EFG TRAINING SERVICES
PRIVATE LTD

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PIW-PRO-3329-1.1-E

SUPERVISE WORK IN CONFINED SPACE OPERATION

LEARNERS GUIDE

Version Control Record

Version	Effective Date	Changes	Author
02	Jun 2022	WDA/SSG	EFG Training Services

Prepared By: ***Sivakolunthu Venkatesan*** **Approved By:** ***Rosli Pitchay***

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

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Table of Contents

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

5.2 Verify that correct procedures are used by the worker to identify, select, inspect and use respiratory protective equipment
5.3 Conduct inspection to fit check of air purifying respirators
5.4 Monitor PPE are properly prepared, stored and maintained.
5.5 Monitor respiratory protection equipment for use in confined space works are properly prepared, stored and maintained

CE6: Assist in Implementing an Emergency Response Plan

6.1 Communicate the Emergency Response Plan to workers in accordance with the organizational procedure
6.2 Activate rescue personnel in accordance with the Emergency Response Plan
6.3 Conduct inspection to ensure that workers wear full-body harness correctly when required
6.4 Conduct inspection on the correct use of self contained breathing apparatus (SCBA)
6.5 Operate communication devices
6.6 Initiate evacuation and self rescue

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.

Supervise Work in Confined Space Operation is one of the skills that comes under all process sectors for competency level 3.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

COURSE OVERVIEW

Competency Elements (CE) and Underpinning Knowledge (UK)

Content	Sub-topic
CE1. Identify duties and responsibilities of a Confined Space Supervisor under the WSH Legislations and Code of Practice **1.1 Identify and communicate the legal requirements on confined space work** **1.2 Identify and explain the roles and responsibilities of all personnel working in a confined space** **1.3 Apply appropriate means to communicate to workers on the legal requirements when working in a confined space**	• 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 • Duties and responsibilities of a Confined space Supervisor when appointed by the Principal or employer at the workplace ▪ Duties and responsibilities of all other personnel involved in confined space work
CE2. Identify, prevent and control confined space hazards **2.1 Identify types of confined space** **2.2 Identify atmospheric hazards and their consequences** **2.3 Identify physical and biological hazards and their consequences** **2.4 Conduct a risk assessment** **^The Risk Assessment /Management process should consider the management of infectious disease outbreak, employees' health (including mental well-being) and terrorist threats. Training Provider should take reference from the 3rd revision of the Code of Practice on Risk Management.**	• Types of confined space ▪ Types of atmospheric hazards and their impact ▪ Types of physical and biological hazards and their impact ▪ Risks when working in a confined space, severity of consequences and likelihood ▪ Symptoms of persons exposed to typical atmospheric hazards ▪ Control measures to eliminate confined spaces hazards (atmospheric, physical and biological hazards) ▪ Optimum and acceptable atmospheric conditions to propose for safe entry and continual work in a confined space (Method of monitoring – range of application)
CE3. Carry out and comply with the requirements of the Confined Space Entry Permit System using a systematic approach **3.1 Identify the elements of an effective confined space entry and how the elements of the programme relate to the various WSH regulations** **3.2 Raise and comply with a Permit-to-Work system** **3.3 Check to ensure that all workers are briefed on the Confined space Entry Permit** **3.4 Terminate the entry permit upon completion of work**	▪ An effective confined space entry programme and its elements (including hierarchy of control, confined space entry permit system) ▪ Elements of a confined space entry programme in the WSH (Confined Space) Regulations , WSH (Shipbuilding and Ship Repair) Regulations and WSH (Construction) Regulations ▪ Confined space Entry Permit System ▪ Procedures to raise a permit-to-work request ▪ Safety measures for confined space entry & work
CE4. Apply Gas Detection Instruments and other control measures when working in confined space **4.1 Apply gas detection instruments gas detection instruments in normal atmospheric condition and abnormal condition** **4.2 Read and interpret results shown on gas testing and gas detection instruments** **4.3 Identify the Limitations of Gas Detection Instruments**	▪ Safe work procedures for working in a confined space ▪ Types of common gas meter detectors, their uses and limitations

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Content	Sub-topic
CE5. Implement the safe use of personal protective equipment and respiratory protective equipment when in a confined space **5.1 Conduct inspection to check that the workers identify, select and use the proper PPE for work/entry into confined space** **5.2 Verify that correct procedures are used by the worker to identify, select, inspect and use respiratory protective equipment** **5.3 Conduct inspection to fit check of air purifying respirators** **5.4 Monitor PPE are properly prepared, stored and maintained.** **5.5 Monitor respiratory protection equipment for use in confined space works are properly prepared, stored and maintained.**	▪ Types of personal protective equipment (PPE) and their functions ▪ Types of respiratory protection equipment and their uses ▪ Maintenance and inspection method and procedures for PPE ▪ Maintenance and inspection method and procedures for respiratory protection equipment
CE6. Assist in implementing an Emergency Response Plan **6.1 Communicate the Emergency Response Plan to workers in accordance with the organizational procedure** **6.2 Activate rescue personnel in accordance with the Emergency Response Plan** **6.3 Conduct inspection to ensure that workers wear full-body harness correctly when required** **6.4 Conduct inspection on the correct use of self-contained breathing apparatus (SCBA)** **6.5 Operate communication devices** **6.6 Initiate evacuation and self-rescue**	▪ A competent individual should be equipped with the following knowledge: ▪ Elements of an Emergency Response Plan (ER) ▪ Elements of a rescue operation plan ▪ Identify hazardous conditions which require evacuation ▪ Communicate the evacuation conditions ▪ Responsibilities of attendant in an emergency ▪ Rescue arrangements ▪ 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

Competency Elemants		Assessment Method
CE 1	Identify duties and responsibilities of a Confined space work under the WSH Legislations and Codes of Practice	W/O Assessment
CE2	Identify, prevent and control confined space hazards	W/O Assessment PP / CS
CE3	Carry out and comply with the requirements of the Confined Space Entry Permit System using a systematic approach	W/O Assessment
CE4	Apply Gas Detection Instruments and other control measures when working in confined space	W/O Assessment
CE5	Implement the safe use of personal protective equipment and respiratory protective equipment when in a confined space	W/O Assessment
CE6	Assist in implementing an Emergency Response Plan	W/O Assessment PP
W/OA : Written/Oral Assessment ; PP : Practical Performance ; CS : Case Study		

Assessment Instruments	Duration
W/OA: Written Assessment PP: Practical Performance ; CS : Case Study	3.0 hour
Total Assessment time per candidate	3.0 hour

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

CE 1: Identify duties and responsibilities of a Confined space Supervisor under the WSH legislations and Codes of Practice

1.1 Identify and communicate the legal requirements on confined space work

About the Workplace Safety & Health Act

The Workplace Safety and Health Act is an essential part of the Workplace Safety and Health framework. The Act has four key features:

a. It places the responsibility for workplace safety on all stakeholders along lines of control at the workplace
b. It focuses on Workplace Safety & Health systems and outcomes, rather than merely on compliance
c. It facilitates effective enforcement through the issuance of remedial orders
d. To prevent accidents at the source, it issues higher penalties for non-compliance and risky behaviour.

What the Act covers:

1. Workplaces covered by Workplace Safety & Health Act
2. Responsibilities of Stakeholders
3. Hazardous Substances
4. Machinery & equipment

1) Workplaces covered by the Act

The Workplace Safety & Health Act covers all factories and workplaces of various risk levels and industries.

A factory is any premise which any of the following is carried out:

- the making of any article or part of any article;
- the altering, repairing, ornamenting, finishing, cleaning or washing of any article;
- the breaking up or demolition of any article;
- the adapting for sale of any article.

Specifically, the following premise types are considered factories:

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Heavy Industries

a. Any yard, including any dock, wharf, jetty, quay and the area within its boundaries, where the construction, reconstruction, repair, refitting, finishing or breaking up of ships is carried out. This includes the waters next to any such yard where similar shipbuilding activities are carried out by the occupier of that yard or by others on his behalf.
b. Any premises where the construction, reconstruction or repair of locomotives, aircraft, vehicles or other plant used for transport is carried on as a part of a transport undertaking or other industrial or commercial undertaking. These premises are not used for the purpose of housing locomotives, aircraft or vehicles where only cleaning, washing, running repairs or minor adjustments are carried out.
c. Any premises where building operations or any work of engineering construction are carried on.

Light Industries

a. Any premises in which the business of hooking, plaiting, lapping, making up or packing of yarn or cloth is carried out.
b. Any premises where the making, adaptation or repair of dresses, scenery or props is carried on as part of the production of films, tapes or discs for public broadcaster screening or to the presentation of theatrical performances for trade or gain. These premises are not a stage or dressing-room of a theatre in which only occasional adaptations or repairs are made.
c. Any premises where the business of making or mending nets is carried on as part of the fishing industry.
d. Any premises where the production of cinematographic films is carried on for trade or gain. These premises are not a stage or a dressing-room of any actor connected with the production of any cinematographic film.
e. Any premises where the printing by letter press, offset, lithography, photogravure, rotogravure, or other similar process, or the binding of such printed materials is carried on for trade or gain or as part of another business.
f. Any premises where mechanical power is used in connection with the making or repair of any article incidentally to any business carried on by way of trade or for purpose of gain.

Ancillary Industries

a. Any premises where the sorting of articles is carried on before the actual work is carried out in any other factory whether that other factory is situated within or outside Singapore
b. Any premises where the washing or filling of bottles or containers or packing of articles is carried on in connection with the work of any other factory, whether that other factory is situated within or outside Singapore
c. Any laundry as a part of another business or in connection with any public institution
d. Any premises where articles are made or prepared as part of any building operations or any works of engineering construction

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

e. Any premises where mechanical power is used in connection with the sorting, packing, handling or storing of articles carried on for trade or gain or as part of another business.

Storage facilities

a. Any premises which are used for the storage of gas, including liquefied gas, in a container having a storage capacity of not less than 140 cubic metres.
b. Any premises which are used for the bulk storage of toxic or flammable liquid in a container (excluding liquefied gas), that is not an underground container and that has a storage capacity of not less than 5,000 cubic metres.

Utilities

a. Any premises where work is carried out for or in connection with generating electrical energy for supply for trade or gain
b. Any premises where mechanical power is used for supplying water or in connection with a water supply
c. Any sewage works where mechanical power is used and any pumping station used in connection with these works

Other workplaces subject to Workplace Safety & Health Act include:

a. Any premises within an airport where any checking, inspecting, cleaning, loading, unloading or refuelling of an aircraft is carried out by persons other than the crew of aircraft.
b. Any ship in a harbour where any of the following is carried out:
    - scaling, scuffing, or cleaning of boilers, including combustion chambers or smoke boxes, in the ship;
    - cleaning of any tanks, bilges or holds in the ship;
    - construction, reconstruction, repair, fitting, furnishing or breaking up.
c. Any dock, wharf or quay where loading, unloading or bunkering of a ship is carried out by persons other than the crew of the ship.
d. Any premises delineated as a railway area under the Rapid Transit Systems Act (Cap. 263A) and where any inspection, testing or maintenance of any railway is carried out.
e. Any premises, other than domestic premises, in which a steam boiler, steam receiver or air receiver is used.
f. Any laboratory or other premises where the testing, examination or analysis of any article is carried out.
g. Any ship where any survey or inspection of the ship or its contents is carried out by any person other than by the crew of the ship.
h. Any tunnel, bridge or viaduct where any survey or inspection of the tunnel, bridge or viaduct is carried out.
i. Any hotel, lodging house, dormitory, service apartment, chalet, camping site or other premises where the provision of short-stay accommodation is carried out by way of trade or for purposes of gain.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

j. Any restaurant, bar, canteen or other premises where food or drinks are sold or catered for consumption within those premises or elsewhere.
k. Any hospital, hospice, nursing home or medical or dental clinic or other premises providing nursing and rehabilitation services.
l. Any veterinary centre providing any of the following services:
   (a) diagnosis of disease in, and injuries to, animals or birds, including tests performed for diagnostic purposes;
   (b) the treatment, vaccination or inoculation of animals or birds.
m. Any premises where landscaping or garden maintenance is carried out.
n. Any premises where the collection, purification or distribution of water is carried out.
o. Any premises where the disposal or treatment of sewage or refuse is carried out.
p. Any premises where the recycling of metal or non-metal waste or scrap is carried out.
q. Any premises where:
   (a) freight forwarding, packing or crating services;
   (b) cargo surveying services;
   (c) container services; or
   (d) crane services
   are carried out by way of trade or for purposes of gain or incidentally to another business so carried out.

2) Responsibilities of stakeholders

The Workplace Safety & Health Act defines the responsibilities for the following stakeholder groups:

If you are an employer or principal

You must, as far as reasonably practicable, protect the safety and health of employees or workers working under your direct control, as well as all who may be affected by their work. Your responsibilities include:

- conducting risk assessments to remove or control risks to workers at the workplace
- maintaining safe work facilities and arrangements for the workers at work
- ensuring safety in machinery, equipment, plant, articles, substances and work processes at the workplace;
- developing and implementing control measures for dealing with emergencies;
- providing workers with adequate instruction, information, training and supervision.

If you are an occupier

You must, as far as reasonably practicable, ensure that the workplace, all entrances to and exits from the workplace, and all machinery, equipment, plants, articles and substances within are safe and without risk to the health of any person within those premises, even if the person is not one of your employees.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

As an occupier, you may also be responsible for the common areas used by your employees and contractors. Occupier of the common area is responsible for the following:

- electric generators and motors located in the common area
- hoists and lifts, lifting gear, lifting appliances and lifting machines located in the common area
- means of entry into or exit from the common area
- any machinery or plant located in the common area

If you are a manufacturer or supplier

You must ensure that any machinery, equipment or substances you provide is safe for use. You are required to:

- provide proper information on the safe use of the machinery, equipment or hazardous substance
- ensure that the machinery, equipment or hazardous substance is safe for use
- ensure that the machinery, equipment or hazardous substance has been tested and examined so that it is safe for use

If you are an installer or erector of machinery

You must ensure, as far as reasonably practicable, that all machinery and equipment erected, installed or modified is safe and without health risks when properly used.

If you are an employee

- You must follow the safe working procedures and principles introduced at the workplace.
- You must not engage in any unsafe act that may endanger yourself or others working around you.
- You must use, in proper manner, any personal protective equipment, devices, equipments or other means provided to secure your safety, health and welfare while working. You must not tamper or misuse such items provided.

If you are self-employed

Even though you are self-employed, you are still required to take measures, as far as reasonably practicable, to ensure the safety and health of others, such as members of the public.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

3) Hazardous substances

The following are classified as hazardous substances under the Workplace Safety and Health Act:

1. Carcinogens
2. Corrosive substances
3. Explosives
4. Flammable substances
5. Gases under pressure
6. Irritants
7. Mutagens
8. Organic peroxides
9. Oxidising substances
10. Pyrophoric substances
11. Self-heating substances
12. Self-reactive substances
13. Sensitizers
14. Substances hazardous to aquatic environment.
15. Substances which in contact with water, or emit flammable gases
16. Teratogens
17. Toxic substances

---

4) Machinery & equipment

Manufacturers and suppliers of the following machinery & equipment have the duty to ensure they are safe for use:

1. Scaffolds and any materials or components used to erect them
2. Lifting equipment
3. Forklifts
4. Power presses
5. Bar-benders
6. Equipment or piping intended for operation under pressure, including all statutory pressure vessels
7. Equipment or piping intended to contain corrosive, toxic or flammable substances
8. Welding equipment, including any accessory, apparatus or fitting necessary to enable its use
9. Materials or components used for the construction of support structures
10. Explosive powered tools
11. Equipment used for abrasive blasting, including any accessory, apparatus or fitting necessary to enable its use and operation

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Liabilities & Penalties

The Workplace Safety and Health Act states a general maximum penalty for offences. The penalties are shown in the tables below.

Failure to comply With Remedial Orders or Stop Work Orders

Offence	Maximum fine	Maximum Imprisonment	Conditions
Failure to comply with Remedial Work Order	$50,000	12 months	Either or both
	Additional fine of $5,000 for each day of continued offence		
Failure to comply with Stop Work Order	$500,000	12 months	Either or both
	Additional fine of $20,000 for each day of continued offence		

General Penalties (for offences where no penalty is expressly provided by WSHA)

Offender Category	Maximum fine		Maximum Imprisonment	Conditions
	1st conviction*	**2nd & subsequent conviction****		
Individual persons	$200,000	$400,000	2 years	Either or both
Corporate body	$500,000	$1 million		
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

PART I
PRELIMINARY

Citation and commencement
1. These Regulations may be cited as the Workplace Safety and Health (Confined Spaces) Regulations 2009 and shall come into operation on 1st November 2009.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Definitions

2. In these Regulations, unless the context otherwise requires —

"authorised manager" means an authorised manager appointed under regulation 9 and includes any other person appointed to perform the duties of an authorised manager by the responsible person;

"competent person" means a person who has sufficient experience and training to perform the work required to be carried out;

"confined space" means any chamber, tank, manhole, vat, silo, pit, pipe, flue or other enclosed space, in which —

(a) dangerous gases, vapors or fumes are liable to be present to such an extent as to involve a risk of fire or explosion, or persons being overcome thereby;

(b) the supply of air is inadequate, or is likely to be reduced to be inadequate, for sustaining life; or

(c) there is a risk of engulfment by material;

"confined space attendant" means a confined space attendant appointed under regulation 22;

"confined space entry permit" means a permit issued under regulation 13;

"confined space safety assessor" means a confined space safety assessor appointed under regulation 9(b);

"entry" means ingress by a person into a confined space which occurs when the person's head passes through an opening into the confined space;

"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 vapor 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);

"responsible person", in relation to a person entering or working in a confined space, means

(a) his employer; or

(b) the principal under whose direction he enters or works in the confined space.

Application

3. These Regulations shall apply in relation to confined spaces in workplaces.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PART II

GENERAL PROVISIONS

Record of confined spaces in factory

4. 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

5. It shall be 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

6. 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 depressurised 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

7. 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

8.—(1) 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.

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

(3) 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.

(4) 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.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PART III

CONTROL OF ENTRY INTO CONFINED SPACE

Implementation of confined space entry permit

9. 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 authorised manager, as an authorised 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

10.—(1) Subject to paragraph (2), no person shall enter or work in a confined space unless

(a) the occupier of the workplace in which the confined space is sited has made an 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 in respect of such entry into or work in the confined space.

(2) Paragraph (1)(b) shall not apply if the person entering or working in the confined space —

(a) is wearing a suitable breathing apparatus;

(b) has been authorised to enter or work in the confined space by the authorised manager for the confined space; and

(c) where reasonably practicable, is wearing a safety harness with a rope securely attached and there is a confined space attendant keeping watch outside the confined space who is provided with the means to pull such person out of the confined space in an emergency.

Application for confined space entry permit

11. An application for a confined space entry permit shall —

(a) be made by the supervisor of the person who is to enter or work in the confined space;

(b) be made in such form and manner as may be required by the authorised manager for the confined space;

(c) state the measures which will be taken to ensure the safety and health of persons who enter or carry out the work in the confined space; and

(d) be addressed to the authorised manager and submitted to the confined space safety assessor for the confined space.

Evaluation of confined space entry permit

12.—(1) 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.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

(2) The confined space safety assessor shall, in relation to the testing of the atmosphere referred to in paragraph (1) —

(a) use a suitable and properly calibrated instrument;

(b) conduct the test in the following sequence:

(i) test for level of oxygen content;

(ii) test for level of flammable gas or vapour; and

(iii) test for concentration of toxic gas or vapour, where applicable;

(c) conduct the test in a manner that will not endanger himself or others; and

(d) record the results of the test in the confined space entry permit.

(3) If the confined space safety assessor is satisfied that entry into or work in a confined space can be carried out with due regard to the safety and health of persons who enter or work in the confined space, he shall endorse the application for the confined space entry permit and forward the endorsed application to the authorised manager for the confined space.

(4) It shall be the duty of the confined space safety assessor to exercise all due diligence when performing his functions in relation to the testing, evaluation and endorsement of an application for a confined space entry permit under paragraphs (1), (2) and (3).

Issue of confined space entry permit

13.—(1) The authorised manager for a confined space may issue a confined space entry permit in respect of entry into or work in the confined space if the authorised manager is satisfied that —

(a) the level of oxygen in the confined space is within the range of 19.5% to 23.5% by volume;

(b) the level of flammable gas or vapour in the confined space is less than 10% of its lower explosive limit;

(c) the levels of toxic substances in the atmosphere of the confined space do not exceed the permissible exposure levels as specified in the First Schedule to the Workplace Safety and Health (General Provisions) Regulations (Rg 1);

(d) the confined space is adequately ventilated;

(e) effective steps have been taken to prevent any ingress of dangerous gases, vapors or any other dangerous substances into the confined space; and

(f) all reasonably practicable measures have been taken to ensure the safety and health of persons who will be entering or working in the confined space.

(2) If the authorised manager issues a confined space entry permit, it shall be his duty to retain a copy of the permit.

(3) It shall be the duty of the authorised manager to exercise all due diligence when performing his function in relation to the issuance of a confined space entry permit under paragraph (1).

(4) If the entry or work in the confined space for which the confined space entry permit is issued is not completed within the validity period of the permit, a fresh application shall be made in accordance with regulation 11.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Posting of confined space entry permit

14. Where a confined space entry permit is issued to a supervisor of a person who is to enter or work in a confined space, it shall be the duty of the supervisor to —

(a) clearly post a copy of the permit at the entrance to the confined space, including where reasonably practicable, a sketch of the area within the confined space where the entry is to be made or work is 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 left the confined space after achieving the purpose of the entry or completing the work, as the case may be, whichever is the earliest.

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

15.—(1) It shall be the duty of the responsible person of a person entering or working in a confined space and the authorised manager for the confined space 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.

(2) t shall be the duty of the responsible person of a person entering or working in a confined space to inform the authorised manager for the confined space 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

16.—(1) It shall be the duty of the responsible person of a person entering or working in a confined space to ensure that —

(a) the atmosphere in the confined space is tested by a confined space safety assessor at such intervals as is necessary to evaluate the safety and health of the person entering or working in the confined space;

(b) if there are 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 by the tests or continuous monitoring referred to in sub-paragraphs (a) and (b) —

(i) all persons in the confined space shall vacate the confined space immediately;

(ii) an evaluation is made to determine how the hazardous atmosphere developed; and

(iii) no person re-enters the confined space until a new confined space entry permit is issued by the authorised manager for the confined space.

(2) It shall be the duty of the confined space safety assessor referred to in paragraph (1)(a) to record the results of the tests referred to in that paragraph.

(3) It shall be the duty of the responsible person to ensure that each of the records referred to in paragraph (2) are kept for not less than 2 years from the date it is made.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Duty to report incompatible work

17.—(1) It shall be the duty of any person who is aware of any work being carried out in a workplace in which a confined space is sited which is incompatible with any other work being carried out in the confined space, to immediately report the incompatible work to his supervisor, the workplace safety and health officer, the workplace safety and health coordinator or the authorised manager for the confined space.

(2) In paragraph (1), "incompatible work" means work which is carried out at or in the vicinity of 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

18.—(1) It shall be the duty of the authorised manager for a confined space who has issued a confined space entry permit 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.

(2) If, after issuing a confined space entry permit, the authorised manager is of the view that the carrying out of the work in the confined space poses or is likely to pose a risk to the safety and health of persons entering or working in the confined space, he may order all persons to leave the confined space immediately and all work in the confined space to cease immediately, and revoke the confined space entry permit.

(3) Without prejudice to paragraph (2), the authorised 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.

PART IV

MISCELLANEOUS

Warning sign

19. It shall be the duty of the occupier of any workplace in which a confined space is sited 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

20. It shall be the duty of a person entering a confined space to display his name and identification badge at the entrance to the confined space; and it shall be the duty of his responsible person to ensure that he does the same.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Training of workers and supervisors

21.—(1) It shall be the duty of the responsible person of a person entering into or working in a confined space to ensure, before such entry or work, that the person has first received adequate safety and health training for the purpose of familiarising himself with the hazards associated with such entry into or work in the confined space and the precautions to be observed.

(2) Where any person conducts oversight or supervisory work in a confined space, it shall be the duty of his responsible person to ensure that the person has first received adequate safety and health training to ensure that the work which the person oversees or supervises can be carried out safely.

Appointment and duties of confined space attendant

22.—(1) It shall be the duty of the responsible person of a person entering into or working in a confined space to appoint a confined space attendant before such entry or work.

(2) It shall be the duty of the confined space attendant to remain outside the confined space in order to —

(a) monitor persons entering into and working in the confined space;

(b) maintain regular contact with the persons in the confined space and when necessary assist them to evacuate should the need arise; and

(c) alert the persons appointed to carry out rescue work in the event of an emergency.

Rescue operation

23.—(1) It shall be the duty of the responsible person of a person entering into or working in a confined space to —

(a) establish a written rescue plan for the purpose of rescuing persons in the confined space in the event of an emergency;

(b) appoint persons to carry out rescue work and ensure that such persons have first received adequate training in rescue operation including first-aid and the proper use of personal protective equipment and other equipment necessary for carrying out a rescue operation in the confined space; and

(c) ensure that there is a 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.

(2) It shall be the duty of the competent person referred to in sub-paragraph (c) of paragraph (1) to —

(a) exercise all due diligence when making the examination referred to in that sub-paragraph; and

(b) record every examination made under that sub-paragraph and produce such record for inspection upon request by an inspector.

(3) It shall be the duty of the responsible person referred to in paragraph (1) to ensure that each of the records referred to in paragraph (2)(b) is kept for not less than 2 years from the date each is made.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Offences

24.—(1) Except as otherwise provided in this regulation, any person who contravenes any provision of these Regulations shall be guilty of an offence and shall be liable on conviction —

(a) in the case where the person is an individual, to a fine not exceeding $20,000 or to imprisonment for a term not exceeding 2 years or to both;

(b) in any other case, to a fine not exceeding $20,000.

(2) Any person who contravenes regulation 9 or 10(1) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $20,000.

(3) Any person who contravenes regulation 20 or 22(2) 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.

(4) Any person who contravenes regulation 23(2) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $2,000 and, in the case of a second or subsequent conviction, to a fine not exceeding $5,000.

WSH Act and its subsidiary legislations:

S/No.	Legislations & Code of Practices	Applicable Workplaces
1	**The WSH Act**	All Workplaces
2	**The WSH (General Provisions) Regulations**	All Workplaces
3	**The WSH (Incident Reporting) Regulations**	All Workplaces
4	**The WSH (Confined Spaces) Regulations**	All Workplaces
5	**The WSH (Construction) Regulations**	All Workplaces
6	**The WSH (Risk Management) Regulations**	All Workplaces
7	**Code of Practice for Confined Spaces (SS568:2011)**	

Confined spaces can be deadly.

Many people are killed or seriously injured while working in confined spaces each year in Singapore. According to the Workplace Safety and Health Council, 10 per cent of workplace fatalities were due to work-related accidents in confined spaces.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

These fatal accidents happened across a wide range of industries: from complex plants to simple storage vessels. Those killed were not only people who worked in confined spaces but also others who tried to rescue them.

Therefore good safety practices should be implemented to ensure a safe working environment for everyone.

Investigation of past cases surfaced the following as contributing factors to fatalities from confined space accidents:

- Absence of risk assessment prior to work commencement;
- Inadequate safe work procedures and emergency response plans;
- Absence of atmospheric testing prior to entry;
- Inadequate or absence of mechanical ventilation;
- Lack of proper supervision;
- Inadequate training;
- Lack of control of contractors and sub-contractors;
- Co-workers performing rescue without proper personal protective equipment and emergency response measures.

People enter a confined space for Cleaning, Inspection, Maintenance and repair, Construction, or Rescue, etc. As such, employer shall ensure that the confined spaces are safe to enter and work in.

Working in confined spaces is more hazardous than working in other workplaces because:

- The entrances/exits of confined spaces might not allow the entrant to evacuate effectively if there is a flood or collapse of free-flowing material;
- Self-rescue by entrant is more difficult;
- Rescue of the victim is more difficult. The interior configuration of a confined space often restricts the movement of people or equipment within it;
- Natural ventilation alone is often not sufficient to maintain breathable quality air because the interior configuration of some confined spaces does not allow air movement to circulate;
- Conditions can change very quickly;
- The space outside the confined space can impact on the conditions inside the confined space and vice versa; or
- Work activities may introduce hazards not present initially.

1.2 Roles and responsibilities of all personnel working in a confined space

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

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

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 equipments.
- 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.)

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

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

Duties of Confined Space Safety Assessor

The person 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.

1.3 Apply appropriate means to communicate to workers on the legal requirements when working in a confined space

It is important to communicate to all the workers who will be exposed to the risks during confined space entry. It is necessary to inform the workers of:

- The confined space work activities to be carried out;
- The associated safety and health hazards affecting them and nature of the risk involved;
- Types of control measures implemented to protect them;
- Any changes to the work conditions and risks control measures; and
- Their responsibilities and expectations to comply with all work requirement including

  ✓ Obeying general safety rules and regulations;
  ✓ The use of personal and respiratory protective equipment;
  ✓ Complying with safe work procedures; and
  ✓ Instructions as required under the Permit to Work system.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Information can be communicated through (but not limited to):

- ❑ Daily toolbox meeting
- ❑ Display of warning signs
- ❑ Training (mandatory and non mandatory)
- ❑ Site Orientation for new workers; to understand the site and associated risks
- ❑ Briefing by WSH officer
- ❑ Posters on WSH
- ❑ WSH Campaign
- ❑ Safety Audit
- ❑ WSH Alert

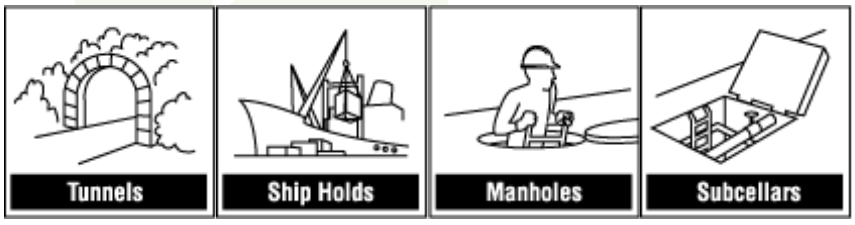
CE 2: Identify, prevent and control confined space hazards

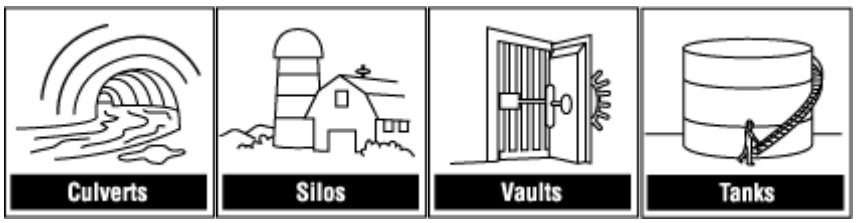
2.1 Identify types of confined space

What is a confined space?

Generally speaking, a confined space is an enclosed or partially enclosed space that:

- is not primarily designed or intended for human occupancy;
- has a restricted entrance or exit by way of location, size or means;
- may contain a hazardous atmosphere;
- contains material that could trap or buy an entrant;
- has such a shape that an entrant could become trapped or asphyxiated; or
- can represent a risk for the for the health and safety of anyone who enters, due to one or more of the following factors:
    - its design, construction, location or atmosphere
    - the materials or substances in it
    - work activities being carried out in it, or the
    - mechanical, process and safety hazards present





No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Confined spaces can be below or above ground. It can be found in almost any workplace. Examples of confined spaces include silos, vats, hoppers, utility vaults, tanks, sewers, pipes, access shafts, boilers, manholes, flue or any other enclosed spaces, in which:

- dangerous gases, vapors or fumes are liable to be present to such an extent as to involve risk of fire or explosion, or persons being overcome thereby;
- The supply of air is inadequate, or is likely to be reduced to be inadequate, for sustaining life; or
- There is a risk of engulfment by material.

Working in confined space is more hazardous than working in other workplace because many factors need to be evaluated when looking for hazards in a confined space. There is smaller margin for error. An error in identifying or evaluating potential hazards can have more serious consequences. In some cases, the conditions in a confined space are always extremely hazardous. In other cases, conditions are life threatening under an unusual combination of circumstances.

Some examples include:

- The entrances / exits of confined spaces might not allow the entrant to evacuate effectively if there is a flood or collapse of free-flowing material;
- Self-rescue by entrant is more difficult;
- Rescue of victim is more difficult. The interior configuration of a confined space often restricts movement of people or equipment within it;
- Natural ventilation alone is often not sufficient to maintain breathable quality air because the interior configuration of some confined spaces does not allow air movement to circulate;
- The space outside the confined space can impact on the conditions inside the confined space and vice versa; or
- Work activities may introduce hazards not present initially.

When any person enters or carries out any work in a confined space, the Employer and / or Principal shall comply with the regulations strictly. Under the legislation, the responsible person has to ensure safe entry and working in the confined spaces. These include:

- Identification / Record / Warning Signs / Information of all confined spaces at the workplace;
- Evaluation of the need for entry into the confined space;
- Safe means of access to and egress from the confined space;
- Sufficient and suitable lighting for entry into and working in a confined space;
- Adequate ventilation of the space to sustain life before entry and during work in a confined space;
- Procedures and control of entry into a confined space including gas testing;
- Safety and health training on working in confined spaces for workers and supervisors
- Emergency rescue operations in confined spaces which include the establishment of a rescue plan and provision of rescue equipment for confined spaces;
- Appointment of a confined space attendant; and
- The worker is fit to work in confined spaces.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

2.2 Identify atmospheric hazards and their consequences

Types of hazards in confined space?

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.

Hazards can be categorized into the following:

a) Atmospheric Hazard
b) Physical and Biological Hazards

a) Atmospheric Hazards

Hazards	Detailed description	
Oxygen enrichment & Oxygen deficiency	▪ 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	▪ 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 O^2 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
Flammable gases and vapours	▪ Flammable substances in a confined space can cause fire and explosions in the presence	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

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

	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 ➢ Lower Explosive Limit (LEL) ➢ Upper Explosive Limit (UEL) ▪ Flammable sources include ➢ 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	substances that can cause explosions or fires in confined spaces: ▪ 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
Toxic gases, vapors, fumes	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 thought ingestion, inhalation or contact to a person through ingestion, inhalation or contact with body surface and includes any substance specified in the First Schedule. Air contamination inside a confined apace 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 <u>Hydrogen Sulphide (H2S)</u> ▪ Colorless gas with a strong smell of rotten eggs	Substances already present ▪ 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. toulene, xylene) ▪ Substances agitated and released during sludge entry ▪ Levels should not exceed Permissible Exposure ➢ Levels (PEL) stipulated in the WSH (General Provisions) Regulations

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

	▪ Higher concentrations sense of smell disappears ▪ Highly toxic, combustible gas and heavier than air ▪ The permissible Exposure Level(PEL) for Hydrogen Sulphide is <10 ppm by air volume ▪ Irritating to eyes and respiratory tract ▪ Cause poisoning, coma and death at high concentration ▪ Poison person by building up in blood stream ▪ Causes asphyxiation <u>Carbon Monoxide</u> ▪ 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 ▪ Effect in human; enter bloodstream through the lungs 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	

Other common toxic vapors / gases:

- Benzene
- Chlorine
- Hydrocarbon Vapors
- Solvent Vapors
- Acid and caustic
- Dust and Fiber
- Ammonia
- Sulphur dioxide
- Nickel carbonyl

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Common control measures of Atmospheric Hazards

- Continuous ventilation of confined space
- Provide Safe Work Practices
- Select the correct testing / monitoring equipment
- Regular testing of atmosphere
- Periodic checking / maintenance of personal gas meter
- Don't do welding, brazing and burning in a poorly ventilated confined space
- Feel weak or difficulty in breathing, get out immediately
- Any leak must be dealt with by people who have been adequately trained and who have the proper equipment
- Proper LOTO procedures
- Don't bring any ignition source or smoking within 5 meters of any confined space
- Do not place diesel or petrol driven pump, compressors, generators, blowers or exhaust fans inside a confined space
- Do not park any car, compressors, generators machine near the confined space

List of Occupational Diseases for reporting

The following Occupational Diseases (updated as of 1 June2012) must be reported to MOM under Workplace Safety & Health Act and/or Work Injury Compensation Act:

1. Aniline poisoning	21. Mercurial poisoning
2. Anthrax	22. Mesothelioma
3. Arsenical poisoning	23. Musculoskeletal disorders of the upper limb
4. Asbestosis	24. Noise-induced deafness
5. Barotrauma	25. Occupational asthma
6. Beryllium poisoning	26. Occupational skin cancers
7. Byssinosis	27. Occupational skin diseases
8. Cadmium poisoning	28. Organophosphate poisoning
9. Carbarmate poisoning	29. Phosphorous poisoning
10. Cataracts due to infra-red, ultraviolet or X-ray radiation	30. Poisoning by benzene or a homologue of benzene
11. Compressed air illness or its sequelae, including dysbaric osteonecrosis	31. Poisoning by carbon dioxide gas
12. Cyanide poisoning	32. Poisoning by carbon disulphide
13. Diseases caused by excessive heat	33. Poisoning by carbon monoxide gas
14. Diseases caused by ionizing radiation	34. Poisoning by oxides of nitrogen
15. Glanders	35. Poisoning from halogen derivatives of hydrocarbon compounds
16. Hydrogen sulphide poisoning	36. Silicosis
17. Lead poisoning	37. Toxic anaemia
18. Leptospirosis or its sequelae	38. Toxic hepatitis
19. Liver angiosarcoma	39. Tuberculosis
20. Manganese poisoning	40. Ulceration of the corneal surface of the eye from exposure to tar, pitch, bitumen, mineral oil (including paraffin), soot

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

2.3 Identify physical and biological hazards and their consequences

b) Physical and biological hazards

Hazards	Detailed description	
Electrical	In contact with electricity (electrocution) that cause injuries / death ➢ Involuntary muscle contractions ➢ Ventricular fibrillation ➢ Cardiac arrest ➢ Pulmonary arrest ➢ Indirect injuries. Do **NOT** contact of persons with live parts (direct contact) ▪ contact of persons with parts which have become live under faulty conditions (indirect contact) The presence of water or wet ground and wet body can lead to electrical shock or short circuit	Electrical equipment's should be inspected before use Lockout-tagout (LOTO) procedures when equipment under maintenance Using approved equipments, maintaining them in good condition (good housekeeping) Substituting with pneumatic equipment Properly grounding Use on dry surfaces / low moisture areas
Mechanical hazards	Moving parts or rotating parts of machinery is dangerous. Machines involve moving parts, sharp edges, hot surfaces and other hazards with the potential of ➢ Crushing ➢ Shearing ➢ Cutting or severing ➢ Entangling ➢ Stabbing or puncture ➢ Friction or abrasion ➢ High pressure fluid injection or ejection	▪ Install machinery guards on rotating parts ▪ Lockout-tagout (LOTO) procedures for machine maintenance ▪ Provide emergency switches or two hand for transmission machinery ▪ Proper Usage and storage of hand tools
Noise and vibrations	Noise such as hacking, chipping, grinding, knocking or hammering, will be louder in a confined space than open area due to reverberation. ▪ Hearing loss (deafness) ▪ Other physiological disorder (e.g., loss of balance, loss of awareness) ▪ Interference with speech communication between entrants leading to accidents.	➢ Use noise monitoring equipments ➢ Wear PPE; hearing protectors ➢ Mounting vibrating machinery on vibrating isolators or applying damping materials

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Noise exposure level	Hearing protection
< 100 db	Ear plugs 
100 db to < 120 db	Ear Mufflers 
> 120 db	Ear plugs and Ear Mufflers

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

THE SCHEDULE

Regulation 2(2)

PERMISSIBLE EXPOSURE LIMITS FOR NOISE

Sound pressure level, dB(A)		*Maximum duration per day*
1.	82	16 hours
2.	83	12 hours 42 minutes
3.	84	10 hours 5 minutes
4.	85	8 hours
5.	86	6 hours 21 minutes
6.	87	5 hours 2 minutes
7.	88	4 hours
8.	89	3 hours 11 minutes
9.	90	2 hours 31 minutes
10.	91	2 hours
11.	92	1 hour 35 minutes
12.	93	1 hour 16 minutes
13.	94	1 hour
14.	95	48 minutes

Extracted from WSH (Noise) Regulations 2011

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Thermal	Heat-related illnesses begin with heat cramps, progress to heat exhaustion, and finally to heat stroke.	
	▪ Heat cramps are intermittent, involuntary muscle spasms occur in an individual who is physically active in hot weather.	Treatment includs resting, cooling the body, hydration, and stretching the muscles that are cramping.
	▪ Symptoms of heat exhaustion include profuse sweating, weakness, nausea, vomiting, headache, lightheadedness, and muscle cramps.	Treatment includes recognizing the symptoms, stopping the activity, and moving to a cooler environment. Rehydration with water, intravenous fluids may be required.
	▪ Heat stroke is a medical emergency and can be fatal if not promptly and properly treated	Cooling the victim is a critical step in the treatment of heat stroke. Always notify emergency services immediately.
	Workers who are exposed to extreme cold or work in cold environments may be at risk of cold stress.	
	▪ Hypothermia, or abnormally low body temperature, affects the brain, making the worker unable to think clearly or move well.	Move to a warm room, warm the center of their body first; chest, neck, head, and groin.
	▪ Frostbite is an injury to the body that is caused by freezing. Frostbite causes a loss of feeling and color in the affected areas. Most often affects the nose, ears, cheeks, chin, fingers, or toes. Frostbite can permanently damage body tissues, and severe cases can lead to amputation.	Move to a warm room, warm the affected area using body heat; example, the heat of an armpit can be used to warm frostbitten fingers. Do not rub or massage the frostbitten area.
	Symptoms include, reduced blood flow to hands and feet, numbness, tingling or stinging, bluish or pail, waxy skin	

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

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, when grain, coal, sawdust, etc. clings to the side of a vessel that is being emptied. The bridging material becomes unstable and may collapse at any time, engulfing workers standing on or below the material The risk of drowning if contents not fully drained or dry.	▪ Wear safety harnesses with retrieval lines, if there is no walkway with railings. ▪ Have a confined space attendant on the outside of the confined space. ▪ Establish a reliable form of communication ▪ Use LOTO, to ensure mechanical moving parts do not activate and materials do not shift underneath the worker. ▪ Use of inspection ports and dipsticks
Radiation	Health hazard arising from exposure to ionizing radiation. Examples of ionizing radiation are ultraviolet and higher frequencies, such as X-rays or gamma rays are ionizing. Effects from ionizing radiation ▪ Acute effects (eg. Radiation sickness, cancers) ▪ Chronic effects (eg. Leukemia) ▪ Genetic effects (eg. Mutation of DNA) Effects of ultraviolet radiation ▪ Erythema ▪ Photokeratitis (arc eye) ▪ Skin cancer ▪ Phoyosensitization Treatment of acute radiation syndrome is generally supportive with blood transfusions and antibiotics	The best prevention for radiation sickness is to minimize the exposure dose or to reduce the dose rate by ➢ Increase distant, ➢ Reduce exposure time ➢ Shielding and ➢ Personal monitoring
Ergonomics: Musculoskeletal Injuries and Disorders	Risk factors in confined spaces workers are most often exposed to include: ▪ Force, ▪ Repetition, ▪ Awkward and prolonged static body posture, ▪ Contact stress, and ▪ Vibration.	Could result from sudden damage from a single episode such as lifting a very heavy load or slipping and falling. However, more often it is the result of gradual wear and tear from repetitive and prolonged manual activity. Therefore, it is important to identify the risk factors and take preventive actions to minimize the risk.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- **Force**; the amount of physical effort required to perform a task (such as heavy lifting, pushing, pulling) or to maintain control of the equipment or tools.
- **Repetition**; performing the same motion or series of motions frequently for an extended period of time.
- **Awkward and prolonged static postures**; assuming positions that place stress on the body, such as repeated or prolonged reaching above the shoulder height, bending forward or to the side, twisting, kneeling, or squatting.
- **Contact stress**; pressing the body or part of the body (such as the hand) against hard or sharp edges, or using the hand as a hammer.
- **Vibration**; using vibrating tools such as sanders, chippers, drills, grinders, or reciprocating saws may result in fatigue, pain, numbness, increased sensitivity to cold, and decreased sensitivity to touch in fingers, hands, and arms. Exposure to whole body vibration may damage the joints of the skeletal system.

Falling from height/ hit by falling objects	In a confined space, persons may fall from heights when their working on elevated grounds. There may be the danger of being struck by falling objects such as 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.	If the hazard cannot be eliminated and there is a danger of falling from a height; ➢ A written Fall Protection Plan in place ➢ A fall protection system such as guardrails or a safety harness and lifeline may be required. ➢ 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 may be constrained by pipe line, support, hatchway and ladders for ascending or descending. Risk of slips, trips, and fall hazards. The flooring of tanks or other wet environments or the rungs of a ladder may also be very slippery.	Install temporary lighting or use portable lighting. ➢ Light must **be AC 50 or DC 110** Use flame-proofed lighting Stand by emergency lighting system

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Biological hazards refer to organisms or organic matters produced by these organisms that are harmful to human health.

These include parasites, viruses, bacteria, fungi and protein.

In general, three major of routes of entry for these micro-organisms into our body:

- through the respiratory system,
- transmission through contact with body fluids of the infected, or
- contact with contaminated objects.

The harmful effects posed to human health by these biological hazards are mainly of three types - **infections, allergy and poisoning.**

Different class of biological hazards:

- Level 1
- Level 2
- Level 3
- Level 4

LEVEL 1
Bacteria and viruses including *Bacillus subtilis*, canine hepatitis, *Escherichia coli*, varicella (chicken pox), as well as some cell cultures and non-infectious bacteria. At this level precautions against the biohazardous materials in question are minimal, most likely involving gloves and some sort of facial protection.

LEVEL 2
It consists 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.

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.

LEVEL 3
Bacteria and viruses that can cause severe to fatal disease in humans but vaccines or other treatments exist.

LEVEL 4
Viruses and bacteria that cause severe to fatal disease in humans, and for which vaccines or other treatments are not available, such as Anthrax, Lyme disease, Ebola.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

2.4 Conduct a risk assessment

What is Risk Assessment?

Every workplace should conduct risk assessments for all routine and non-routine operations carried out under various environmental situations, e.g., weather and soil conditions. Routine operations include activities such as preparatory and troubleshooting work activities. Non-routine operations include commissioning, repair and maintenance of plants.

Different methods of risk assessments may be adopted, but all methods should include the 3 basic steps of Hazard Identification, Risk Evaluation and Risk Control. The selection of control measures must be based on the principles of Hierarchy of Control.

A tool, qualitative (Risk Matrix) or quantitative (QRA), to
- Identify the Occupational Safety and Health (OSH) hazard
- Evaluate the risk involved
- Prioritize the actions / measures to reduce the risk

It is a process of
- Evaluating the process and consequences of injuries / illness
- Arising from exposure to identified hazard and
- Determining the appropriate actions / measures for risk control

Purpose of Risk Assessment (RA)?

- Legal obligation
- Reduce injuries and accidents
- Protect the safety and health of the employees

Workplace Safety and Health (Risk Management) Regulations 2006

The Workplace Safety and Health (Risk Management) Regulations states that employers, self-employed persons and principals (including contractors and sub-contractors) are responsible in identifying safety and health hazards at workplaces and taking appropriate actions to eliminate or reduce the risks associated with the hazards.

Risk Assessment Team

Risk assessment should be conducted by a multidisciplinary team who has a thorough knowledge of the work to be undertaken. Team members should include management staff, process or facility engineers, technical personnel, supervisors, production operators, maintenance staff and safety personnel if available. The risk assessment team should include contractors/suppliers personnel who are involved with the work, whenever necessary.

The team leader should have undergone training in risk assessment. Alternatively, a safety consultant trained and has experience in job safety analysis and risk management could be engaged to assist in the conduct of risk assessment.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Roles and Responsibilities

Risk management duties are imposed on every employer, self-employed person and principal (including contractor and sub-contractor). These parties must take all reasonably practicable measures to ensure that the workplace is safe to every person within its premises.

The Employer should:

1. Designate, assign, appoint or engage a competent person leading a team of personnel (including contractors) associated with the process or activity to conduct risk assessments;
2. Ensure that the risk control measures are implemented without undue delay after the completion of risk assessment;
3. Inform all persons working at the workplace of the risks, and the means to minimize or, where possible, eliminate the risks;
4. Provide a risk assessment register to record the findings of risk assessment;
5. Endorse and approve the risk assessments conducted;
6. Keep risk assessment records for inspection for at least three years from the date of the assessment; and submit the records to the Commissioner for Workplace Safety and Health if the Commissioner so requires;
7. Review and update the risk assessment at least once every three years or whenever there is a significant change in the work, or after an incident involving the work process;
8. Ensure that all employees are aware of the risk assessment for the work activity they carry out;
9. Develop and implement safe work procedures (SWPs) for work which poses safety or health risks to workers; and
10. Keep a written description of SWPs and produce this to the inspector for inspection when requested.

The Team Leader should:

1. Have adequate knowledge of the risk assessment method;
2. Recommend appropriate risk control measures to reduce or eliminate the risks identified;
3. Prepare a record of the risk assessment for the employer after completion of the assessment; and
4. Assist management in monitoring the effectiveness of risk control measures after their implementation.

Employees should:

1. Participate in the risk assessment or assist in conducting the risk assessment;
2. Adhere to SWPs established to reduce any safety and health risks in the workplace; and
3. Inform their supervisors of any shortcomings in the SWPs or risk control measures.

Contractors and Suppliers

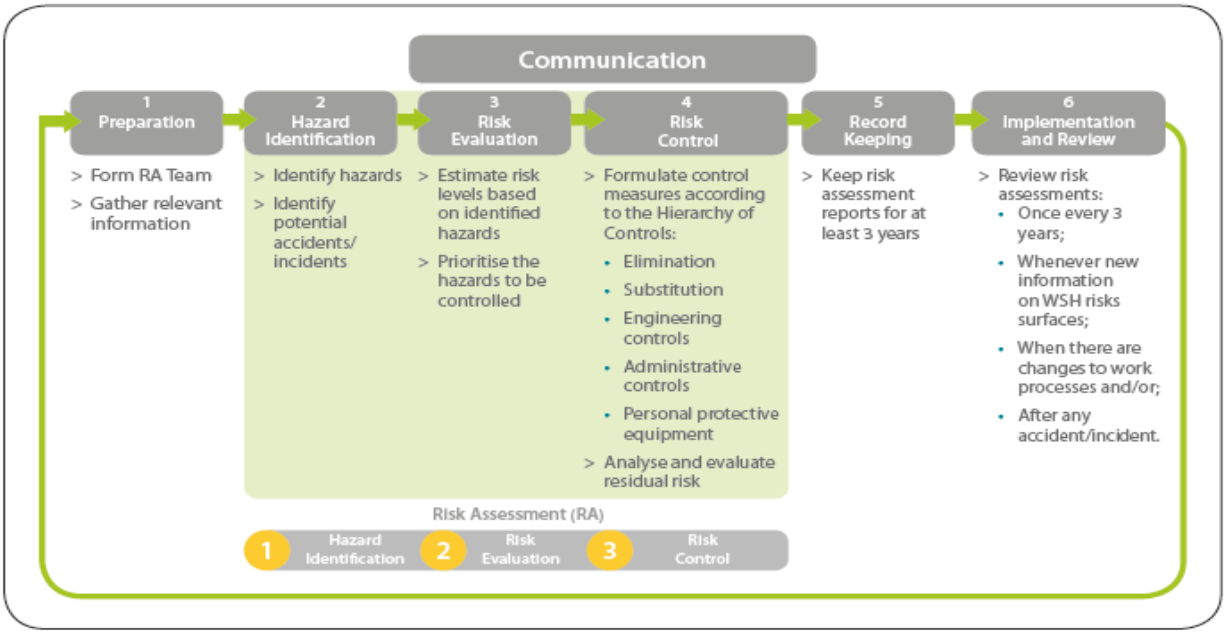
Whenever necessary, contractors and suppliers should work with the risk assessment team to identify hazards, evaluate and control the risks that machinery, equipment or hazardous substances may pose. Contractors and suppliers must provide information of any machinery,

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

equipment or hazardous substances to their customers who may require the information to conduct risk assessment in their workplaces. For example, contractors and suppliers should provide operation manuals, maintenance manuals, safety data sheets, etc.

Where contractors and suppliers undertake work for their customers, they must take all reasonably practicable measures to eliminate or reduce the risk that may be posed by their machinery, equipment or hazardous substances as much as reasonably practicable.

How to do a Risk Assessment (RA)?



Risk assessment is the process of identifying hazards, evaluating the risks and determining the appropriate measures for risk control.

Hazard identification is a critical step in risk assessment because hazards can only be controlled if they are identified. Hazard Identification involves identifying the hazards associated with the activity of each process and type of potential accidents or incidents.

Hazard refers to any source or situation with the potential to cause harm or injury. Hazards may be classified as:

- Chemical (acids, alkalis, solvents);
- Biological (bacteria, fungi and viruses);
- Electrical (frayed wires);
- Ergonomic (repetitive work, awkward postures, prolonged standing);
- Mechanical (damaged equipment, forklifts, cranes, overhead cranes, power press);
- Physical (excessive noise, heat, radiation);
- Psychosocial (overwork, poor supervision)

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Risk Evaluation is the process of assessing the risk level of the identified hazards and their possibility or probability that one would be harmed or suffered if exposed to the hazard. It is a function of *Likelihood* and *Severity*. This is used as a basis for prioritizing actions and resources to control the hazards.

- Likelihood refers to the probability or frequency of an event occurring. Likelihood is classified into Remote, Occasional and Frequent.

  Remote: Unlikely to Occur
  Occasional: Possible, known to occur
  Frequent: Common, repeated occurrence

- Severity refers to the degree or extent of injury or harm caused by the hazard, or as a result of an accident. Severity is classified into Minor, Moderate or Major.

  Minor: First-aid related injuries, i.e. minor cut, bruise, light abrasion of skin, etc.
  Moderate: Injury that requires medical treatment or ill health leading disability, i.e. laceration, burns, sprains, minor fractures, dermatitis, deafness, work-related upper limb disorders, etc.
  Major: Fatal, serious injuries or life threatening occupational disease, i.e. amputations, major fractures, multiple injuries, occupational cancer and acute poisoning & fatal diseases, etc.

Risk rating

Once the severity and likelihood have been established, the risk rating can be determined; Low, Medium or High risk

Risk level	Acceptability of risk	Recommended Actions
Low	Acceptable	Although no additional control measures may be needed, frequent reviews may be necessary to ensure that the risk level does not increase as a result of significant changes.
Medium	Moderately acceptable	A careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as is practicable within a defined time period. Interim risk control measures, such as administrative controls, may be implemented. Management attention is required.
High	Unacceptable	**High Risk level must be reduced to at least Medium Risk before work commences. There should not be any interim risk control measures and risk control measures should not be overly dependent on personal protective equipment or appliances. If need be, the hazard should be eliminated before work commences. Immediate management intervention is required before work is allowed to commence.**

.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

3 x 3 risk matrix

Likelihood / Severity	Remote	Occasional	Frequent
Major	Medium risk	**High risk**	**High risk**
Moderate	Low risk	Medium risk	**High risk**
Minor	Low risk	Low risk	Medium risk

The matrix works by selecting the appropriate consequences from across the top, and then cross referencing against the row containing the likelihood, to read off the risk rating.

5 x 5 risk matrix

LIKELIHOOD					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5
					CONSEQUENCES

Likelihood (Probability)	Consequences (Impact)
5. Almost Certain	**5. Fatality**
4. Probable	**4. Major Injury, resulting in disability**
3. Possible	**3. Injury required Doc's or Hospital attendance**
2. Possible (under unfortunate circumstances)	**2. Minor injury, 1st Aid required**
1. Rare	**1. Minor injury, 1st Aid NOT required**

The risk rating is calculated by multiplying the likelihood against the consequences, e.g. taking a likelihood of 4, which is classified as Probable, and multiplying this against a consequence of 2, which is classified as a Minor Injury 1st aid required, would give you and overall risk rating of 8, which would be risk rated as a low risk.

- High risk equals 16 to 25.

High Risks activities should cease immediately until further control measures to mitigate the risk are introduced.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- Medium risk equals 9 to 15.

Medium Risks should only be tolerated for the short-term and then only whilst further control measures to mitigate the risk are being planned and introduced, within a defined time period.

- Low risk equals 1 to 8.

Low Risks are largely acceptable, subject to reviews periodically, or after significant change etc.

2.5 Implement control measures to eliminate various confined spaces hazards

Risk control, the concept of acceptable risk is known as the ALARP principle. "ALARP" is the acronym for "as low as reasonably practicable. It is essential for risks to be eliminated or reduced at source. If the risk cannot be controlled completely by engineering measures, it is necessary to protect the employees by administrative control and / or personal protection.

The control of hazards and reduction of risks can be accomplished by following the Hierarchy of Control measures. These control measures are not mutually exclusive, i.e., engineering controls can be implemented together with administrative controls (e.g., training and safe work procedures).

Hierarchy of Control measures is used to manage the identified risks:

- Elimination

Eliminate all hazards in the space or control the hazards so that the entrants can accomplish their tasks and exit the space safely. For example, disconnect, Lockout & Tagout (LOTO) all electrical energy sources of equipment in the confined space to eliminate the hazards; remove remnants of sludge and remove any potential trapped products or gases through continual cleaning.

- Substitution

Instead of entering a confined space to carry out an activity, consider the possibility of using an alternative method to do the job without entering. For example, using a vacuum machine and extended hose to suck out the sludge instead of having workers enter the confined space to physically remove it.

- Engineering Control

Engineering controls are physical means that limit the hazards. These include using continuous forced ventilation with continuous monitoring of the atmosphere to ensure the ventilation is adequate in the confined space. These will help to maintain a safe atmospheric and comfortable work environment.

- Administrative Control

Administrative control means the implementation of any administrative requirement including permit to work system.

i) Establish Entry Procedures

Before any worker enters a confined space, it is necessary to establish safe work procedures covering all phases of the entry process. It is crucial that the entry permit is duly completed and the confined space is safe for workers to enter. "Entry" occurs when a person's head passes through an opening into the confined space.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

ii) The Entry Permit

It is necessary for the entry permit documents to reflect acceptable entry conditions and indicate that the confined space is safe for workers to enter. It is important to display the entry permit at the entrance of the confined space.

- Personal Protective Equipment

If reasonably practicable control measures are not available to mitigate the risks of working in a confined space, the use of Personal Protective Equipment (PPE) may be considered as the last line of defence.

Residual risks are the remaining risks for which the planned risk controls are not able to effectively remove or control. Addition measures may be recommended / highlighted to ensure that residual risk is further minimized.

Communication is important to communicate the final outcome of the risk assessment to all workers who may be exposed to the risks during confined space entry. It is necessary for managers / supervisors to inform the workers of:

- The confined space work activities to be carried out;
- Associated safety and health hazards affecting them and nature of the risks involved;
- Types of control measures implemented to protect them;
- Their responsibilities and expectations to comply with all work requirements including:
  i) Obeying general safety rules and regulations;
  ii) The use of personal and respiratory protective equipment;
  iii) Complying with safe work procedures; and
  iv) Instructions as required under the Permit to Work system.
- Any changes to the work conditions and risks control measures.

Review of Risk Assessment

It is essential to review or revise the confined space risk assessment at least once every 3 years. It is also necessary to review the risk assessment when:

✓ When there is significant change to work practices or procedures including implementation of additional risk control measures; or

✓ After an incident arising from work in confined spaces.

Documentation

It is important to maintain duly approved records and current risk assessments. It is essential for the record to include:

✓ The results or findings recorded in the risk assessments;
✓ Risk control measures taken or to be taken within an agreed time frame; and
✓ Any safe work procedures.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

2.6 Propose optimum and acceptable atmospheric conditions for safe entry and continual work in a confined space

Covered in CE4: Apply Gas Detection Instruments and other control measures when working in confined space

CE 3: Carry out and comply with the requirements of the Confined Space Entry Permit System using a systematic approach

---

3.1 Identify the elements of an effective confined space entry and how the elements of the programme relate to the various WSH regulations

WHAT ARE PERMITS-FOR-ENTRY?

A permit for entry system is a formal written system used to ensure that all the elements of a safe system of work are in place before persons are allowed to enter or work in confined spaces. No person shall enter or work in a confined space without a valid entry permit. It specifies the work to be done, the precautions to be taken and used as part of an overall safe system of work, which has been devised by company to meet its specific needs. Work activities in confined spaces can only start after safe work procedures have been defined and a clear record that all foreseeable hazards have been considered. It is also a means of communication between site / installation management, plant supervisors and operators and those who carry out work in the confined spaces.

In Workplace Safety and Health (Construction) regulations 2007, Permit-To-Work (PTW) is applicable to the following types of work that form part of any building operation or works of engineering construction:

(a) demolition work;
(b) excavation and trenching work in a tunnel or hole in the ground exceeding 1.5 metres depth;
(c) lifting operations involving tower, mobile or crawler crane;
(d) piling work;
(e) tunnelling work;
(f) work on a scaffold where a person could fall more than 2 metres; and
(g) **work involving entry into a confined space.**

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

The permit-to-work system shall provide that

- any high-risk work at the workplace must be carried out with due regard to the safety and health of persons carrying out the high-risk work in the workplace;
- such persons are informed of the hazards associated with the high-risk work and the precautions they have to take; and
- the necessary safety precautions are taken and enforced when the high-risk work is being carried out in the workplace.

The objectives and functions of Permit-To-Work / Entry Permit can be summarized as:

- Ensuring the proper authorization of designated works. Clear identification of who may authorize the jobs and who is responsible for specifying the necessary precautions / measures.
- Making clear to people carry out the work the exact identity, nature and extend of the job and the hazards involved, and any limitations on the extent of work and the time during which the job may be carried out.
- Specifying the precautions to be taken including safe isolation from potential risks such as hazardous substances and energy sources.
- Ensuring that the person of the plant or installation is aware of all the work being done.
- Providing a system of continuous control and also a record showing the nature of the work and the precaution needed have been checked by an appropriate person.
- Providing for the suitable display of the permits.
- Provide a procedure when work has to be suspended before it is complete.
- Provide for the procedures or arrangements for works activities that may interact with or affect any of these activities.
- Specifying the training and instruction in the issue and use of permit.
- Monitoring and auditing to ensure that the system works as intended.

In Workplace Safety and Health (Confined Space) regulations 2009, PART III: CONTROL OF ENTRY INTO CONFINED SPACE, stipulates that

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

IMPLEMENTATION OF CONFINED SPACE ENTRY PERMITS

9. 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

10.—(1) Subject to paragraph (2), no person shall enter or work in a confined space unless

(a) the occupier of the workplace in which the confined space is sited has made an 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 in respect of such entry into or work in the confined space.

(2) Paragraph (1)(b) shall not apply if the person entering or working in the confined space —

(a) is wearing a suitable breathing apparatus;
(b) has been authorised to enter or work in the confined space by the authorised manager for the confined space; and
(c) where reasonably practicable, is wearing a safety harness with a rope securely attached and there is a confined space attendant keeping watch outside the confined space who is provided with the means to pull such person out of the confined space in an emergency.

APPLICATION FOR CONFINED SPACE ENTRY PERMITS

11. An application for a confined space entry permit shall —
(a) be made by the supervisor of the person who is to enter or work in the confined space;
(b) be made in such form and manner as may be required by the authorized manager for the confined space;

(c) state the measures which will be taken to ensure the safety and health of persons who enter or carry out the work in the confined space; and

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

(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

12.—(1) 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.

(2) The confined space safety assessor shall, in relation to the testing of the atmosphere referred to in paragraph (1) —

(a) use a suitable and properly calibrated instrument;

(b) conduct the test in the following sequence:
(i) test for level of oxygen content;
(ii) test for level of flammable gas or vapor; and
(iii) test for concentration of toxic gas or vapor, where applicable;

(c) conduct the test in a manner that will not endanger himself or others; and

(d) record the results of the test in the confined space entry permit.

(3) If the confined space safety assessor is satisfied that entry into or work in a confined space can be carried out with due regard to the safety and health of persons who enter or work in the confined space, he shall endorse the application for the confined space entry permit and forward the endorsed application to the authorized manager for the confined space.

(4) It shall be the duty of the confined space safety assessor to exercise all due diligence when performing his functions in relation to the testing, evaluation and endorsement of an application for a confined space entry permit under paragraphs (1), (2) and (3).

13.—(1) The authorised manager for a confined space may issue a confined space entry permit in respect of entry into or work in the confined space if the authorised manager is satisfied that —
(a) the level of oxygen in the confined space is within the range of 19.5% to 23.5% by volume;

(b) the level of flammable gas or vapour in the confined space is less than 10% of its lower explosive limit;

(c) the levels of toxic substances in the atmosphere of the confined space do not exceed the permissible exposure levels as specified in the First Schedule to the Workplace Safety and Health (General Provisions) Regulations (Rg 1);

(d) the confined space is adequately ventilated;

(e) effective steps have been taken to prevent any ingress of dangerous gases, vapours or any other dangerous substances into the confined space; and

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

(f) all reasonably practicable measures have been taken to ensure the safety and health of persons who will be entering or working in the confined space.

(2) If the authorised manager issues a confined space entry permit, it shall be his duty to retain a copy of the permit.

(3) It shall be the duty of the authorised manager to exercise all due diligence when performing his function in relation to the issuance of a confined space entry permit under paragraph (1).

(4) If the entry or work in the confined space for which the confined space entry permit is issued is not completed within the validity period of the permit, a fresh application shall be made in accordance with regulation 11.

POSTING OF CONFINED SPACE ENTRY PERMIT

14. Where a confined space entry permit is issued to a supervisor of a person who is to enter or work in a confined space, it shall be the duty of the supervisor to —

(a) clearly post a copy of the permit at the entrance to the confined space, including where reasonably practicable, a sketch of the area within the confined space where the entry is to be made or work is 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 left the confined space after achieving the purpose of the entry or completing the work, as the case may be, whichever is the earliest.

MONITORING TO ENSURE SAFETY AND HEALTH OF WORKER DURING ENTRY INTO OR WORK IN CONFINED SPACE

15.—(1) It shall be the duty of the responsible person of a person entering or working in a confined space and the authorised manager for the confined space 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.

(2) It shall be the duty of the responsible person of a person entering or working in a confined space to inform the authorised manager for the confined space 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.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PERIODIC TESTING OF ATMOSPHERE

16.—(1) It shall be the duty of the responsible person of a person entering or working in a confined space to ensure that —

(a) the atmosphere in the confined space is tested by a confined space safety assessor at such intervals as is necessary to evaluate the safety and health of the person entering or working in the confined space;

(b) if there are 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 by the tests or continuous monitoring referred to in sub-paragraphs (a) and (b) —

(i) all persons in the confined space shall vacate the confined space immediately;
(ii) an evaluation is made to determine how the hazardous atmosphere developed; and
(iii) no person re-enters the confined space until a new confined space entry permit is issued by the authorised manager for the confined space.

(2) It shall be the duty of the confined space safety assessor referred to in paragraph (1)(a) to record the results of the tests referred to in that paragraph.

(3) It shall be the duty of the responsible person to ensure that each of the records referred to in paragraph (2) are kept for not less than 2 years from the date it is made.

DUTY TO REPORT INCOMPATIBLE WORK

17.—(1) It shall be the duty of any person who is aware of any work being carried out in a workplace in which a confined space is sited which is incompatible with any other work being carried out in the confined space, to immediately report the incompatible work to his supervisor, the workplace safety and health officer, the workplace safety and health coordinator or the authorised manager for the confined space.

(2) In paragraph (1), "incompatible work" means work which is carried out at or in the vicinity of 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

18.—(1) It shall be the duty of the authorised manager for a confined space who has issued a confined space entry permit 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.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

(2) If, after issuing a confined space entry permit, the authorised manager is of the view that the carrying out of the work in the confined space poses or is likely to pose a risk to the safety and health of persons entering or working in the confined space, he may order all persons to leave the confined space immediately and all work in the confined space to cease immediately, and revoke the confined space entry permit.

(3) Without prejudice to paragraph (2), the authorised 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

3.2 Raise and comply with a Permit-to-Work system

INFORMATION REQUIRED ON THE ENTRY PERMIT

The entry permit should include:

- Identification of the confined space;
- Location of the confined space;
- Purpose of entry;
- Entry date and time duration;
- Validity of the permit (date and time of completion/expiration of entry/work);

- Potential hazards in the confined space:
  i. Atmospheric hazards
  ii. Non-atmospheric hazards

- Control measures (how hazards will be controlled so that the space is safe to enter).
  The following are some of these measures:
  i. Isolation:
  De-energization and lockout/tagout (LOTO);
  Blanking/bleeding/isolation of pipes;
  Removal of mechanical belt / linkages.

  ii. Personal Protective Equipment (PPE):
  Safety helmet;
  Safety shoes;
  Eye protection;
  Hand protection;
  Fall protection/lifelines;
  Respiratory protection;
  Protective and reflective clothing; and
  Other personal equipment, such as personal gas detector, torchlight

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

iii. Other precautions: barricades and signboards.

iv. Emergency response:
A well-rehearsed rescue plan;
Rescue equipment;
Name and contact number of emergency responders.

- Name of confined space attendant;
- Provision of ventilation;
- Lighting arrangement (use of flame-proof light);

- Results of the atmospheric testing of the confined space:
  i. Oxygen;
  ii. Flammable gases;
  iii. Other toxic gases.

- Names and signatures of supervisor, confined space safety assessor (CSSA), and authorized manager.

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;

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- ✓ 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.

ISSUANCE OF ENTRY PERMIT

An entry permit procedure typically consists of the following stages:
STAGE 1 — Application of Entry Permit by Supervisor

The supervisor should:

- ✓ State the measures which will be taken to ensure the safety and health of the persons who will enter or carry out work in the confined space based on the completed risk assessment;
- ✓ Inspect and prepare the pre-entry requirements for the confined space;
- ✓ Highlight the intended work to the concerned personnel; and
- ✓ Complete and forward the entry permit to the CSSA.

PERMIT FOR ENTRY INTO CONFINED SPACES

S/NO	RA Reference No. _____	
LOCATION:	COMMENCEMENT DATE : ____/____/____	TIME : HRS
IDENTITY OF CONFINED SPACE :	COMMENCEMENT DATE : ____/____/____	TIME : HRS
PURPOSE OF ENTRY :		

STAGE I : APPLICATION BY SUPERVISOR

1. **Potential atmospheric hazards:** _____
   Potential non-atmospheric hazards: _____
2. **Control measures:** I have highlighted my intention to enter the confined space at the safety meeting and it has been coordinated. Further, I shall take the under mentioned control measures prior to the entry into the space and during the course of work in the space:-

Pre-Entry Requirements	Personal Protective Equipment (PPE)	Particulars of Confined Space Attendant
☐ Ventilation ☐ Lighting ☐ Flame-proof light ☐ Barricades and signboards ☐ De-energisation/ lockout-tag out (LOTO) ☐ Blanking/ bleeding of pipes ☐ Personal gas detector ☐ Torchlight	☐ Safety helmet ☐ Eye protection ☐ Hand protection ☐ Safety harness/ lifelines ☐ Respiratory protection ☐ Other PPE: _____ ☐ Name/ identification badge	Name: _____ NRIC/ FIN: _____ Department: _____ Company: _____ Contact No: _____

NAME : _____ SIGNATURE : _____ DATE : ____/____/____ TIME : _____ HRS

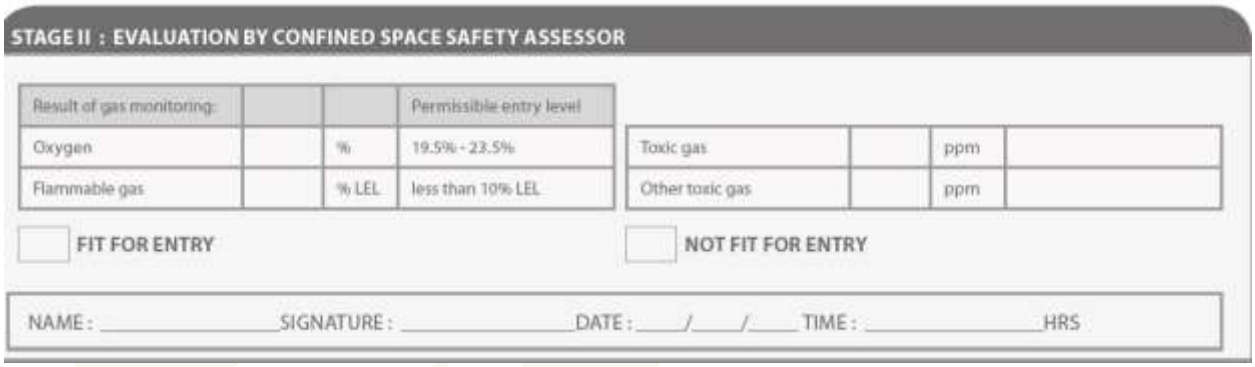
Note: 1. **The necessary safety measures must be complied with before the application is handed over to the confined space safety assessor for his evaluation.**
2. **Where reasonably practicable, applicant to provide a sketch of the area within the confined space where the entry is to be made or work is to be conducted on a separate sheet of paper and attach it with the permit.**

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

STAGE 2 — Evaluation by Confined Space Safety Assessor

The CSSA should:

- ✓ Inspect the site/area together with the applicant;
- ✓ Determine possible atmospheric hazards and establish appropriate sampling strategy, such as measurement method, number and location of sampling points;
- ✓ Use suitable and properly calibrated atmospheric gas/vapor testing instruments;
- ✓ Conduct the test in the following sequence:
  i. test for level of oxygen content;
  ii. test for level of flammable gas or vapor; and
  iii. test the concentration of toxic gas or vapor, where applicable.
- ✓ Conduct the test in a manner that will not endanger himself or others;
- ✓ Record the results of the test in the entry permit;
- ✓ Highlight any deviation from the acceptable limits to the authorized manager; and
- ✓ Endorse and forward the permit to the authorized manager.



STAGE II : EVALUATION BY CONFINED SPACE SAFETY ASSESSOR

Result of gas monitoring:			Permissible entry level
Oxygen		%	19.5% - 23.5%
Flammable gas		% LEL	less than 10% LEL

Toxic gas		ppm	
Other toxic gas		ppm	

☐ FIT FOR ENTRY ☐ NOT FIT FOR ENTRY

NAME : _____ SIGNATURE : _____ DATE : ____/____/____ TIME : _____ HRS

STAGE 3 — Issuance by Authorized Manager

The authorized manager may issue an entry permit if he is satisfied that:

- ✓ The level of oxygen in the confined space is within the range of 19.5% to 23.5% by volume;
- ✓ The level of flammable gases or vapors in the confined space is less than 10% of its lower explosive limit;
- ✓ The levels of toxic substances in the atmosphere and toxic substances in the atmosphere of the confined space do not exceed the PELs specified in the First Schedule of the Workplace Safety and Health (General Provisions) Regulations;
- ✓ The confined space is adequately ventilated;

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

✓ Effective steps have been taken to prevent any ingress of dangerous gases, vapors or any other dangerous substances into the confined space; and

✓ All reasonable practicable measures have been taken to ensure the safety and health of persons who will be entering or working in the confined space.

If the authorized manager issues a confined space entry permit, it shall be his duty to retain a copy of the permit. He / She shall exercise all due diligence when performing his / her function in relation to the issuance of a confined space entry permit

If the entry or work in the confined space for which the confined space entry permit is issued is not completed within the validity period of the permit, a fresh application shall be made.

STAGE III : ISSUANCE BY AUTHORISED MANAGER

I am satisfied that:
(a) the levels of oxygen, flammable gas and toxic substances are within the permissible range. (Refer to Stage II)
(b) the confined space is adequately ventilated.
(c) effective steps have been taken to prevent any ingress of dangerous gases, vapours or any other dangerous substances into the confined space.
(d) all reasonably practicable measures have been taken to ensure the safety and health of persons who will be entering or working in the confined space.

NAME : _____ SIGNATURE : _____ DATE : ____/____/____ TIME : _____ HRS

STAGE 4A — Posting of Entry Permit

The supervisor should:

✓ Clearly post a copy of the permit at the entrance to the confined space, including where reasonably practicable, a sketch of the area within the confined space where the entry is to be made or work is to be conducted; and

✓ Ensure that the copy of the permit is not removed until:
i. the date of the expiry of the permit;
ii. the revocation of the permit; or
iii. 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; whichever is the earliest.

STAGE IVa : POSTING OF ENTRY PERMIT

I shall ensure that the copy of the entry permit is posted at the entrance to the confined space, including where reasonably practicable, a sketch of the area within the confined space where the entry is to be made or work is to be conducted.

NAME : _____ SIGNATURE : _____ DATE : ____/____/____ TIME : _____ HRS

STAGE 4B — Review, Endorsement and Revocation of Entry Permit

The Authorized Manager should:

✓ Review and assess the need to continue the work in the confined spaceon a daily basis;

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- ✓ If the work need to be continued after the assessment, the Authorized Manager shall endorse the permit by signing or use other equally effective means
- ✓ When the entry operation covered by the permit have been completed or a condition pose a risk to the safety and health of the persons, terminate entry immediately and cancel /revoke the permit

STAGE IVb : NOTIFICATION OF REMOVAL OF ENTRY PERMIT

The permit has been removed for the following reasons:

☐ Permit expired ☐ Permit revoked ☐ Work completed

Remarks:_____

NAME : _____ SIGNATURE : _____ DATE : ____/____/____ TIME : _____ HRS

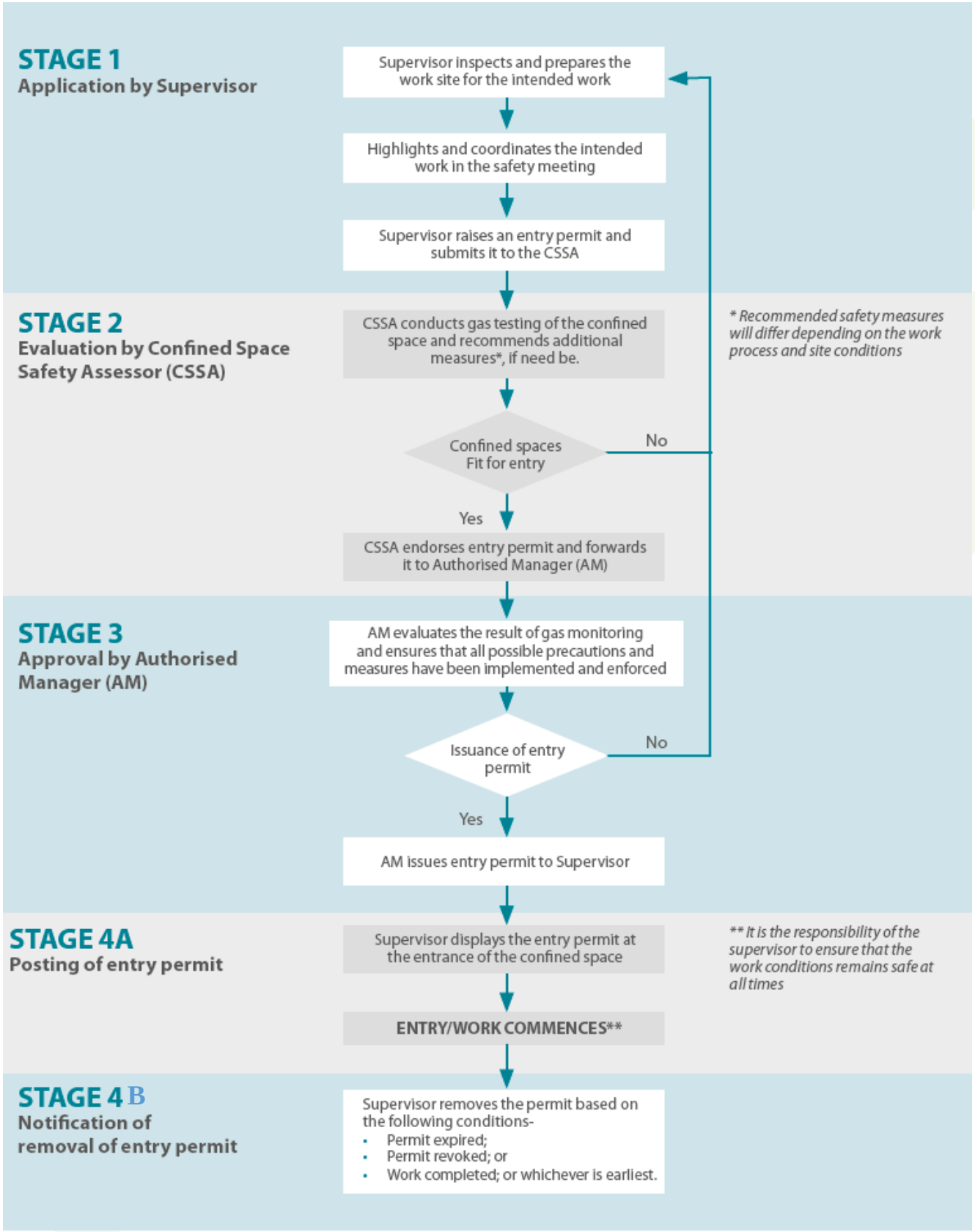
Note: 1. THIS PERMIT IS STRICTLY FOR ENTRY INTO THE SPACE ONLY.
2. IT DOES NOT ENTITLE THE APPLICANT TO CARRY OUT HOTWORK OR ANY OTHER HAZARDOUS WORK.

In case of emergency, please contact HSE Department at Tel.no. xxxx (internal) or xxxx-yyyy (External)

DAILY ENDORSEMENT BY AUTHORISED MANAGER

DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
DATE:	DATE:	DATE:	DATE:	DATE:	DATE:
NAME:	NAME:	NAME:	NAME:	NAME:	NAME:
SIGNATURE	SIGNATURE	SIGNATURE	SIGNATURE	SIGNATURE	SIGNATURE

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg



DISPLAY OF ENTRY PERMIT

A copy of the entry permit issued by the authorized manager shall be displayed by the supervisor clearly at the entrance to the confined space so that entrants are informed of the condition of the space and the measures taken to ensure safe entry.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

REVIEW AND ENDORSEMENT OF ENTRY PERMIT

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

If the work in the confined space needs to be continued after the assessment, the authorized manager shall endorse the entry permit by signing on the permit or by using other equally effective means.

3.4 Terminate the entry permit upon completion of work

REVOCATION OF ENTRY PERMIT

If, after issuing an entry permit, the authorized manager determines that carrying out the work in the confined space poses or is likely to pose a risk to the safety and health of persons in the confined space, he may order the work to cease immediately and revoke the entry permit.

The authorized manager shall terminate entry and cancel the permit when:

- The entry operations covered by the entry permit have been completed; or
- A condition that is not allowed under the entry permit arises in or near the permit space.

For example, the authorized manager is to revoke the entry permit when the monitoring equipment alarm sounds; indicating the deficiency of oxygen level, or 10% of LEL, or PEL of toxic gas is exceeded.

RE-CERTIFICATION OF CONFINED SPACES

When a hazardous atmosphere in a confined space is detected by periodic tests or continuous monitoring, the supervisor or confined space safety assessor shall withdraw the entry permit.

A “no entry” sign shall be clearly displayed at the entrance of the confined space to prevent anyone from entering. The authorized manager shall revoke the entry permit.

The supervisor, CSSA and the authorized manager shall evaluate how the hazardous atmosphere developed. Effective means shall be provided to remove the atmospheric hazards in the confined space.

Upon removal of the atmospheric hazards, the supervisor shall raise a “new” entry permit for the confined space, if entry or work in the confined space is to be continued.

No person shall re-enter the confined space until the confined space has been re-certified safe for entry and a new entry permit is issued by authorized manager.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

RECORD KEEPING

Employers are required to keep records of work in confined spaces, including entry permits and test results for two years as stipulated under the WSH (Confined Space) Regulations.

CONTROL OF HAZARDOUS ENERGY

It is important to ensure, as much as possible, that the confined space is isolated before entry. This is to prevent materials from coming into the space via pipelines or vents and to ensure that equipment inside the space does not start up while the entrant is inside.

This procedure is also to protect personnel from injury due to unexpected energisation, start-up or the release of stored energy from the machines, equipment or processes during the repair or maintenance of equipment.

- Energy Isolation and Lockout

Before allowing any person to enter a confined space, the authorized manager shall ensure that all potentially hazardous services and energy sources normally connected to that space are isolated in order to prevent:

✓ The introduction of any materials, contaminants, agents or conditions harmful to people occupying the confined space; and

✓ The activation or energization in any way of equipment or services which may pose a risk to the health or safety of persons within the confined space.

The authorized manager shall ensure that positive steps are taken to achieve the following:

✓ Prevention of accidental introduction into the confined space of materials, through equipment such as piping, ducts, vents, drains, conveyors, service pipes or fire protection equipment.

✓ De-energization and lockout, or if lockout is not practicable then tagout or both lockout and tagout of machinery, mixers, agitators or other equipment containing moving parts in the confined space. Additional isolation may be required, blocking or de-energizing of the machinery itself to guard against the release of stored energy.

✓ Isolation of all other energy sources which may be external to, but still capable of adversely affecting the confined space (e.g., heating or refrigerating methods).

- Forms of Hazardous Energy

Energy sources can come in many forms but not limited to electrical, mechanical, hydraulic pneumatic, chemical, thermal, gravitational, ionizing and non-ionizing radiation. It is necessary to isolate all mechanical, electrical equipment and all other energy sources connected to a confined space to prevent them from unintentional activation. If gases or vapors can enter the confined space, physical isolation of pipelines, valves, and so on needs to be locked and tagged using LOTO procedures. In all cases, a check is required to ensure isolation is effective.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

GENERAL REQUIREMENTS

- Openings of Confined Spaces

Before an entrance cover is removed, any known unsafe conditions shall be eliminated. When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier. This will prevent anyone from falling through the opening. The barrier or cover shall prevent foreign objects from entering the space and protect each employee working in it. If it is in a traffic flow area, adequate barriers shall be erected to divert the traffic.

It is necessary to take precautions when opening the covers to tanks and within other confined or enclosed spaces in the event the space is under pressure or hazardous materials have leaked from internal piping systems. It is important to leave at least two nuts on opposite sides of the cover in place until the cover can be cracked and any internal pressure has released.

- Barricade

It is essential to use safety barriers to separate workers from hazards that cannot be reasonably eliminated by other engineering controls. Selection of suitable barriers will depend on the nature of the hazard and the size of the area or equipment to be cordoned off. The supervisor must determine if safety barriers will be needed for the confined space entry prior to any workers entering the confined space.

- Communication / Warning Signs

Warning sign can be used to inform workers about the confined spaces. It is critical for the workers to know the location of the confined space, its hazards, the required safe work procedures and permit to enter the confined space.

- Access and Egress

Where the possibility for inadvertent or unauthorized entry to a confined space exists, it is required to use appropriate means to prevent such an entry (e.g., a barrier or safety warning sign that is clear, legible and visible).

A safe way in and out of the confined space should be provided for the individuals carrying out the work. Wherever possible, quick, unobstructed and ready access and egress should be allowed. It is essential that the means of escape be suitable for use by every individual who enter the confined space so that he or she can escape quickly in an emergency.

The size of openings used for access to and egress from confined spaces needs to be adequate to allow ready passage. Openings providing access need to be sufficiently large and free from obstruction to allow the passage of persons wearing the necessary protective clothing and equipment, and to allow adequate access for rescue purposes.

These openings need to be kept clear whenever a confined space is occupied. Where practicable, it is necessary to have an alternative opening for insertion of hoses, ventilation ducts, power lines and other cables required for the work.

Certain confined spaces may have design deficiencies which increase the level of entry risk to an unacceptable level. These include spaces whose openings are too tight for safe passage or which are of convoluted construction, or which involve excessive distances to a point of escape.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Structural modifications (e.g., the making of temporary openings) will be necessary before entry is possible in these cases.

- Display of Name and Identification Badge

The person entering a confined space must display his name and identification badge at the entrance to the confined space. It is also the duty of the responsible person of the entrant to ensure that he does the same

- Communication

An effective and reliable means of communication among entrants inside the confined space, and between entrants and attendants, is required. When choosing a means of communication, it is advisable to give careful consideration to all anticipated conditions inside the confined space (e.g., visibility, possibility of a flammable atmosphere, and noise levels) and to the personal protective equipment in use (e.g., ear muffs and breathing apparatus).

The communication system used can be based on speech, hand signals, telephone, radio, and so on. Whatever system is used, it is important that all messages can be communicated easily, rapidly and unambiguously between relevant people. It is important to take note on the limited penetration of radio signals into buildings, vessels and below-ground structures. The advantages of having a person outside the confined space in direct voice and visual contact with the entrants are clear. This also facilitates the monitoring of entrants for the symptoms or behavioral effects of exposure to hazards.

It is important that confined space entrant(s) are informed quickly if a situation arises on the outside which could endanger the entrants, such as problems with a supplied air system or ventilation system.

It is essential that the means of raising the alarm and setting in motion the emergency rescue procedures are effective and reliable. It is also necessary that the line of communication be available at all times during the work.

It is required to have an appropriate means of communication between the person working inside a confined space and the attendant stationed outside, whether by voice, rope tugging, tapping or by a battery-operated communication system specially designed for confined space use.

- Lighting and Electrical Equipment

Adequate and suitable lighting shall be provided for entry and work in a confined space. Access and passage into a confined space shall be provided with illumination of not less than 50 lux.

All portable hand-held lightings provided in confined spaces shall be operated at a voltage not exceeding alternative current (AC) 55 volts between the conductor and earth or direct current (DC) 110 volts.

Temporary lights shall be equipped with guards to prevent accidental contact with the bulb, except when the construction of the reflector is such that the bulb is deeply recessed.

Temporary lights shall be equipped with heavy-duty electric cords with connections and insulation maintained in safe condition. Temporary lights may not be suspended by their electric cords

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

unless cords and lights are designed for this means of suspension. Splices shall have insulation equal to that of a cable.

Working spaces, walkways, and similar locations shall be kept clear of cords so as not to create a hazard to workers.

3.3 Check to ensure that all workers are briefed on the Confined space Entry Permit

All workers must be trained, briefed and authorized to enter when working in confined space. It is therefore necessary for them to recognize and understand the Confined space Entry Permit.

The Confined space Entry Permit can be briefed to workers through

- ❑ Daily toolbox meeting
- ❑ Display of warning signs
- ❑ Training (mandatory and non mandatory)
- ❑ Site Orientation for new workers; to understand the site and associated risks
- ❑ Briefing by WSH officer
- ❑ Posters on sample Confined Space Entry Permit
- ❑ WSH Campaign
- ❑ Safety Audit
- ❑ WSH Alert

CE4: Apply Gas Detection Instruments and other control measures when working in confined space

4.1 Apply gas detection instruments gas detection instruments in normal atmospheric condition and abnormal condition

Why Working in Confined Spaces is Hazardous

Working in confined spaces is more hazardous than working in other workplaces because:

- The entrances/exits of confined spaces might not allow the entrant to evacuate effectively if there is a flood or collapse of free-flowing material;
- Self-rescue by entrant is more difficult;
- Rescue of the victim is more difficult. The interior configuration of a confined space often restricts the movement of people or equipment within it;

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- Natural ventilation alone is often not sufficient to maintain breathable quality air because the interior configuration of some confined spaces does not allow air movement to circulate;
- Conditions can change very quickly;
- The space outside the confined space can impact on the conditions inside the confined space and vice versa; or
- Work activities may introduce hazards not present initially.

2.6 Propose optimum and acceptable atmospheric conditions for safe entry and continual work in a confined space

What to Test and What are the Acceptable Limits

It is the responsibility of the CSSA to know and establish what atmospheric hazards may be present in the confined space. Once the atmospheric hazards are known, the correct gas testing equipment and their corresponding alarm concentrations on the equipment must be pre-set.

The pre-set would provide a warning on the dangerous level according to the limit values for the substance of concern.

As a minimum, the following shall be tested:

- **Oxygen reading,**
- **Flammable gases and vapors reading, and**
- **Toxic gases and vapors reading.**

The acceptable limits are:

- Oxygen reading: ≥ 19.5 % Vol. to ≤ 23.5 % Vol.
- Flammable gases and vapors reading: ≤ 10% LEL
- Toxic gases and vapors reading: ≤ PEL values

Types of Testing Methods/Equipment

Without the right gas detection equipment, it is not possible to recognize the danger of the atmosphere early enough to ensure that proper countermeasures are taken. It is also important to know that not all the gas hazards identified can be measured with an electronic gas detection instrument.

Due to the different physical and chemical properties of the gases, different detection principles may be used to ascertain that the atmosphere is safe. There are various types of portable and transportable electronic gas testing instruments which may be used for the detection of the gas hazards found in confined space.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Type of Gas Hazard	Example	Gas Measurement Principles				
		Catalytic Sensor	Infrared Sensor	PID Sensor	Electrochemical Sensor	Colorimetric Tubes
Toxic	Ammonia				X	X
Flammable in Inert	Propane	X (with dilution probe)	X			
Toxic & Flammable	Benzene	X		X		X
Toxic & Flammable	Carbon Monoxide	X			X	X
Oxygen deficiency	Nitrogen				X	
Toxic	Hydrogen Sulphide				X	X

Flammable gas detectors

Catalytic (Pellistor)

The operating principle of this point detector is that heat is generated during the catalyzed reaction between the gas and oxygen in air. The resulting rise in temperature of the catalyst bead (also known as a 'pellistor') causes a change in electrical resistance of a platinum wire embedded in the bead, also acting as the heater, which is a measure of gas concentration. The heated wire is contained within an Ex-certified enclosure with a porous sintered metal insert that allows the gas to enter.

This detector is small and is used for detecting flammable gases from 0-100% LEL. It needs a level of more than 10% oxygen to work correctly. It can give false readings in gas rich atmospheres, ie above the upper explosion limit (UEL). The catalyst can be poisoned by trace gases such as silicones and hydrogen sulphide and the metal screen can be blocked. This can result in drift of the zero point, and loss of sensitivity, so it needs regular calibration and replacement.

Used in portable and fixed instruments.
Infrared

The operating principle is based on the absorption of infrared light by certain molecules which are detected by a decrease in transmitted radiation over a beam path. For point detectors the beam length is short (centimetres). For open-path sensors the source of infrared light is a powerful narrow beam that illuminates the space between source and detector. Alternatively, a mirror is positioned at the end of the path which reflects the beam back to the detector. Gas can be detected anywhere in the beam.

Infrared detectors can be either point or open-path and are used mainly for hydrocarbon vapors from 0-100% v/v. The detectors do not require oxygen, cannot be poisoned and are not ambiguous above the LEL. But they cannot detect hydrogen and are inherently pressure-sensitive. For open-path detectors large spaces can easily be monitored but the alignment of source and detector requires great care and objects in the beam can give false readings. If the sun is low in

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

the sky, stray radiation can enter the detector which may cause interference with the beam. If the beam is uncompensated this can give high readings.

Used in portable and fixed instruments.

Oxygen detectors

Electrochemical

The operating principle is that the gas diffuses through a permeable electrode to its interface with the cell's electrolyte. Here electrochemical reactions take place which alter the electrical characteristics of this electrode. Measurement of these electrical parameters, with respect to other electrodes within the cell give a signal proportional to the gas concentration. This sensor measures oxygen from 0-100% (and toxic gases from 0-1000 ppm).

Used in portable and fixed instruments.

Fixed or portable

Detectors can be fixed, portable or transportable. A 'fixed' detector is permanently installed in a chosen location to provide continuous monitoring of plant and equipment. It is used to give early warning of leaks from plant containing flammable gases or vapors, or for monitoring concentrations of such gases and vapors within plant. Fixed detectors are particularly useful where there is the possibility of a leak into an enclosed or partially enclosed space where flammable gases could accumulate.

A 'portable' detector usually refers to a small, handheld device that can be used for testing an atmosphere in a confined space before entry, for tracing leaks or to give an early warning of the presence of flammable gas or vapor when hot work is being carried out in a hazardous area
These instruments may be available either as a single gas monitoring instrument for just one gas or contaminant, or a multi-gas monitoring instrument that will typically measure oxygen, flammable gases and toxic gases.

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. It is important that training on the use of these instruments include instrument calibration, equipment maintenance and the proper interpretation of the instrument readings and warning alarms. When in doubt, it is advisable for the CSSA to check with the instrument manufacturers for more details.

As mentioned, not all gases can be measured with an electronic gas detection instrument. The colorimetric tubes are still a common method used by many gas testers. These tubes are impregnated with chemicals that will react in the presence of a specific gas or vapor. The reaction will produce a color change and from the length of the color change or the intensity of the color change, the concentration of this gas or vapor can be determined.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Testing Procedures and Considerations

CSSA shall be appointed to test the atmosphere of a confined space before entry by any person into the confined space.

Steps to be taken **BEFORE** gas testing is conducted:

- Determine equipment type for the atmospheric testing;
- Check to see if the atmosphere can be tested from outside. Determine if the atmosphere can be tested at all depths before entry;
- Ensure that the gas testing instrument is calibrated or function tested;
- Ensure that the right and necessary accessories are used;
- Brief all persons concerned on the hazards to be expected, their limit values and action needed when instrument alarm comes on;
- Brief all persons concerned on the emergency procedure, key contacts and assembly point;

Steps to be taken **WHEN** gas testing is conducted:

- Use suitable accessories such as water and dust filter and float probe when sampling from confined space with liquid.
- The sampling hose or sensor may come into contact with the liquid. This could result in contamination of the hose and saturation of sensor filters thereby blocking the gas entry to the instrument;
- Ensure all depths are tested in the following sequence; start with oxygen, followed by flammable gases and vapors and finally toxic gases and vapors;
- Record all results and update this information on the entry permit document;
- Evaluate and determine the frequency of re-tests and notify all concerned; and
- Evacuate everyone in the confined space immediately whenever an atmospheric hazard is detected during entry, while working or when re-tests are done. Re-evaluate the space thoroughly to determine if the dynamics in it has changed drastically. It is important to take all required measures before any re-entry is to take place.

Response time

The response time is usually defined as the time it takes the output of the sensor to reach 90% of its final value when subject to a step change in gas concentration at its sample point; it is written as T90.

The overall response time of a gas sensing system is governed by three factors:

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- The intrinsic time it takes for the gas-sensing mechanism to respond (this is dependent on the type of sensor, eg it is determined by diffusion rates for catalytic sensors and spectroscopic transitions for infrared sensors);

- The response time of the signal processing electronics;

- The time taken to transport the sample to the sensor. For pumped (aspirated) systems the transport time is determined by the sample tube length, tube diameter, aspiration rate and diffusion rate from the flow system to the sensor.

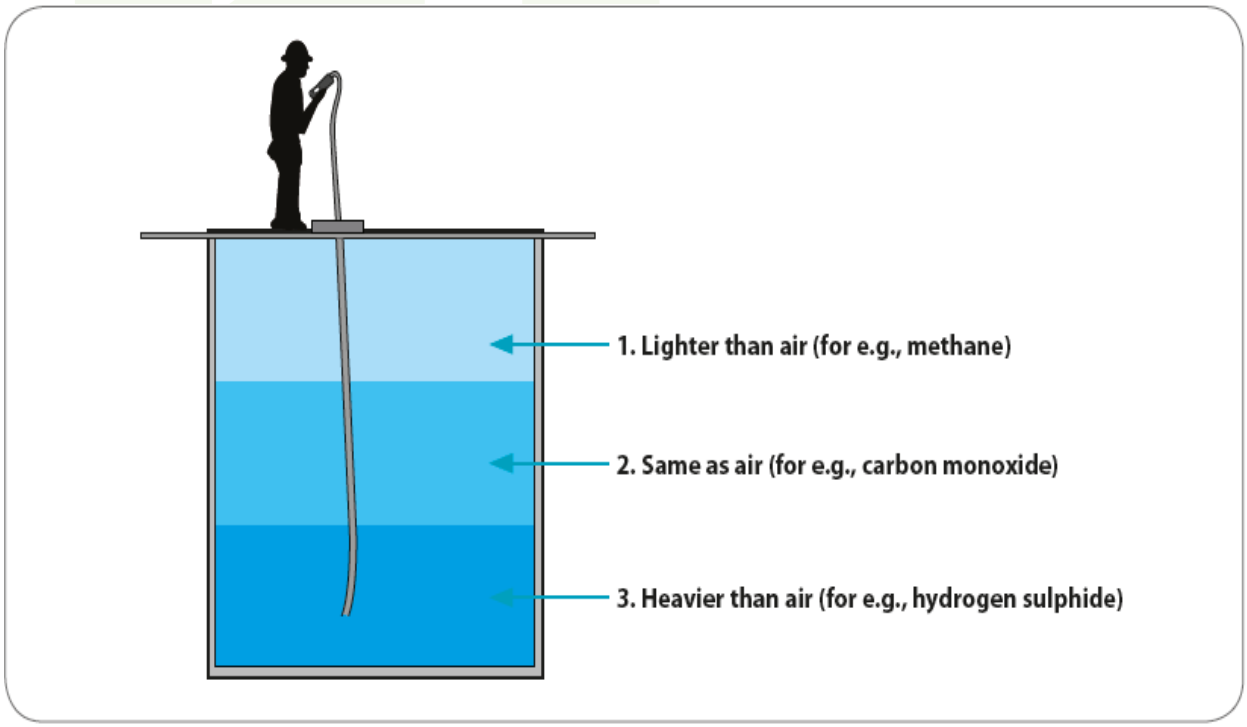
The required response time will depend on the location, purpose of the system and speed of development of the expected problem. Protection of people from large leaks requires a fast response time but where the gas concentration is expected to build up slowly a slower response time may be acceptable.

Different Depths

When performing gas testing before entry, it is important to determine the proper equipment to be used. It is critical to know the limitations of these equipment types and that they are understood by all competent gas testers. It is important to pre-inspect the accessories to ensure that they are of the right material and are functioning properly.

It is also important that the gas testers understand and take into account the geometry of the confined space and the physical properties of the gases to be monitored. These gases could be found stratified at different levels or locations of the confined space.

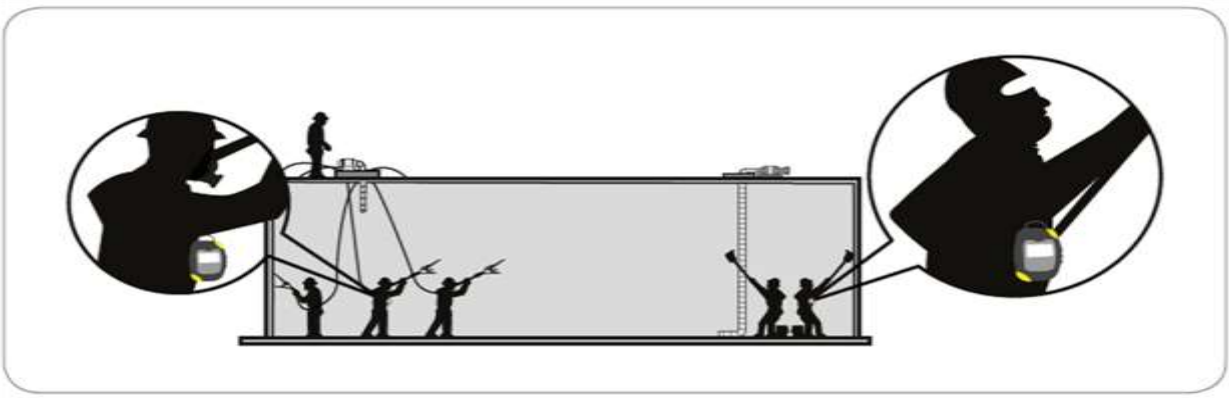
The general rule of thumb for gas testing using sampling hose = **10 sec for each meter** of sampling hose for vertical or horizontal entry.



No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Continuous Monitoring and Frequency of Tests

Even when the confined space is tested and certified safe for any person to enter, at least one person in a group working in the same vicinity shall be equipped with suitable instrument for measuring oxygen, combustible and the identified toxic contaminants.



At least one person in a group working in the same vicinity of a confined space is equipped with a portable gas detector.

It is important for the CSSA to determine the frequency of the re-testing of the atmosphere. In addition to the continuous ventilation requirement, it is essential to conduct the periodic retesting, taking the following factors into consideration:

- ✓ The possibility or likelihood of a change in the space by the potential release of the hazardous materials;
- ✓ When continuous occupation exceeds 6 hours;
- ✓ When a confined space is vacated for a significant period of time ≥ 30 min, without the space being monitored continuously;
- ✓ When the atmospheric hazards in a confined space are detected by the confined space safety assessor during periodic testing or continuous monitoring, all persons in the confined space shall vacate the confined space immediately;
- ✓ The confined space entry permit shall be cancelled immediately and “No Entry” signs must be prominently displayed at the entrance to prevent unauthorized entry;
- ✓ An evaluation shall be made to determine how the hazardous atmosphere was developed; and
- ✓ No person shall re-enter the confined space until it has been re-certified safe for entry and a new confined space entry permit is issued.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

4.2 Read and interpret results shown on gas testing and gas detection instruments

Gas Reading detector

Multi-Gas Monitor for O2, H2S, CO and LEL

Reference from www.indscri.com/m40/

Multi-Gas Portable Detector for CO, H2S, O2 and LEL

SPECIFICATIONS

Range	CO: 0-1000 ppm H_2S: 0-100 ppm O_2: 0-30% by Volume LEL: 0-100% LEL CH_4
Alarm Points	CO: 35 and 100 ppm instant; TWA: 25 ppm; STEL: 200 ppm H_2S: 10 and 15 ppm instant; TWA: 10 ppm; STEL: 15 ppm O_2: 19.5% by Vol. decreasing and 23.5% by Vol. increasing LEL: 10 and 50% LEL CH_4
Method of Detection	Diffusion
Sensors	CO, H_2S and O_2 - Electrochemical; Combustible Gases - Catalytic
Display	Color Quadrant LCD
Temperature Range	-20°C to +50°C
Humidity Range	5 to 95% RH, non-condensing
Power	3.6 VDC, Lithium Battery, Rechargeable
Operating Time	Approximately 8 hours, continuous, non-alarm condition
Charge Time	Approximately 6 hours
Weight	7 oz (200 g)
Dimensions	2.0 x 4.6 x 1.2 in (66 x 116 x 31 mm)

*Reference from **ENMET Corp.***

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

SPECIFICATIONS

Gas Portable Detector for Combustible, Oxygen and Toxic Gases

Function	Multi-gas Detector
Configuration	3 Electrochemical Sensors for O_2 &Toxic Gases 1 Catalytic Combustible Gas Sensor
Display	2 x 16 Character LCD Display with Backlight
Visual Alarm	Large, Flashing Red Lens Section
Alarm Levels	Combustible – One Instant Alarm Toxic – Instant STEL &TWA Alarms Oxygen – One Increasing and One Decreasing Alarm
Temperature Range	20 to 105 °F (-5 to 40 °C)
Humidity Range	15% to 95% rH, Non-condensing
Ingress Protection	IP66

Power Source	Rechargeable Battery Pack
Operating Time	12 hours Minimum between Recharge
Size	Excluding Case: 7.25 x 4.25 x 1.95 in (18.5 x 10.8 x 4.9 cm)
Weight	28 oz (1 kg)
Approval	Certifications: • Baseefa 03ATEX0235X • II 2G EEx ia IIC T3 • CE Marked; E 50081-2, EN50082-1, EN55022 (Limit B)
Flammable Gas	New Page 1

Flammable Gas Menu

Via the 'MENU' select button any one of a number of flammable gases may be chosen as show below, these are monitored by a common sensor

Methane	MEK
Ethane	Ketone
Propane	Ethylene
Butane	IPA
Pentane	Propylene
Hexane	Triethylamine
Heptane	Hydrogen
Nonane	Others -user defined
Methanol	via PC software

*Reference from **ENMET Corp.***

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

4.3 Identify the Limitations of Gas Detection Instruments

Limitation of Gas detectors

The combustible gas detection instruments using catalytic sensor are usually not designed to detect the presence of combustible materials such as fiber or dusts. Most of these combustible gas detection instruments are also not gas specific, that is, they are broad range sensors that detect any gases or vapors that can be burnt in the reaction chamber. If the 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. Under such conditions, it is recommended that the calibration is made using the gas that the sensor is least sensitive to. It is also important to note that some combustible gases and vapors 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.

Function Test

A function test is a qualitative exposure to gas to verify that the calibration is still valid and the instrument is functioning properly. A function test is an exposure to a test gas of known concentration long enough to ensure that
the sensor is responding within the sensor's response time and that the display is within 10% of the calibration gas concentration. It is also important for the alarms to be activated at the preset level.

A function test is recommended to be performed under the following conditions:

- ✓ Before use of the instrument;
- ✓ After an over-exposure to the targeted gas;
- ✓ After exposure to extreme environmental conditions (Examples of extreme environmental conditions, +55°C in an engine room, positively pressured atmosphere in an underground tunnel, water ingress when working outdoors, in
- ✓ drains, sewers, etc.);
- ✓ After a severe physical jolt or was dropped;
- ✓ When changing shift; or
- ✓ When in doubt.

This function test typically takes less than a minute to perform and it is not necessary to make a calibration adjustment unless readings are off from the expected value.

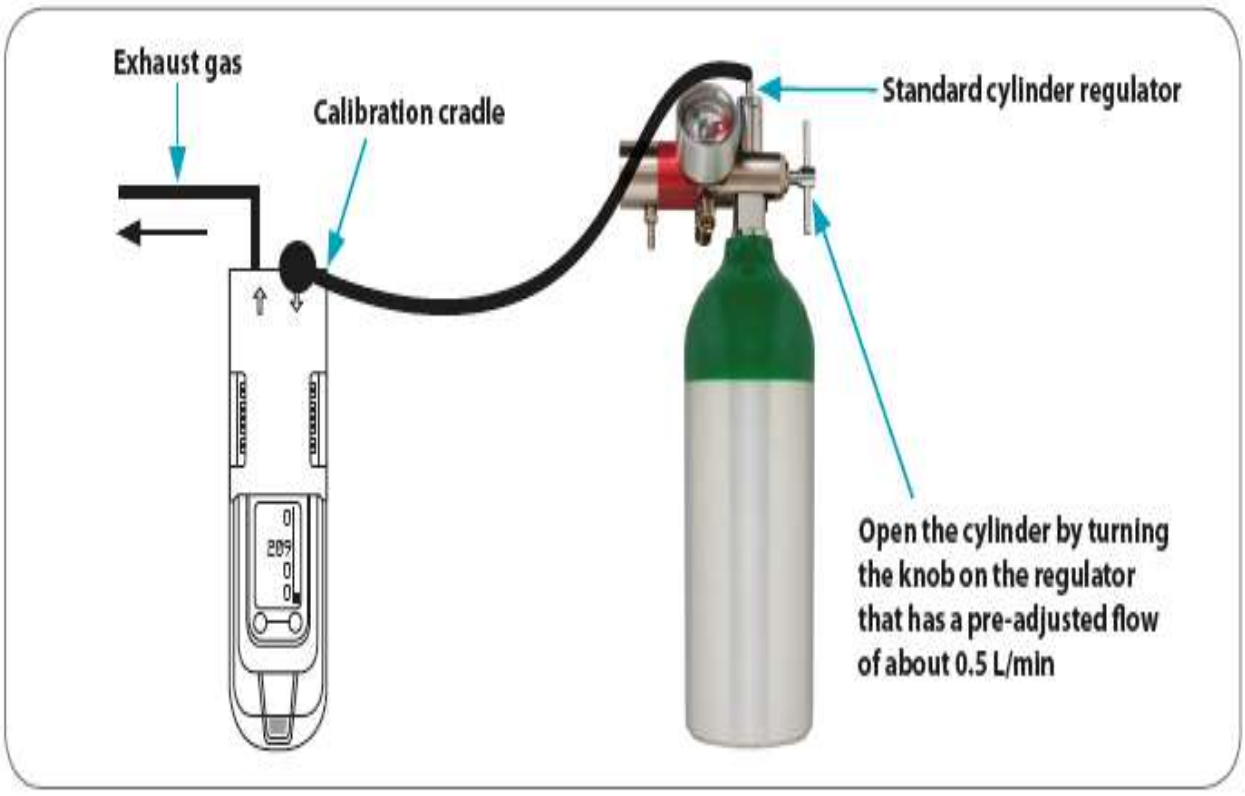
If the instrument does not perform properly after the function test, it is advisable that the calibration is performed by trained personnel or is sent to manufacturer.
Sequence of function test:

- ➢ Attach the calibration adapter to the gas detection instrument;
- ➢ Connect the hose and the calibration gas to the calibration adapter;

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- Switch on the gas detection instrument (for instrument that comes with function test mode, please follow the procedure given by the manufacturer);
- Supply the calibration gas by turning the regulator valve manually;
- Check the display on the gas detection instrument;
- Ensure that the audible and visual A1/A2 alarm as shown;
- Check that the concentration matches that of the test gas calibration gas bottle, indicating the instrument is working properly; and
- Turn off the regulator valve and remove device.

If the sensor in the instrument does not perform properly after function test, it should be calibrated.



Calibration gases

Ideally, the gas to be measured should be used to calibrate the gas detector. Calibration of fixed and portable gas detectors is normally done using a calibrated gas mixture from a cylinder, supplied by a gas company. The supplied gas mixture should contain the same gases in similar concentrations to those being monitored.

When it is not possible to obtain calibration mixtures containing the required gases, another gas mixture should be used which gives a similar detector response to the target gas(es). The detector output is corrected by use of a response, calibration or correction factor. Most detector

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

manufacturers have tables (often programmable in the instrument) that show the calibration gas mixture and correction factor for every target gas or vapor that the sensor will respond to. It must be noted that these tables are model-specific. Different types of sensor (for example infrared or catalytic) will have different correction factors.

In some cases it is not possible to calibrate for the exact gas or vapor because it contains many different chemical compounds; petrol vapor is an example. When petrol vapor is being measured the detector can be calibrated using a higher alkane such as heptane or octane, which gives a good approximation. The supplier should provide information on the recommended calibration gas for petrol.

If more than one gas may be present and there is no obvious calibration mixture, then it is advisable to calibrate for the least sensitive gas. This approach will lead to artificially high readings of the other gases but will ensure that a flammable concentration is not reached before the detector measures it. Specialist knowledge will be required to determine which gas should be used to calibrate the detector as sensitivity may vary depending on the sensor.

Many gas sensors are sensitive to pressure and care must be taken when calibrating instruments that readings are not affected by pressure variations. For example, when using a gas cylinder to calibrate a diffusion instrument the gas should be passed through a calibration mask and out to atmosphere. Excessive flow through the mask will lead to over-pressuring the sensor, which will produce false high readings. On the other hand, too little flow will lead to air ingress and a false low reading.

Purging and Ventilation

When a confined space is known to contain hazardous contaminants, it is crucial to purge the space adequately before any entry. Subsequently, continuous ventilation should be provided to maintain a safe work environment. It is also important to note that purging and ventilation do not exclude the need for gas testing.

Purging

Purging of a confined space is conducted before any entry and the purpose is to remove any existing contaminants by displacing the hazardous atmosphere with another medium such as air, water, steam or inert gases. The choice of a suitable medium will depend on factors such as nature of the contaminants and their concentrations.

Purge Time

The amount of time that is required to remove the contaminants is dependent on the concentration of the contaminants and the capacity of the air moving devices used. If no further contaminant release is expected (static condition), the following formula* can be used to calculate the amount of time needed.

Q = V/T ***Ln = Co/C***

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Where:
T (min) is the time required
Q (m3/min) is the quantity of the supplied purging medium
V (m3) is the confined space volume
Co (ppm) is the initial concentration of the contaminants
C (ppm) is the final concentration of the contaminants after T mins

** The above requirements assume an ideal mixing and distribution of supplied air. In practice, higher rate of ventilation may be necessary depending on the efficiency of supplied air distribution.*

Ventilation

It is unsafe to enter any confined space when adequate ventilation is absent. Adequate and effective ventilation is required throughout the validity period of the entry permit. Even when the confined space has been certified safe for entry, new contaminants may be introduced from the change in conditions, or when work performed in the space such as welding releases new contaminants. As such, it is important to provide an adequate and effective ventilation to always maintain the contaminants concentration level as low as possible, and the level of oxygen within safe range.

Type of Ventilation and its Uses

Due to the unique characteristics of confined spaces, natural ventilation is usually not adequate and would require the use of mechanical ventilation. Mechanical ventilation can largely be classified into two main types:

- Forced (supplied) ventilation; and
- Local exhaust ventilation (LEV).

Factors to consider in determining the type of ventilation to use include:

✓ The nature of contaminants;

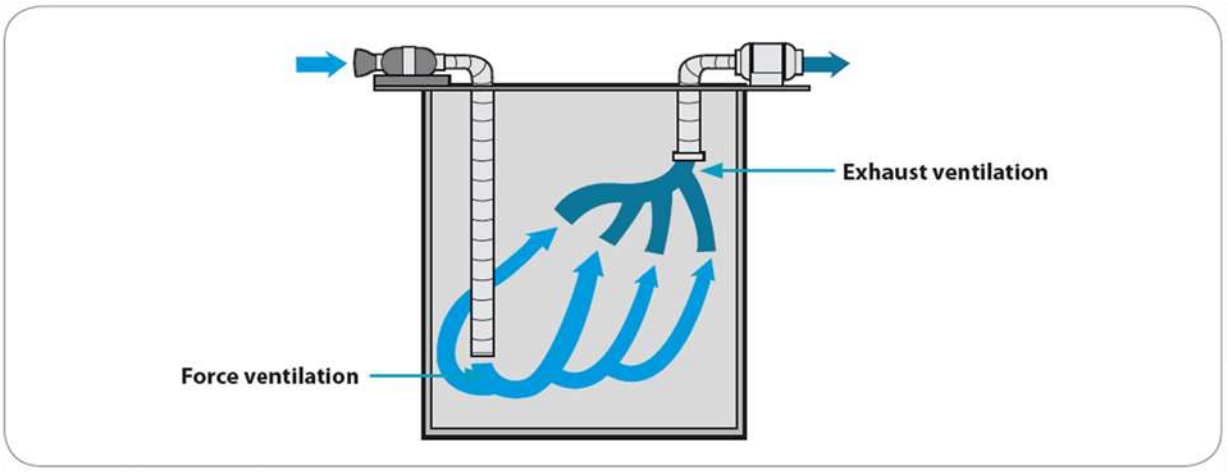
✓ The configuration of the space; and

✓ The expected work to be performed in the confined space.

Push-pull System

A push-pull system uses a combination of both forced ventilation and exhaust ventilation. It usually provides more effective ventilation of the space than using any of the ventilation system alone, and is recommended for use whenever practicable. The push-pull system introduces fresh air into the space while removing contaminants by exhausting them.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg



: Example of a push-pull system.

Use a combination of both forced and exhaust ventilation. It usually provides more effective ventilation of space than using any of the ventilation system alone and is recommended to use whenever practicable.

There are typically three types of air moving devices that are used in the mechanical ventilation of confined spaces.
These are:

Axial-flow Fans

Axial-flow fans are designed to move air parallel to the axis of rotation of the blades. The operating principle is similar
to that of standing fans used at home. Axial-flow fans can be used for both forced or exhaust ventilation and are most
effective for moving high volumes of air under relatively low airflow resistance, such as when minimal or no tubing is attached. However, care is necessary when flammable gases/vapors are present as the fan motor is in the direct
path of the airflow and can act as an ignition source. It is important to consider using an explosion-proofed fan for such an application.

Centrifugal-flow Fans

Centrifugal-flow fans, or radial-flow fans, move air perpendicular to the axis of rotation of the blades. Centrifugal-flow fans tend to be heavier, bulkier and generally produced lower airflow but higher static pressure as compared to axial-flow fans. This ability to generate high static pressure is important in application such as in LEV especially where long runs of ducting may be used.

Venturi Eductor

Venturi eductors are powered by compressed air or steam. The air or steam is released into the eductor through a nozzle at high velocity and this, in turn, induces air into the inlet and forces it along the tube for discharge at high velocity. Eductors are usually lighter, more compact and less expensive but they are not able to move large volumes of air and require a significant supply of

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

compressed air or steam to operate. In addition, the high velocity air movement may also generate static electricity that could serve as an ignition source.

Ducting

Ducting is used widely and extensively to channel air to and from confined spaces. There are two main types of ducting commonly used:

- Flexible collapsible ducting; and
- Flexible non-collapsible ducting.

It is important that the ducting length be as short as possible and that the number of elbows or bends in the duct is kept to a minimum to reduce friction loss. Friction loss will reduce the efficiency of the ventilation and could potentially result in lower than the designed/calculated capacity.

Flexible Collapsible Ducting

Flexible collapsible ducting, such as plastic material tubing is commonly used. Such ducting lacks structural support and can only be used for forced ventilation. While they usually cost less and are more flexible, the lack of structural support can often result in less effective ventilation due to increased static pressure drop across the ducting.

Particular care is required when using plastic material tubings as they are more susceptible to wear and tear during use. It is also important to note that such plastic material tubings are combustible. When they catch fire, smoke/toxic gas will be emitted and travel back to the confined space.

Flexible Non-collapsible Ducting

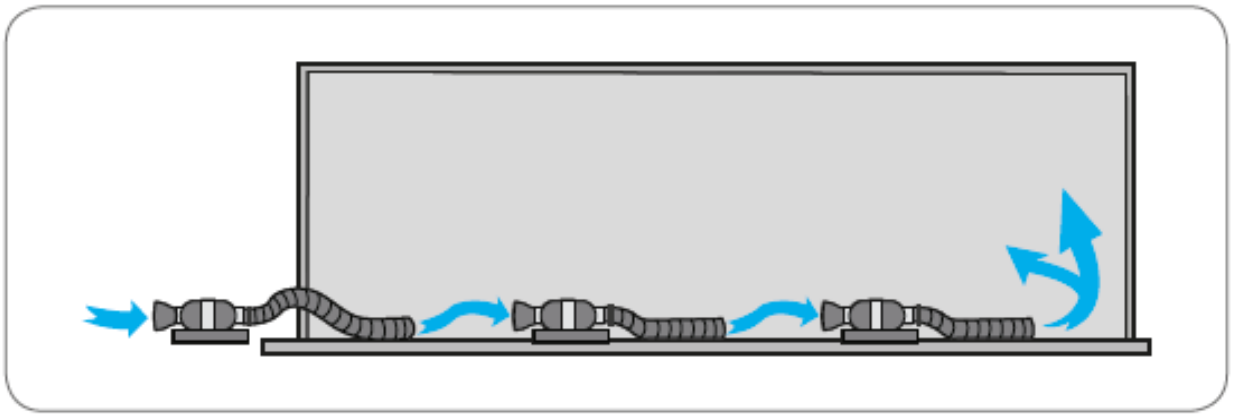
Another type of ducting used is the flexible non-collapsible ducting. It usually has a wire helix that provides the shape
and prevents collapse. Such ducting offers strength, flexibility and can be compacted for storage. Flexible non- collapsible ducting can be used for both forced and exhaust ventilation.

Effective Ventilation

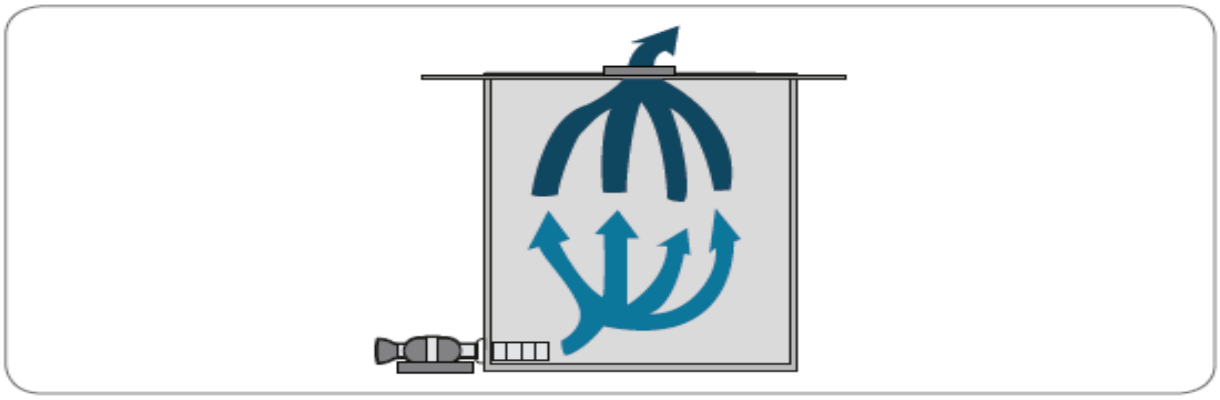
Another key component of ventilation in the confined space is to ensure that the ventilation systems in place are effective. As a general principle, ventilation systems should be set up with the following considerations:

- Long confined space;
- Deep confined space;
- Prevent short-circuiting;
- Prevent re-circulation of exhaust air;
- Remove lighter-than-air contaminants; or
- Remove heavier-than-air contaminants.

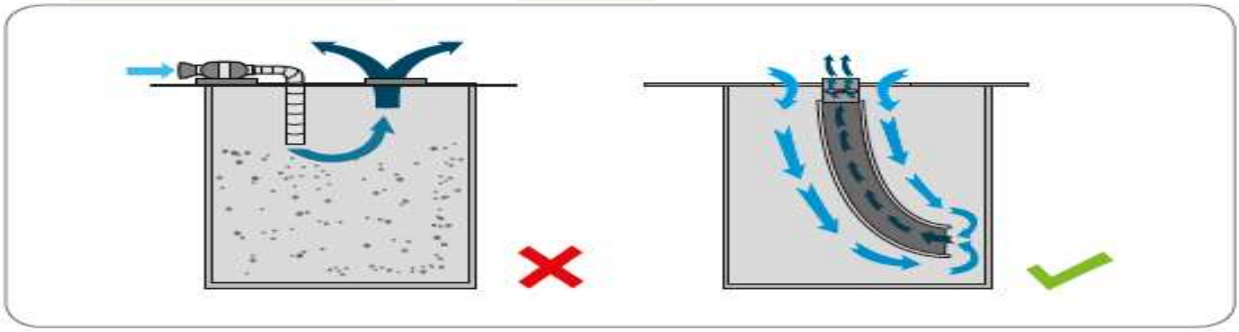
No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg



For long confined space, fresh air is blown in at one end and the containmented air being exhausted at the other end. If necessary, a series of fan (do not connect them) to move air through the long distances.

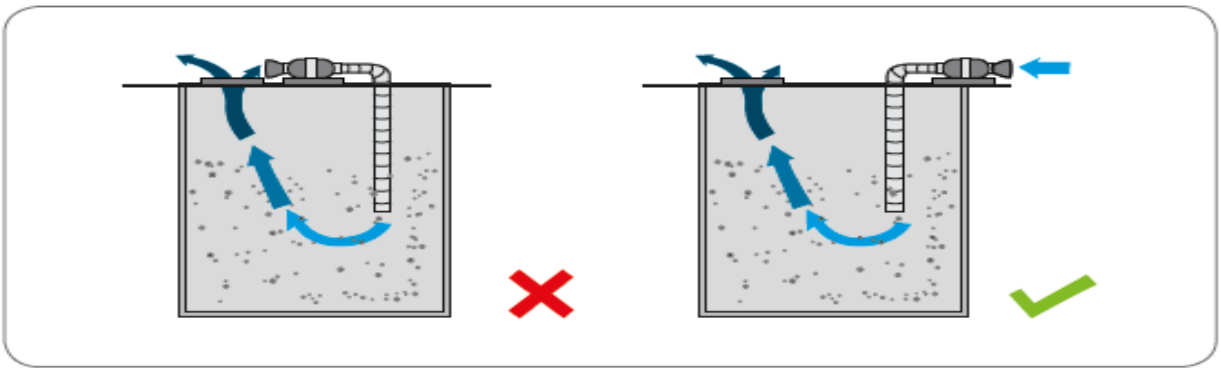


For deep confined space, the fresh air is blown into the bottom, and the containmented air is being exhausted near the top.

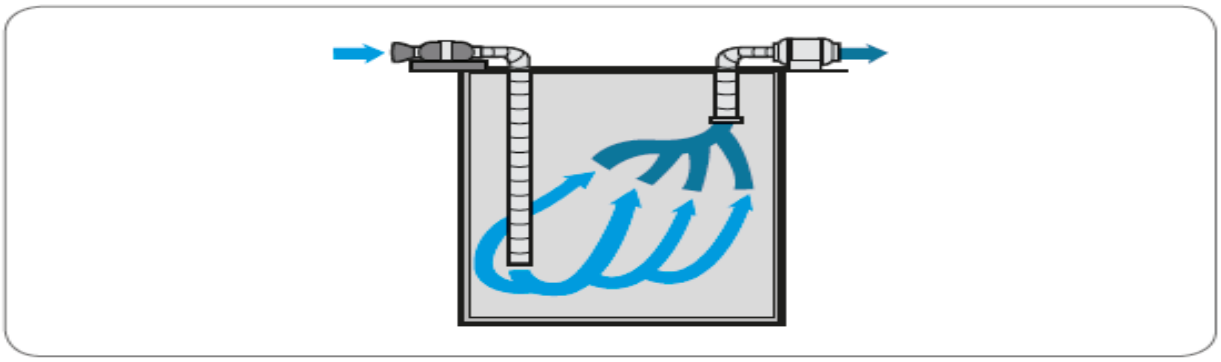


To prevent short circuiting that has only one opening, a powerful blower is used to blow clean air into the entire space or a long ducting to reach the bottom.

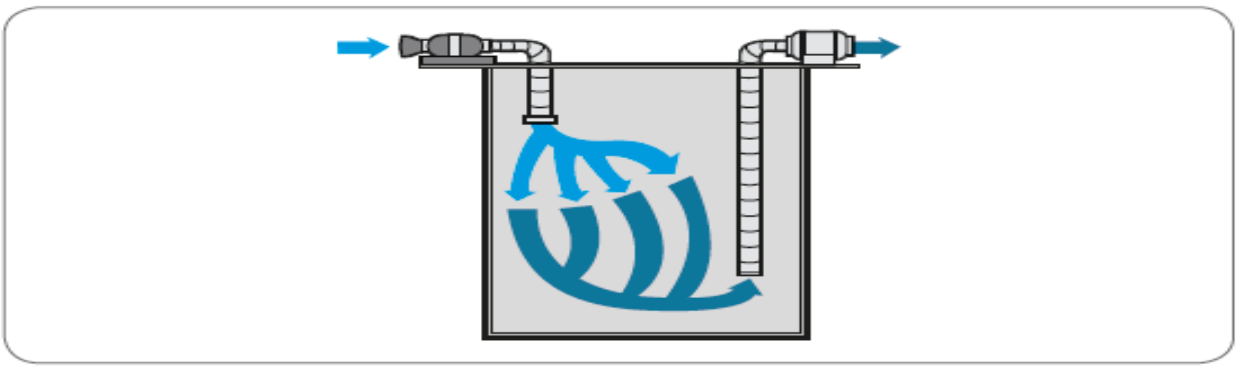
No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg



To prevent re-circulation of exhaust air, position air intake away from any containmented source. This includes facing away from the opening of a confined space.



To remove lighter than air containments that has two openings at the top, use a blower and duct work to introduce fresh air to the bottom. Place an exhaust fan at the other opening to draw the containmented air from the top.



To remove heavier than air containments that has two openings at the top, use an exhaust fan and duct work to capture low lying containments. Place a blower at the other opening to provide fresh air to the space.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

CE 5: Implement the safe use of personal protective equipment and respiratory protective equipment when in a confined space

5.1 Conduct inspection to check that the workers identify, select and use the proper PPE for work/entry into confined space

WHAT IS PERSONAL PROTECTIVE EQUIPMENT (PPE)?

Personal protective equipment (**PPE**) refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes.

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present. PPE has the serious limitation that it does not eliminate the hazard at source and may result in employees being exposed to the hazard if the equipment fails.

The hierarchy of control provides a policy framework which ranks the types of hazard controls in terms of absolute risk reduction.

At the top of the hierarchy are elimination and substitution, which remove the hazard entirely or replace the hazard with a safer alternative.

If elimination or substitution measures cannot apply, engineering controls and administrative controls, which seek to design safer mechanisms and coach safer human behavior, are implemented.

Personal protective equipment ranks last on the hierarchy of controls, as the workers are regularly exposed to the hazard, with a barrier of protection.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PERSONAL PROTECTIVE EQUIPMENT BY TYPE

Personal protective equipment can be categorized by the area of the body protected, by the types of hazard, and by the type of garment or accessory. A single item, for example boots, may provide multiple forms of protection: a steel toe cap and steel insoles for protection of the feet from crushing or puncture injuries, impervious rubber and lining for protection from water and chemicals, high reflectivity and heat resistance for protection from radiant heat, and high electrical resistivity for protection from electric shock. The protective attributes of each piece of equipment must be compared with the hazards expected to be found in the workplace.

Hazards can commonly be classified into four groups:

- Chemical agents can come into contact with through direct contact with contaminated surfaces, deposition of aerosols, immersion or splashes.
- Physical agents such as extreme temperatures and ultraviolet or solar radiation can be damaging to the skin over prolonged exposure.
- Mechanical trauma occurs in the form of friction, pressure, abrasions, lacerations and contusions.
- Biological agents such as parasites, microorganisms, plants and animals can have varied effects when exposed to.

PPE acts as a barrier between the person and the agent of exposure.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PPE – HEAD PROTECTION

There are three widely used types of head protection:

- Industrial safety helmets (hard hats), which are designed to protect against materials falling from height and swinging objects
- Industrial scalp protectors (bump caps), which are designed to protect from knocking against stationary objects
- Caps/hair nets, which protect against entanglement

It is important to wear a safety helmet which complies with applicable codes or international standards.

PPE – FACE & EYES PROTECTION

Face shields to protect from potential impact hazards, chemical splashes or infectious fluid;

Most eye injuries occur when solid particles such as metal slivers, wood chips, sand or cement chips get into the eye. Blunt force trauma occurs to the eye when excessive force comes into contact with. Chemical burns, biological agents, and thermal agents, such as welding torches and UV light also contribute to occupational eye injury.

- Safety glasses provide minimum protection from external debris, and are recommended to provide side protection via a wrap-around design or via side shields.
- Goggles provide better protection than safety glasses, and are effective in preventing eye injury from chemical splashes, impact, dusty environments and welding. It is recommended that goggles with high air flow be used, in order to prevent fogging.
- Face shields are a useful form of additional protection to be worn over the standard eyewear, and provide protection from impact, chemical, and blood-borne hazard.
- Full-face piece respirators are considered the best form of eye protection when respiratory protection is needed as well, but may be less effective against potential impact hazards to the eye.
- Eye protection used for welding operations is shaded to different degrees, depending on the specific operation.

It is critical to use eye and face protection equipment which complies with applicable codes or international standards.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

PPE – BODY PROTECTION
Protective Clothing

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.

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.

PPE - HAND PROTECTION

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.

- Rubber gloves, cut-resistant gloves, chainsaw gloves and heat resistant gloves;

PPE - FOOT PROTECTION

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.

There are a number of types of safety footwear

- Safety boots, normally with steel toe-cap, can also have other safety features (e.g steel mid soles, slip resistant soles, insulation against heat and cold)
- Wellington boots, which can be supplied with steel toe-caps
- Anti-static and conductive footwear. These protect against the build-up of static electricity.

PPE - HEARING PROTECTION

All persons are required to wear hearing protection if they are exposed to excessive noise.

Under the WSH (Noise) Regulations 2011, Permissible Exposure Limit for Noise

- No person shall be exposed to 85dB(A) over an 8 hrs work day.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

- No exposure to noise in excess of 140 dB(A) is allowed.
- The duration of exposure is to be obtained by adding up the total duration of exposure per work day, whether there is one continuous exposure or a number of separate exposures.
- All continuous, impulsive or impact noise of sound pressure levels from 80 dB(A) to 140 dB(A) must be included in the computation of noise exposure of the person.
- The permissible exposure limit is exceeded if a person is exposed to noise at a sound pressure level listed, in excess of the corresponding duration.

Noise exposure level	Hearing protection
< 100 db	**Ear plugs**
100 db to < 120 db	**Ear Mufflers**
> 120 db	**Ear plugs and Ear Mufflers**

5.4 Monitor PPE are properly prepared, stored and maintained.

PPE – INSPECTION, STORAGE AND MAINTENANCE

Where PPE is provided, adequate storage facilities for PPE must be provided for when it is not in use, unless the employee may take PPE away from the workplace (e.g. footwear or clothing).

All PPE must be stored in a clean and sanitary condition ready for use. Accommodation may be simple (e.g. pegs for waterproof clothing or safety helmets, zip-lock bags on a designated shelf) and it need not be fixed (e.g. a case for safety glasses or a container in a vehicle).

Proper storage should be adequate to protect the PPE from contamination, loss, damage, damp or sunlight, and is not subject to temperature extremes.

Where PPE may become contaminated during use, storage should be separate from any storage provided for ordinary clothing.

An effective system of maintenance of PPE is essential to make sure the equipment continues to provide the degree of protection for which it is designed. Therefore, the manufacturer's maintenance schedule (including recommended replacement periods and shelf lives) must always be followed.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Maintenance may include;

- cleaning,
- examination,
- replacement,
- repair and
- testing.

The wearer may be able carry out simple maintenance (e.g. cleaning), but more intricate repairs must only be carried out by competent personnel.

The costs associated with the maintenance of PPE are the responsibility of the employer.

It is the management responsibility to ensure that correct PPE is available and a program is in place. When considering arrangements for providing replacement PPE it must be remembered that unless a task requiring PPE can be stopped, avoided or delayed until new PPE is obtained, replacement PPE must always be readily available.

5.2 Verify that correct procedures are used by the worker to identify, select, inspect and use respiratory protective equipment

PPE – RESPIRATORS

Respirators are devices that allow workers to breathe safely without inhaling harmful levels of toxic gases or particles. It is critical to have a competent person to determine the appropriate respiratory protective equipment based upon conditions and test results of the atmosphere and the work activity to be performed.

There are two main types of respirators:

Air-purifying respirators (APRs):

- particulate respirators (previously called dust, fume, and mist respirators or masks),
- chemical cartridge respirators that can have a combination of chemical cartridges, along with a dust pre-filter: this combination provides protection against different kinds of contaminants in the air
- gas masks (contain more adsorbent than cartridge-type respirators and can provide a higher level of protection than chemical cartridge respirators)
- powered air-purifying respirators (PAPRs).

What are the different types of cartridges and filters?

Equally important is the selection of the correct type of cartridge or filter.

- Filters are made of material that is designed to trap particles as you breathe.
- Cartridges contain a material that absorbs gases and vapors.

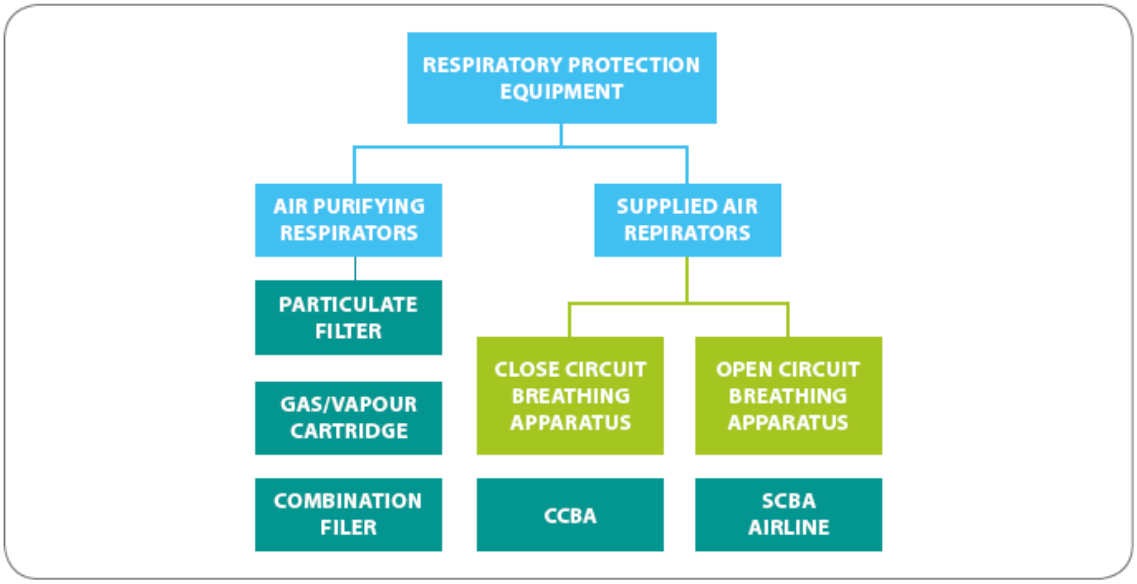
No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

It is very important to make sure using the right filter or cartridge for the chemicals or substances present in the workplace.

Supplied-air respirators (SARs):

- self-contained breathing apparatus (SCBA),
- airline supplied-air respirators, protective suits that totally encapsulate the wearer's body and incorporate a life-support system.

There are some combinations of airline respirators and SCBAs that allow workers to work for extended periods in oxygen-deficient areas or where there are airborne toxic contaminants.



In work environments, respirators are relied upon when adequate ventilation is not available or other engineering control systems are not feasible or inadequate. It is important that the breathing apparatus fits properly and is safe to use. Care needs to be taken in the selection of the device and in its use.

Selection of respiratory protective devices is generally based on:

- Type of air contaminants present (i.e., articles, vapors, gases);
- Hazard of exposure (i.e., IDLH, eye irritant, Toxicity);
- Warning properties of contaminants;
- Level of exposure;
- Exposure time;
- Work activity;
- Characteristics and limitations of the respirator equipment; and
- Level of protection needed.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

How to select the right respirator?

Before the proper respirator can be selected for a job, be sure you have already:

- Identified the respiratory hazard.
- Evaluated the hazard.
- Considered whether engineering controls are feasible.

When selecting a respirator:

- Is it to be used in firefighting or emergencies?
- Is it to be used in oxygen-deficient atmospheres (less than 18% oxygen in air; some jurisdictions say below 19.5%)?
- What is the nature of the hazard (chemical properties, concentration in the air, warning properties)?
- Is there more than one contaminant (i.e. a mixture or more than one chemical is present)?
- Is the airborne contaminant a gas, vapor or particulate (mist, dust or fume)?
- Are the airborne levels below or above the exposure limit, or are they above levels that could be immediately dangerous to life or health?
- What are the health effects of the airborne contaminant (carcinogenic, potentially lethal, irritating to eyes, absorbed through the skin)?
- What are the characteristics of the operation or the process (e.g., hot temperature, confined space)?
- What activities will the worker be doing while wearing the respirator (e.g., strenuous work)?
- How long will the worker need to wear the respirator?
- Does the selected respirator fit the worker properly?
- Where is the nearest safe area that has breathable air?

Air Purifying (Cartridge) Respirators offer no protection against oxygen deficiency. Only Supplied Air Respirators (SCBA and air lines) are recommended for use in confined spaces where there is lack of oxygen (oxygen deficiency).

It is important not to use any kind of filtering respiratory protection device:

- In oxygen deficient atmospheres (less than 19.5 vol. % O2);
- In poorly ventilated areas or confined spaces, such as tanks, tunnels, or vessels;
- In atmospheres where the concentrations of the toxic contaminants are unknown or in IDLH (Immediately dangerous to life and health) atmosphere;
- When the concentration of a contaminant is higher than the maximum permissible concentration and/or the filter class capacity;
- When facial hair, or other conditions that interfere with the seal between the face and the respirator; or
- When the respirator is being altered, abuse, or misuse.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

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. When compared to the more conventional SCBA, this arrangement provides greater freedom of movement and less fatigue to the user.

5.3 Conduct inspection to fit check of air purifying respirators

Fit Testing

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.

There are two forms of fit-testing – **qualitative** and **quantitative**.

Qualitative fit-testing is usually adequate for disposable filter face pieces and half-masks. This can be done as a simple pass/fail based on the wearer's subjective assessment of the fit and leakage. This method is not suitable for full-face masks.

Qualitative fit testing comprises two steps:

- A sensitivity test with a diluted test solution (without filtering device) to check if the wearer can detect or taste the test solution.
- The actual test will be conducted using a concentrated test solution. The user is asked to wear the filtering device and perform the following tasks; to breathe normally, to breathe deeply, to turn his head from side to side, to move his head up and down, talking, bending over, jogging on the spot and then back to breathing normally.
  If the test solution cannot be tasted after completing all the above, the qualitative fit testing is a success and the user will be given a certificate for wearing this filtering respiratory protection device. A retest will be required, if other filter respiratory devices are to be used.

Quantitative fit-testing provides a numerical measure of the fit known as a 'fit factor'. These tests give an objective measure of face fit. They require specialized equipment and are more complicated to carry out. These methods are recommended for full-face masks.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

5.5 Monitor respiratory protection equipment for use in confined space works are properly prepared, stored and maintained.

Inspection, storage and maintenance for filtered respirator

Inspect before every use look out for

- Physical damage; cracks, tears, dirt and fatiguing;
- Inhalation / exhalation valves
- Head straps
- Filter gaskets
- Filter / Cartridge
- Establish a regular change out schedule

Storage

- Follow Manufacturer's instructions
- Protect from dust, sunlight, temperature and chemicals

Cleaning

- Disassemble
- Use warm soapy water
- Brush gently
- Rinse thoroughly

Sanitize

- 1ml of bleach to 1L of water
- Always refer to user instructions of respiratory for sanitizing procedures
- Rinse thoroughly

6.4 Conduct inspection on the correct use of self contained breathing apparatus (SCBA)

Inspection, storage and maintenance for SCBA

SCBA equipment shall be inspected periodically to determine its readiness for use and to discover and repair any damage or excessive wear sustained by the unit.
The frequency of inspection is as follows:

A. After each use:

After each use, each SCBA shall be inspected for the following:

- Low or empty cylinder: Cylinders should be cleaned, low or empty cylinders should be refilled, or replaced with full ones.
- Components and face pieces: Shall be cleaned, checked for excessive wear or damage, sanitized, and checked for proper function.
- Anytime an SCBA has been used in a contaminated atmosphere, the unit shall be completely decontaminated prior to being returned to service.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

B. Monthly

- Each piece of SCBA equipment assigned to an apparatus shall be inspected monthly
- The inspection shall be made to ensure that the SCBA is fully charged, clean, free of damage, and fully operational.
- Cleaning, refilling cylinder's or minor repair shall be done
- Any unit showing damage or that does not function properly shall be removed from service and tagged with a description of the defect.
- The defects shall be forwarded to the in-charge

C. Annual inspection:

- All SCBA's shall be inspected and serviced every twelve months by an authorized repair facility.
- The inspection and servicing shall include the following:
  a. Disassembly and cleaning of the regulator and other major components, such as the low-air alarm, face-piece, etc.
  b. Replacement of all worn parts.
  c. Reassembly of the SCBA and testing for proper function.
  d. Function test shall include a flow test.

No.	Task Steps	1st test		Re-test	
1.	Removes SCBA from apparatus and places on floor				
2.	Inspects mounting bracket for damage or wear				
3.	Examines overall condition of SCBA and note any damage				
4.	Check cylinder from the harness and check hydrostatic test date				
5.	Check cylinder for damage and wear				
6.	Inspect should straps and waist belt				
7.	Check all buckles and fasteners				
8.	Examine the back plate for damage, cracks or rust				
9.	Make sure all connection points between cylinder and SCBA operate properly and free of damage or corrosion				
10.	Re-attach the cylinder to the harness				

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

11.	Check all hose and connection points for wear, cuts and damage				
12.	Activate cylinder valve and compares pressure gauge readings				
13.	Attach face piece and check regulators for proper operation				
14.	Allow SCBA to idle until PASS activate				
15.	Close cylinder valve and open by-pass valve to bleed pressure while checking low pressure alarm				
16.	Return unit to mounting bracket in ready condition				

CE6: Assist in Implementing an Emergency Response Plan

Before anyone is authorized 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.

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, in operation readiness 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.

Confined space rescues can be technically challenging due to the environment in which they occur. They are usually narrow and constricting preventing easy access by rescuers, and either unlit or poorly lit so rescuers must provide their own light source. Finally, confined spaces often contain hazardous materials in liquid or gas form which can be harmful or fatal to humans.

6.1 Communicate the Emergency Response Plan to workers in accordance with the organizational procedure

Establishment of Rescue Operation Plans

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; and
- Provide an effective means to summon the designated rescue personnel in a timely manner.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

6.2 Activate rescue personnel in accordance with the Emergency Response Plan

Who to activate

- During an emergency, it is necessary to inform the following personnel:
- SCDF
- Police
- Emergency Response Manager / Coordinator
- Company Emergency Response Team (CERT)
- First Aiders
- Supervisors
- Project Manager / Maintenance Manager

Rescue Arrangements

The risk assessment will determine what rescue arrangements are necessary. The arrangements will depend on

- the nature of the confined space,
- the risks identified and
- the types of emergency situations which are foreseeable.

It is important to note the possible emergencies in the confined space, and any other foreseeable accident for a rescue operation. For example, the incapacitation of a person, wholly or partially, following a fall inside a confined space.

The risk assessment shall determine the combination of confined space rescue strategies appropriate for the particular situation.

It is important for suitable and sufficient emergency arrangements to take account of:

- Rescue considerations;
- Rescue logistics;
- Training of rescue personnel;
- Provision of rescue equipment; and
- Provision of safety data sheet.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

6.6 Initiate evacuation and self rescue

Confined Space Rescue

There are three categories of confined space rescue: self rescue, non-entry rescue and entry rescue.

a. Self rescue

In a self-rescue, much as the name suggests, the individual recognizes a critical condition or symptoms of exposure and exits the space on his or her own. Alternatively, an entry monitor, who is outside of the space, may recognize a new hazard and order individuals to leave the space before they are affected.

This is the preferred rescue method as confined space hazards can quickly incapacitate or kill an individual. An individual can almost always exit a confined space in far less time than it takes to wait for someone to come in and retrieve them.

b. Non-entry rescue

A non-entry rescue involves attempting to extricate an incapacitated person without having anyone else enter the confined space. This can be done via a safety line attached to the personnel in the confined space or by grabbing the personnel with a rope, strap or pole and pulling them to safety.

c. Entry rescue

This is a last resort option as having more personnel enter an area that has already incapacitated one or more person(s) places the rescuer at considerable risk. Entry rescues must be carefully planned and executed to avoid creating more victims in need of rescue. Rescuers need to be aware of their surroundings and must re-evaluate their plans immediately if there is any change in the conditions of the confined space.[1]

In the event of an entry rescue, standby rescuers are recommended in the event that the initial entry rescuer(s) encounter trouble.

Retrieval techniques for injured personnel

Retrieve without stretcher	
	A fireman's carry or fireman's lift is a technique allowing one person to carry another person without assistance, by placing the carried person across the shoulders of the carrier. The technique was commonly used to carry injured or unconscious people away from

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

	danger.
	Fore Method Casualty of similar weight or heavier than rescuer
	Pick-a-back This technique is used when the casualty is able to cling on and there is no danger of the casualty losing conscience.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

	The Cradle This method is used for children or light-weight casualties.
	The backward drag is used when the casualty is too heavy to be lifted.
	The human crutch is used with casualties who can walk with assistance. It can be used with one or two people assisting.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

<table>
<tr>
<td>  </td>
<td>The fore and aft technique is used if the casualty is unable to walk.

It requires two rescuers.</td>
</tr>
<tr>
<td> 
  </td>
<td>4-Handed set

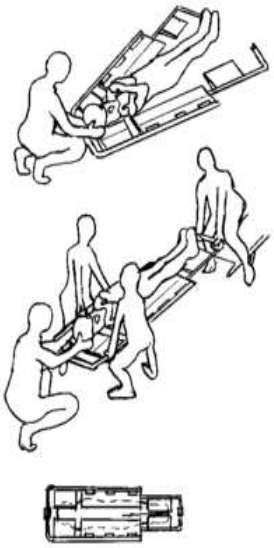
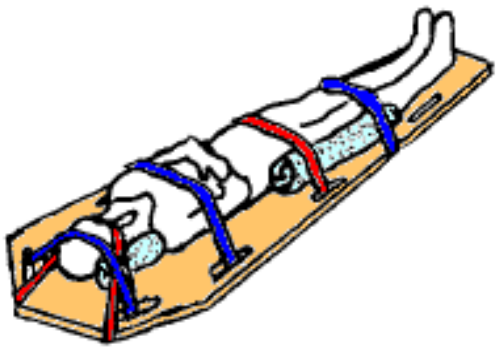
Casualty needs to be carried rather than dragged.

Casualty’s weight beyond the capability of 1 person.</td>
</tr>
<tr>
<td colspan="2">Factors influencing the methods used

Methods employed will depend on a combination of the following factors:

➢ Type and severity of the injuries
➢ Casualty’s status (conscious / unconscious)
➢ Weight of the casualty
➢ Availability of Rescuers
➢ Distance and Route</td>
</tr>
</table>

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Retrieve with stretcher: Scoop Stretcher	
 	Frequently used to lift supine patients from the ground, either due to unconsciousness or in order to maintain stability in the case of trauma, especially spinal injury. Used as an intermediate step between the ground and a restraining device such as a long spine board or vacuum mattress. A device used specifically for casualty lifting.
Retrieve with stretcher: Other Stretchers	
	A spinal board, or long spine board (LSB) is a patient handling device used primarily in pre-hospital trauma care designed to provide rigid support during movement of a patient with suspected spinal or limb injuries It is designed primarily as an extrication device.
	A vacuum mattress, or vacmat, is a medical device used for the immobilization of patients, especially in case of a vertebra, pelvis or limb trauma. It is also used for manual transportation of patients for short distances, replaces stretcher.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

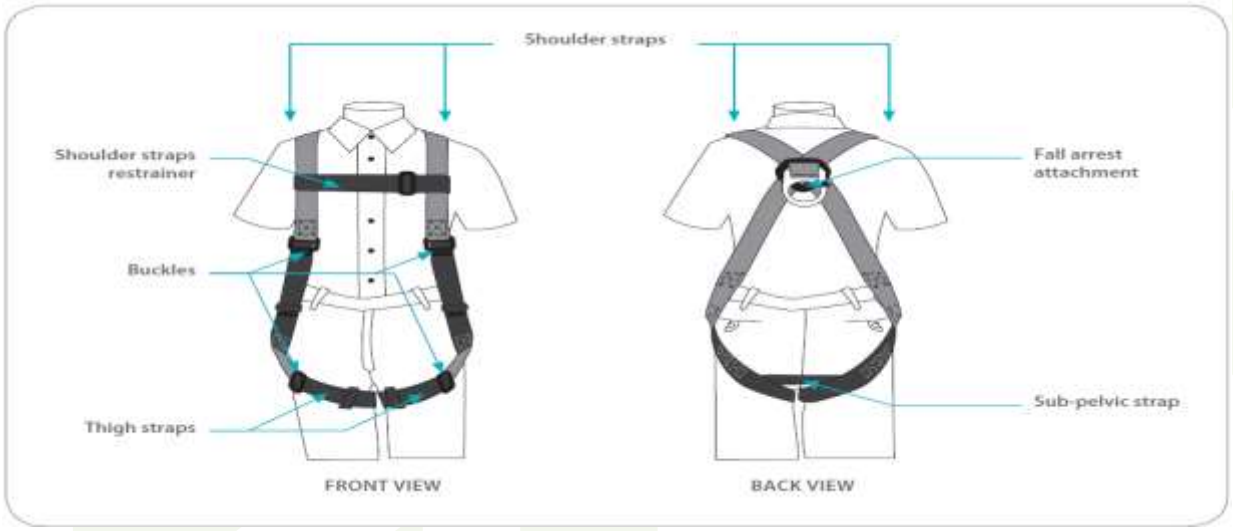
6.3 Conduct inspection to ensure that workers wear full-body harness correctly when required

Full Body Harness

A full body harness (FBH) is a component of a body holder device that connects a user to a Personal Fall Arrest System (PFAS).

It comprises components such as fittings, straps, buckles or other elements that could support the body of a user and restrain the user during and after the arrest of a fall.

There are four classes of full body harnesses, namely Class A, Class D, Class E, and Class P.



Class A

Fall arrest

- It shall incorporate at least one fall arrest attachment element.
- The fall arrest attachment element shall be positioned so that it lies either at the back ("dorsal" attachment D-ring) of the user (centrally between the upper shoulder blades), or centrally in front of the chest (at approximately the height of the sternum).

Class D

Controlled descent/ ascent

Class D shall meet the requirements for Class A.

- It has additional attachment elements that allow the user to connect to a controlled descent system.
- It shall have the controlled descent and ascent attachment elements incorporated so that the user can adopt an approximate seated position (whilst in suspension).

Note: Controlled descent or ascent attachment elements should only be connected to the controlled descent system, and not to the PFAS.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Class E

Confined space access

Class E shall meet the requirements for Class A.

- It has additional attachment elements that allow the user to connect to a confined space access system.
- It shall have a sliding attachment element on each shoulder strap to be used as pair, so that they enable the user to adopt a near upright position (whilst in suspension).

Note: Confined space access attachment elements are to be connected only to the confined space access system, and not to the PFAS.

Class P

Work positioning

Class P shall meet the requirements for Class A.

- It has additional attachment elements that allow the user to connect to a work positioning system.
- It shall have at least one work positioning attachment element incorporated at approximately waist level.
- If only one work positioning attachment element is provided, it shall be designed to lie in the middle of the torso.
- If work positioning attachment elements are provided (other than centrally at the front), they should be designed to be placed symmetrically in pairs and not be used separately.

Note: Work positioning attachment elements should only be connected to the work positioning system, and not to the PFAS.

Important Points to Note when Wearing a Full Body Harness:

- Must be worn properly to protect a worker in the event of a fall.
- The rear or dorsal D-ring should be located between the user's shoulder blades.
- The dorsal plate on the rear of the FBH must be in good working condition to prevent the D-ring from slamming into the back of the user's head during a fall and prevent it from becoming a noose.
- The front chest strap (without the front attachment D-ring) must be fastened correctly as per the manufacturer's instructions. This will prevent the user from falling out of their harness.
- Select a harness with the correct D-ring orientation. If the anchor point is behind a user, the rear or dorsal D-ring would be appropriate and vice versa if the anchor point is in front of the user.
- Ensure that the FBH is correctly fitted on the user.
  A loose harness could lead to death or serious injuries (such as extreme testicular trauma and severe rectal damage) during a fall.

  If the harness is too tight, can cause discomfort and limit movement. Ensure that the body harness is of the correct fit ("snug tight") is the "two-finger test".
- Secure the FBH as the fall energy may exceed the strength of the stitching and pass through the unlocked buckle, which can cause the user to fall through the bottom of the FBH.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Inspection of Full Body Harness

Parts	Methods
Webbing	Hold the webbing with both hands and bend it into an inverted "U" shape. Due to surface tension, major cuts and damaged fibres will be revealed.  Cracks will reveal due to surface tension. Repeat this step for the entire length and both sides of webbing. • Look out for frayed edges, broken fibres, pulled stitches, cuts, burns and signs of ultraviolet (UV) and chemical damage.  Cuts on webbing.  Frayed on webbing.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Parts	Methods
Webbing	 Damaged stitches on webbing.  1. Discolouration due to UV. 2. New Full Body Harness.  Chemical damage due to paint marking on webbing.  Webbing damaged by burns.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

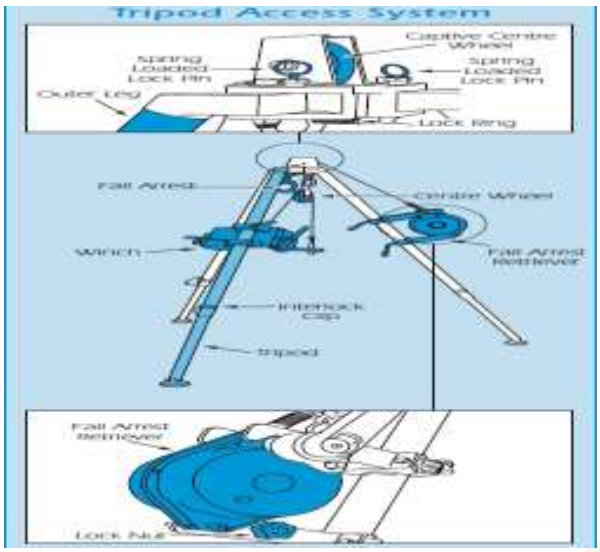
Parts	Methods
Energy-absorbing lanyard	• Examine this type of lanyard using the same method described for webbing lanyard (see above). • It is important to check for signs of deployment of the indicator or warning flag. If activated sign is shown, the energy-absorbing lanyard must be discarded.
Wire rope lanyard	• Inspect the wire rope lanyard by rotating it. • Check for cuts, kinked, frayed areas or unusual wear patterns on the wire. Broken strands will be separated from the body of the lanyard.
Energy absorbers	• The outer protective pack should be examined for signs of holes, cuts or tears.  Cuts on energy absorber. • Check the stitching on the areas where the pack is sewn or attached to D-rings, belts or lanyards for loose strands, rips and deterioration. • Check for signs of activated energy absorber.  1. Energy absorber after being activated. 2. New and inactivated Energy absorber.

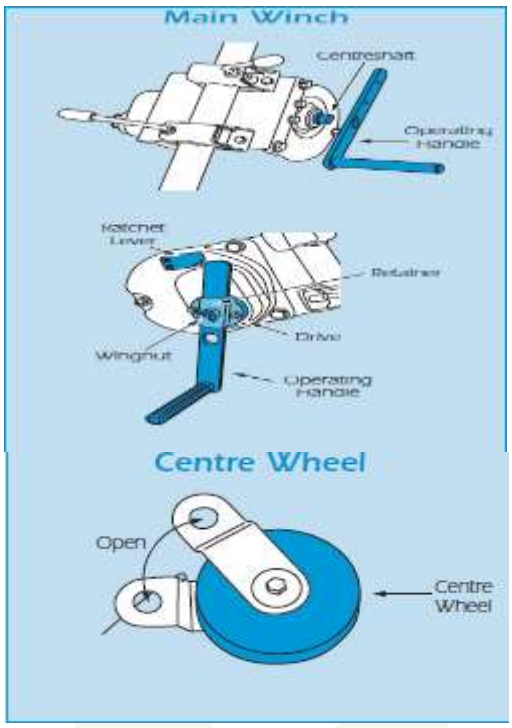
No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Inspection Checklist for Full Body Harness				
Model no.:		Inspector:		
Serial no.:		Inspection date:		
Date made:		Disposition:		
No.	**Description**	**Qty.**	**Overall Assessment**	**Comments**
Fabric Parts				
Webbing (Straps)				
1	Shoulder			
2	Shoulder strap retainer			
3	Shoulder ring strap			
4	Thigh			
5	Sub-pelvic			
6	Tool belt support			
Stitching				
7	Shoulder ring strap			
8	Shoulder strap tip			
9	Shoulder strap retainer			
10	Shoulder strap reinforcement			
11	Buckle			
12	Thigh strap			
13	Thigh strap edges			
14	Sub-pelvic strap			
Metallic Parts				
D-Rings/ Oval Rings				
15	Back			
16	Hip			
17	Chest			
18	Shoulder			
Buckles/ Adjusters/ Grommets				
19	Adjuster, torso sizing			
20	Buckle, tongue			
21	Buckle, friction			
22	Grommets, thigh strap			
Plastic Parts				
23	Back D-ring locator			
24	Strap collar			
25	Labels			
26	Tool belt support clips			

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Retrieve by winch tripod





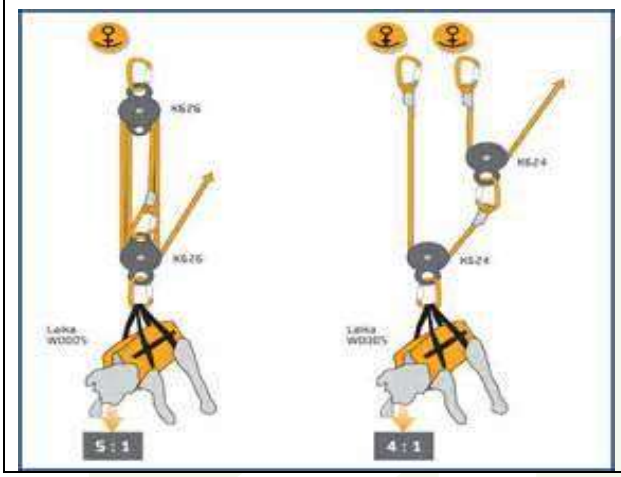
Attach your harness to the main winch and the fall arrest unit.

Connect each to a different attachment ring, do not attach both to the same attachment point.

To lower the user turn the winch handle clockwise, to raise the user turn the winch handle anti-clockwise

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Retrieve by rope and pulleys



Pulley-and-rope systems are employed in rescue operations to basic yard and tree pruning chores.

To keep the system intact, it is necessary to tie off and anchor the rope and pulleys to prevent the ropes from coming out of the pulleys.

The rope-and-pulley system is anchored by using rope cleats set on key locations or with a webbing anchor and carabiner.

Rescue Considerations

Plan and prepare emergency response and rescue procedures for all confined space entry work. These procedures must be in place before any work commences. It is important to note that a very short period, approximately four minutes, without adequate breathing can cause a worker to suffer permanent brain damage due to lack of oxygen.

Characteristics When Deciding the Appropriate Rescue Plan

Considering the following characteristics when deciding the appropriate rescue plan for a confined space entry work:

a. Internal Configuration

i) Open
There are no obstacles, barriers, or obstructions within the space. Example is a water tank.

ii) Obstruction
The space contains some type of obstruction that a rescuer would need to manoeuvre. Example is a baffle or mixing blade. Large equipment, such as a ladder or scaffold, brought into the space for work purposes would be considered an obstruction if the positioning or size of the equipment would make rescue more difficult.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

b. Elevation

i) Elevated
A permit space where the entrance or opening is above ground by 4 feet o more.
This type of space usually requires knowledge of high angle rescue procedures because of the difficulty in packaging and transporting a victim to the ground from the space.

ii) Non-elevated
A permit space with the entrance located less than 4 feet above ground. This type of space will allow the rescue team to transport an injured worker normally.

c. Portal Size

i) Restricted
A portal of 24 inches or less in the smallest dimension. Portals of this size are too small to allow a rescuer to simply enter the space while using SCBA. The portal size is also too small to allow normal spinal immobilization of an injured worker.

ii) Unrestricted
A portal of greater than 24 inches in the smallest dimension. These portals allow relatively free movement into and out of the permit space.

d. Space Access

i) Horizontal
The portal is located on the side of the permit space. Use of retrieval lines could be difficult.

ii) Vertical
The portal is located on the top or bottom of the permit space. Rescuers must climb down or up the permit space respectively to enter it. Vertical portals may require knowledge of rope techniques, or special patient packaging to safely retrieve a downed entrant.

For confined space entry, it is important for the authorized manager to designate a standby worker; one or more workers who are trained in industrial first aid, and also trained in confined space emergency and rescue procedures.

It is necessary that the designated standby worker be present and remains at the entrance to the confined space at all times while his co-worker is in the confined space.

Conducting of Drills

It is important that all parties involved in a potential rescue operation understand and agree on the emergency and evacuation procedures. It is necessary to include all steps for safe rescue in the confined space entry procedures. It is also critical for a rescue to be well planned and evidence to be made available that indicates drills have been frequently conducted on emergency procedures. A rescue drill in a confined space shall be held at least once in every 12 months.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

The record of such a drill should be kept and should include the time, date of drill, personnel involved, a short description of the drill and the evaluation of the drill.

It is also important to note that workers who are not trained in proper rescue procedures should not undertake or be permitted to undertake rescue operations.

Rescue Logistics

Careful consideration on the means of raising the alarm and carrying out a rescue. The emergency plan needs to be suitable and sufficient for all anticipated accidents.

Communication

It is necessary to put in place measures that enable those in the confined space to communicate to others outside the space who can initiate rescue procedures or summon help in an emergency.

The emergency can be communicated in a number of ways, for example, by the tug of a rope, by radio or by means of a "lone worker" alarm. Whatever the system, it should be reliable and tested frequently.
Depending on the risk assessment, it may be necessary to have one or more standby persons located outside the confined space whose function is to keep those inside in constant direct contact including visual where feasible, in case of an emergency.

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

It is also important to give careful consideration on the selection of an appropriate confined space rescue strategy. Retrieval using non-entry methods is preferable to rescue by entry and should be used where practicable.

Where entry is necessary, ensure the rescuers are protected from the risk of injury and to address any emergency situation.

Rescue equipments provision

Make adequate provisions when preparing the emergency plan.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

The method of retrieving a casualty from a confined space needs to be carefully planned. Lifting equipment will often be needed in combination with a safety harness and line, as even the strongest person is unlikely to be able to lift or handle an unconscious person on his own using only a rope.

It is critical to properly adjust the line and the harness worn so that the wearer can be safely drawn through any confined space or opening.

The use of BA will often be considered as a means of protecting the rescuers from the cause of the emergency. BA may either be of the self-contained or air line-fed types. In the case of the latter, a suitable supply of breathing air quality is essential and the length of the air line needs to be taken into account. The use of RPE of the canister respirator or cartridge type is not acceptable for use by rescuers.

The number, size and location of access/egress openings will have an important bearing on the choice of rescue methods and equipment. It will often be necessary to check that a person wearing suitable equipment can safely and readily pass through such openings. In case of restricted openings, air line-fed breathing apparatus offers a more compact alternative.

It may be appropriate for the occupants of a confined space to use equipment known as “escape breathing apparatus” or “self-rescue” devices in situations where there will be time to react to an anticipated emergency. For example, smoke logging in tunnels or reacting to atmospheric monitoring devices. These devices are intended to allow the user time to exit the hazard area. They are generally carried by the user or those stationed inside the confined space, but are not used until needed. They are designated to operate for only a short duration but they are sufficient to allow the user to move to a safer place. It is important to have it at the area where such hazards are expected in an emergency.

Emergency rescue and medical support

It is critical to make arrangements (including means of communications) to summon the local public emergency services (e.g., local fire or ambulance service) without delay when an accident occurs. This will help to provide them with all known information about the conditions and risks of entering the confined space upon arrival.

Reliance on the local public emergency services to carry out rescue is not acceptable if the risk assessment determines that a timely rescue is necessary. For example, if resuscitation is likely to be necessary as a consequence of an incident (e.g., the exposure of a confined space occupant to a severe oxygen-deficient atmosphere), it generally begins within 4 minutes of the person collapsing. It is important that emergency planners be mindful of these considerations when devising the rescue strategy.

Where there are a number of entrants into a confined space, it is important to establish the method of carrying out a full-scale evacuation. Measures to prevent openings from becoming bottlenecks would be necessary.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Lighting / illumination

Ensure the lighting condition in the confined space is adequate to facilitate a successful rescue. Obstructions in the confined space and the presence of fog or mist due to high humidity may lead to poor visibility. If the existence of a flammable atmosphere is possible, any lighting, including hand-held torches, will have to be intrinsically safe.

Training of Rescue Personnel

Any person appointed to carry out any emergency arrangements to receive appropriate instruction and training to enable him to perform that role effectively. Such training includes first aid, CPR, the proper use of PPE and other equipment necessary for carrying out the rescue operation and as an authorized entrant.

The level of training will vary according to the complexity and skill content of the role. It is necessary to conduct refresher training as often as possible to maintain an acceptable level of competence.

Familiarity with procedures and equipment is essential. It can be developed and fine-tuned by frequent drills and realistic simulation.

All rescue personnel need to understand the likely causes of an emergency. They will need to be familiar with the rescue plan and procedures developed for each type of confined space that they may encounter. They need to be able to rapidly size-up an emergency situation and evaluate their ability to conduct a safe rescue. These factors need to be given consideration in the development of a training programme. It is important to design the training in such a way that rescuers are capable to perform rescues in a safe and timely manner.

Rescuers need to be fully familiar with the equipment for use in rescue, communications or medical purposes and operation. They would need to check that the equipment is functioning well before use. It is important for potential users of breathing apparatus to receive appropriate formal training. It is critical for trained persons to carry out the resuscitation procedures efficiently.

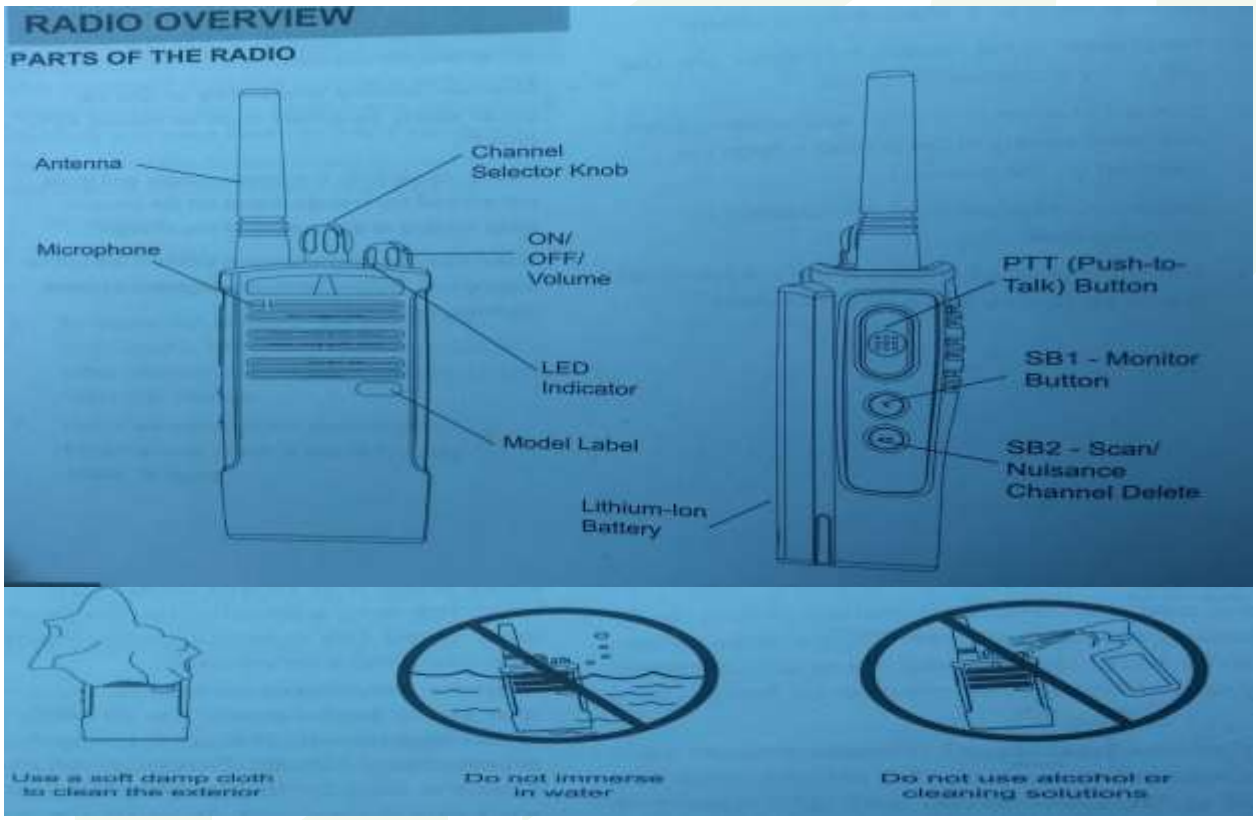
Designated first-aiders need appropriate current certification.

6.5 Operate communication devices

A **walkie-talkie** is a hand-held, portable, two-way radio transceiver, offer a push to talk handset.

- ✓ Widely used in any setting where portable radio communications are necessary.
- ✓ Made very small and inexpensive.

No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg



No: 3, Soon Lee Street, 01-16,
Pioneer Junction, Singapore - 627606,
Tel: +6563347872 / Fax +6563347891
ROC: 201329358M
Email: admin@efg.com.sg ,
Website: http://www.efg.com.sg

Getting started	
Turning radio ON / OFF	▪ Turn ON radio, rotate the ON/OFF volume knob clockwise, radio will chirp and LED will blink red ▪ Turn OFF radio, rotate the ON/OFF volume knob anti clockwise until a "click" sound, radio LED indicator turn OFF
Adjust volume	▪ Turn the ON/OFF volume knob clockwise to increase, or anti clockwise to decrease the volume
Select channel	▪ Rotate channel selector knob and select the desired channel number ▪ Program each channel separately, each channel has its own frequency, interference eliminator code and scan setting.
Talking and monitoring	▪ Monitor for traffic before transmitting to avoid "talk over" someone. ▪ To monitor, press and hold the SB1 button for 2-3 sec to access channel traffic, if no activity is present will hear "static". Once channel has cleared, proceed with call by pressing the PTT button. ▪ When transmitting, the radio LED will blink every 3 sec.
Receiving a call	➢ Select a channel by rotating the channel selector knob. ➢ Make sure PTT button is released and listen for voice ➢ LED indicator blinks RED while radio receiving call ➢ To respond, hold the radio vertically 1-2inch from mouth. Press the PTT button to talk

RADIO STATUS	LED INDICATION
Channel Alias Edit	Red heartbeat
Channel Busy	Solid orange
Cloning Mode	Two orange heartbeats
Cloning In Progress	Solid orange
Fatal Error at Power up	One green blink, one orange blink, one green blink, then repeat for 4 seconds
Low Battery	Orange blink
Low Battery Shutdown	Orange heartbeat
Monitor	LED is OFF
Power-Up	Solid red for 2 seconds
'Idle' Programming Mode / Channel Mode	Green heartbeat
Scan Mode	Red heartbeat)
Transmit (Tx)/Receive (RX)	Red heartbeat

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.

----------End----------