampling tube.
- Do not leave the detector in outside atmosphere especially during the rainy season



CE 4: Comply with Permit-to-work system (Confined Space Entry Permit System) and safe work procedures when working in confined space

4.1 Introduction

This section focuses on the requirements of confined space entry permit system for confined space works. It also covers the general key information and the works to be carried out and its precautions. It shall also focus on the safe work procedures that need to be followed when working manhole/confined spaces.

4.2 Permit-to-work system (Confined Space Entry Permit System) for confined space

- Is authorized and performed by designated personnel.
 - Forms an essential part of safe system of work activities.
 - Provides a clear record and understanding of all foreseeable hazards
-
- Is a formal written system used to control and ensure all works are carried out under the safest possible condition
 - It specifies the work to be carried out and the necessary precaution to be taken before work is allowed to start.
 - Is authorized and perform by designated personnel.
 - Forms an essential part of safe system of work for many maintenance activities.
 - Provides a clear record and understanding of all foreseeable hazards that have been examined





4.3 Key information on a permit-to-work (Confined Space Entry Permit System)

- Job location
- job details
- who asked to do the work
- responsible person during the execution of work
- Date of work and validity of work.
- Resources to be used
- Precautions to be taken

4.4 Safe work procedures for working in a confined space

The following should be taken where appropriate, to prevent deaths and injuries from confined space work.

- Conduct risk assessments to identify all hazards, evaluate risks and planned mitigating measures;
- Implementation of a confined space entry permit system;
- Provide safe means of access to and egress from confined space;
- Implement safe practices for opening of the entrance/cover of a confined space;
- Conduct gas testing of the confined space prior to entry;
- Display of identification tags or badges for all entrants;
- Provide sufficient and suitable lighting for entry into or work in a confined space;
- Provide adequate ventilation to the space before entry and during work in a confined space;
- Provide appropriate personal protective equipment to reduce exposure to any residual risks;
- Maintain clear and proper communication between entrants, attendants and rescue personnel;
- Provide adequate safety and health training on working in confined spaces to all entrants and confined space attendants;
- Provide adequate training on rescue operations in confined spaces to rescue personnel;
- Appointment of a confined space attendant for every confined space entry or work;
- Establish a rescue plan and provision of rescue equipment for the confined space.

CE 5: Participate in an emergency for confined space

5.1 Introduction

This section focuses on identifying hazardous conditions and emergency situations that requires evacuation. Personnel involved in confined space works must know the various methods of rescue and the different channels of communications available.

5.2 Identify hazardous conditions which require evacuation



Life threatening conditions
(Immediate Danger to Life and Health)

1. Toxic gas release
 - H₂S
 - Ammonia
 - SO₂
 - Cyanide gas
2. Fire and Explosion
3. Man collapse due to:
 - Heat and exhaustion
 - Falling from height
 - Serious Injuries
 - Electrocution

5.3 Elements of an Emergency Response Plan

- ▶ Establishing Policy and Organizational Structure
- ▶ Identifying Hazards, Risks, and Assets
- ▶ Plan for Readiness
- ▶ Plan for Action
- ▶ Plan for Resuming Operations
- ▶ Training, Drills, and Exercises
- ▶ Keeping the Plan Current

Before anyone is authorised to enter a confined space, it is crucial to have trained emergency rescue personnel available when an entrant needs help. It is important for such personnel to reach the site promptly and know how to deal with the emergency.

In any unplanned rescue, such as when someone instinctively rushes in to help a downed co-worker, it can easily result in a double fatality or even multiple fatalities if there are more than one would-be rescuer.

REMEMBER: An unplanned rescue will probably be your LAST.

It is “A MUST” to have a written and established rescue operation plan on-site that includes equipment, such as retrieval devices, breathing and resuscitating apparatus, and ready for emergency use immediately. The severity of accidents can be reduced with timely alerts from attendants outside the confined space. A well-trained and fully equipped rescue team can ensure a speedy response in an emergency.

5.4 Elements of a Rescue Operation Plan

A written rescue operation plan shall be established for the purpose of rescuing persons in a Confined space. The rescue operation plan shall:

- Have names of the designated rescue personnel available;
- Indicate the methods of rescue to retrieve persons inside a confined space;
- Prescribe the types and availability of equipment necessary for rescue;
- Provide an effective means to summon the designated rescue personnel in a timely manner.

Confined Space Rescue Plans

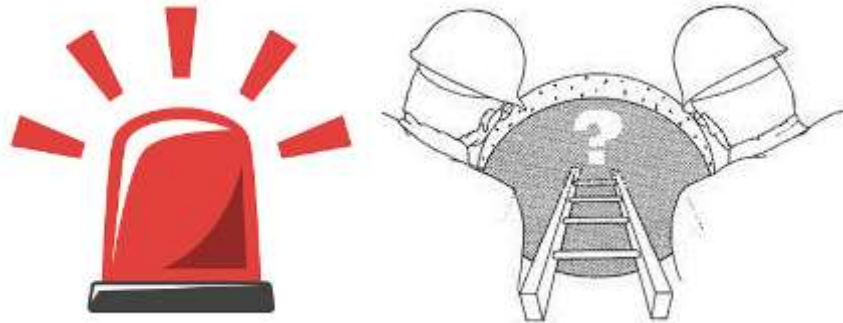


5.5 Self-Rescue procedures

❑ Self-rescue is **where the entrant recognizes a problem early on, before it gets to a serious or IDLH level**. Problems could be inherent to the confined space, external events that adversely affect the space, or personal health/medical issues of an entrant.

- The lowest level of emergency responses
- The entrants are uninjured and are able to escape the space without any assistance from that outside
- Examples of situation requiring evacuation include
 - Failure of the air-line respirators
 - Activation of alarm that signals a reduction of oxygen or increase in flammable or toxic gases
 - Failure of ventilation blower
 - Entrants experience signs and symptoms of chemical exposure

5.6 Alarms and communications



Communications while working inside confined space:

- Two way communication
 - Walkie Talkie
 - Visual communications (with direct eye contact)
 - Verbal communication (Voice-out and reach his ears)
- Use life-line pulling systems

Example:

 - 1 – pull - Indicates attendant release life line
 - 2 –pulls – Indicates attendant stop releasing the life line
 - 3 –pulls – Indicates attendant retract the life line

5.7 Rescue and emergency equipment for use for rescue in confined space with hazardous conditions

- Full body harness with retrieval line attached
- Hand-cranked mechanical winch and tripod (required when entrant is five feet or more below the entrance)
- Ladder
- Explosion-proof lighting
- Breathing apparatus
- Stretcher
- Approved head protection and
- Resuscitating apparatus.
- First aid provisions
- Portable eye wash
- Fire extinguishers
- Communication equipment
- Air supplied respirators
- Victim transport devices
- Independent work support devices
- Onsite and offsite rescue services information
- Exit routes



Breathing Apparatus



Retrieval System



Safety Harness



**Stretcher
Equipment**



Gas Detection Monitor



Resuscitation

5.8 Entry and non-entry rescue methods

Entry rescue method

Entry rescue: involves additional people entering the confined space to perform the rescue. This method poses the greatest risk - there is a casualty inside the space and the hazards that contributed to the situation may not be fully known. Planning should account for the hazards that may not be apparent.

Entry rescue method maybe required under the following situations

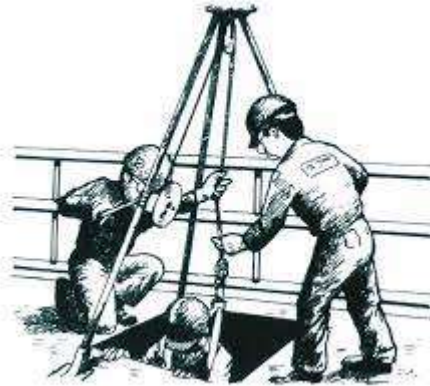
- Multiples injuries involved
- Some or all of them may be unconsciousness
- Size and configuration of the space prevent rescue from outside
- Deficiency of oxygen or high concentration of toxic gases
- Rescuers need to be protected when enter the space to do rescue work

Entry rescue is clearly the form of rescue that presents the greatest risk. Entry rescues should be avoided whenever possible and requires a considerable amount of equipment



Non-entry rescue method

Non-entry rescue method is performed from outside the space. Prior to entry, a retrieval systems and body harnesses should be in place.



- If the injured person is conscious and can help himself – Rescue without entering the confined space
- Use safety harness “D” ring and use tripod and assistance from C.S attendant to retract

Applicable only when the entrant is conscious and aware of what he is doing.

5.9 Retrieval techniques for injured personnel

It is essential to have a proper retrieval system for both workers/injured and rescue equipment e.g. stretcher to facilitate entry into and exit from a confined space.

It is critical to ensure that all hoisting components are capable of supporting a worker with a 4-to-1 safety factor.

It is important to ensure that all hoists are equipped with an adequate brake mechanism. This would allow for immediate fall arrest and the immediate retrieval of the worker at all times through the hoisting mechanism.

Retrieval techniques for injured personnel, which may include but not limited to:

- Manual lift
- Retrieve with/without stretcher
- Retrieve by winch tripod
- Retrieve by rope and pulleys

REVISION OF DOCUMENT

This document is subject to revisions and updates. The revision status is indicated at the cover page of this document, and version number is reflected in the footer throughout this document.

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