

PETRONAS TECHNICAL STANDARDS

HEALTH, SAFETY AND ENVIRONMENT

STANDARD

ENTRY INTO CONFINED SPACES

PTS 60.2105

JANUARY 2011



© 2011 PETROLIAM NASIONAL BERHAD (PETRONAS)

All rights reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without the permission of the copyright owner.

PTS Circular 2011



PTS No:	60.2105
PTS Title:	Entry Into Confined Spaces

This revision of PTS 60.2105: Entry into Confined Spaces incorporates requirements based on DOSH Industry Code of Practice for Safe Working in a Confined Space 2010, 'Garis panduan Latihan Pekerja Pendaftaran Tenaga Pengajar dan Pengendalian Kursus Keselamatan dan Kesihatan Pekerja di Ruang Terkurung' 2008, USECHH Regulation 2000, OSHA 1994, Factories and Machinery Act 1967, PETRONAS Technical Standards and local regulation requirements. (Refer Reference)

The previous version of PTS 60.129 on Guidelines for Entry into Confined Spaces (**April 1992, Revision 0**) will accordingly be removed from PTS binder/e-repository.

The custodian of this PTS is: TP, Safety Management - Operations, GHSED.

Please direct any questions regarding this PTS to the above-mentioned.

DOCUMENT APPROVAL

	Name	Designation	Date	Signature
Prepared	Megat Muzafar B M Mokhtar	Staff, Safety Management Operations, Group HSE Division	18/4/11	
Technical Approved	Morris Kho Kee Wee	Custodian, Safety Management Operations. Group HSE Division	18/4/11	
Verified	Maureen Song Chai Kee	General Manager, Group HSE Strategy & Performance, Group HSE Division	18/4/11	
Approved	M Tarmizi B Munir	Head, Group HSE Division	19/4/11	

REVISION HISTORY

Date	Version	Description of Updates	Author
Apr 1992	Original		
Jan 2011	Rev 1	To comply to legal requirements and adopt industry best practices	GHSED

ACKNOWLEDGEMENT

This document was jointly prepared with contribution from the following organizations:

1. M Hadzir B M Said (PPMSB)
2. Saira Hanim Bt Shamsi (PPMSB)
3. Megat Muzafar B M Mokhtar (GHSED)
4. M Ariff B Zulkifli (GHSED)
5. M Jailani B Adam (OPTIMAL)
6. Harun B Sani (EPMSB)
7. Jaafar B Ahmad (PPTSB)
8. Deneshwaran a/l Muniandy (MTBE)
9. M Zakiamani B M Nor (PGB)
10. Dr. M Nasir B Sulaiman (PCSB)

PREFACE

PETRONAS Technical Standards (PTS) publications reflect the views, at the time of publication, of PETRONAS OPU/Divisions.

They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use PTS they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, it is expected of them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the PTS. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the owner.

The right to use PTS rests with three categories of users:

- 1) PETRONAS and its affiliates.
- 2) Other parties who are authorised to use PTS subject to appropriate contractual arrangements.
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) and 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, PETRONAS disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any PTS, combination of PTS or any part thereof. The benefit of this disclaimer shall inure in all respects to PETRONAS and/or any company affiliated to PETRONAS that may issue PTS or require the use of PTS.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, PTS shall not, without the prior written consent of PETRONAS, be disclosed by users to any company or person whomsoever and the PTS shall be used exclusively for the purpose they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of PETRONAS.

The copyright of PTS vests in PETRONAS. Users shall arrange for PTS to be held in safe custody and PETRONAS may at any time require information satisfactory to PETRONAS in order to ascertain how users implement this requirement.

TABLE OF CONTENT

1. INTRODUCTION	7
1.1 Scope	7
1.2 Definitions	7
2. CONFINED SPACE HAZARDS	9
2.1 Oxygen Deficiency/Enrichment	9
2.2 Flammability, Fire and Explosion	9
2.3 Chemical Hazards	10
2.4 Physical Hazards	11
2.5 Biological Hazards.....	11
2.6 Other Hazards	11
3. MANAGEMENT CONTROLS.....	12
3.1 General.....	12
3.2 Written Policy/Procedures	12
3.3 Supervision.....	12
3.4 Roles and Responsibilities	12
3.4.1 Employer or Owner of Industry.....	12
3.4.2 Contractor.....	13
3.4.3 Permit Issuer	13
3.4.4 Entry Supervisor	13
3.4.5 Authorized Gas Tester (AGT)	14
3.4.6 Standby Person	14
3.4.7 Authorized Entrant	15
3.5 Rescue Team	15
4. PRE-ENTRY PREPARATIONS.....	16
4.1 Risk Assessment.....	16
4.2 Equipment Preparation	16
4.2.1 Isolation	16
4.2.2 Ignition Sources	17
4.2.3 Lock-out and Tag-out	17
4.2.4 Extreme Temperature	17
4.2.5 Radiation Exposure	17
4.3 Ventilation	17
4.4 Atmospheric Testing	18
4.5 Approve Entry under Defined Conditions	18
4.5.1 Approved Entry Under Gas Free/Respirable Condition – Without BA	18
4.5.2 Approved Entry Under Hazardous Condition – With BA.....	18
4.5.2 Entry into Temporary Confined Space	19
4.5.3 Entry into Inerted Spaces/ Non-acceptable Conditions for Entry	19

4.6 Issue Permit.....	19
4.6.1 Personal Protective Equipment (PPE).....	20
4.6.2 Standby Person.....	20
4.6.3 Fire Protection.....	20
4.6.4 Illumination/Electrical Equipment.....	20
4.6.5 Temporary Suspension of Work.....	20
4.6.6 Means of Access and Egress.....	20
4.6.7 Selection of Personnel.....	21
4.6.8 Control of Unauthorized Access.....	21
4.6.9 Means of Communication.....	21
4.7 Record Keeping Requirement.....	21
5. RESCUE PROCEDURE/PLAN.....	22
5.1 Emergency Response Planning and Rescue Procedures.....	22
5.2 Rescue Personnel.....	23
6. TRAINING.....	24
6.1 Authorized Entrant and Standby Person.....	24
6.2 Authorized Gas Tester (AGT) and Entry Supervisor.....	24
7. HEALTH REQUIREMENTS OF PERSONS WORKING IN CONFINED SPACE.....	25
8. CHECKLIST.....	26
REFERENCES.....	27
APPENDIX 1: EXAMPLE OF STANDARD SIGNAGE FOR MALAYSIAN OPERATIONS.....	28
APPENDIX 2: EXAMPLE OF PHYSICAL BARRIER.....	29
APPENDIX 3: SAMPLE OF CSE RESCUE PLAN.....	29

1. INTRODUCTION

Serious accidents have occurred and continue to occur to personnel entering or working in confined spaces.

This guide covers the precautions necessary for safely entering and working in confined spaces as they exist in the petroleum and chemical industry.

The Industry Code of Practice for Safe Working in a Confined Space 2010 published by DOSH was referred to during development of this standard. This standard should be used together with other related PTS such as Permit to Work System PTS, Energy Isolation Standard PTS, Ignition Source Control PTS and Working in Inert Space PTS.

1.1 Scope

This Standard is intended to guide those responsible for operations in confined spaces on the preparation of detailed procedures and safeguards for performing such work safely and thereby preventing accidents, injuries or illness.

More stringent requirements may have to be adopted due to local, state or national legislation or experience gained in specific areas of operation.

Note: Entry should only be considered when all specified safety precautions have been fully observed.

1.2 Definitions

Confined Space means a space which:

- a) is not intended as a regular workplace (i.e. continuous employee occupancy);
- b) has restricted means of entry or exit;
- c) is large enough and so configured that an employee can bodily enter and perform assigned work; and
- d) is at atmospheric pressure during occupancy.
- e) all excavation activities more than 1.5 meter depth

In addition, this space has at least one of these characteristics:

- a) it contains or has a potential to contain a hazardous atmosphere;
- b) it contains material (solid or fluid) that has potential for engulfing an entrant;
- c) it has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- d) it contains any other recognized serious safety or health hazards, for example exposed rotor blades, noise etc.

Examples of confined spaces are:

- a) Process vessels and related equipment (vessel tower skirts and flare stacks), boilers, water storage tanks, other tanks including pontoons on floating roof tanks, tank cars and trucks;
- b) Spaces located below ground or deck level, such as drain pits, sewage pits and associated tunnels, ducts, trenches, wells, shafts, cellars, vaults and unventilated rooms which may be considered confined spaces under specific circumstances;
- c) The cargo ballast or void spaces onboard ships;
- d) The support columns/legs/pontoons of fixed or mobile offshore installations.

Authorised Entrant means an employee who is authorised by the employer to enter a confined space and had attended a training course on working in confined space for authorised entrant and stand by person and passed the test or examination

Authorised Gas Tester (AGT) means a competent person to carry out atmosphere test registered with Director General of Department of Occupational Safety and Health or local requirement;

Entry Supervisor means the person appointed by the employer and had attended a training course on safe working in confined space for authorised gas tester and entry supervisor and passed the test or examination, be responsible for determining if acceptable entry conditions are present at a confined space where entry is planned;

- a) authorised entry to confined space
- b) oversee entry to confined space operations
- c) terminate entry to confined space

LEL (Lower Explosive Limit) means the minimum concentration of gas in air which shall be present before it is capable of being explosively ignited by an ignition source;

Standby Person means an individual who has attended a training course on working in confined space for authorize entrant and stand by person and passed the test or examination, stationed outside one or more confined spaces who monitors the authorised entrants and who performs all stand-by person's duties assigned in the employer's confined space programme;

Temporary Confined Space means atmosphere projected from an opening in a confined space that contains physical, biological or chemical agent at or above applicable exposure limit (i.e. when nitrogen is projected from an opening of purged vessel). Be aware that possible hazardous atmosphere can extend beyond a confined space, especially during purging process. This is considered oxygen deficient area.

TENORM (Technologically Enhanced Naturally Occurred Radioactive Materials)

This material consists of the calcium carbonate scale which may be found inside vessels. The primary danger of scale which emits Alpha particles is the breathing or ingestion of the dust. Suitable dust filters and keeping the scale wet with water will reduce the hazard to workers.

Entry refers not only to complete body entry, but also to partial entry when any part of body is inserted, e.g. into manhole openings, hatches, pipe ends, void space above floating roofs, etc. The same risk may exist in close proximity to equipment which has been opened up, in which case some of the precautions which apply to entry would also apply.

In this document the recommendations for a course of action are made with varying degree of emphasis. As a rule:

'may' indicates a possible course of action.

'should' indicates a preferred course of action.

'shall' indicates a course of action with a recommended mandatory status within the PETRONAS Group of Companies.

'must' is used as an alternative for 'shall'.

2. CONFINED SPACE HAZARDS

Before entering confined spaces, the following particular hazards need to be considered and safeguarded against:

- Oxygen deficiency/enrichment
- Flammability, fire and explosion
- Chemical hazards
- Physical hazards
- Biological hazards
- Other hazards

2.1 Oxygen Deficiency/Enrichment

Oxygen deficiency in the air results in asphyxiation.

Atmospheres containing less than 20% vol oxygen are considered to be oxygen-deficient.

Under no circumstances should oxygen be used to increase the level of an oxygen deficient atmosphere.

Common causes of reduced oxygen levels are slow oxidation of metals (rusting), combustion, welding, and the displacement of oxygen by other gases (inerting with nitrogen or CO₂) the use of inert welding and inadequate ventilation, absorption by grains, chemicals or soil; or physical activity.

Since the rate of combustion is closely dependent upon the concentration of oxygen present, an enriched oxygen atmosphere (greater than 20.9% vol) becomes a hazard.

There are three main causes which may result in oxygen enrichment:

- Leaks from oxygen containing equipment;
- Inadvertent use of oxygen instead of air or inert gas;
- Deliberate addition of oxygen.

The most common oxygen containing equipment is that used in cutting operations. Storage cylinders, gas hoses, and valves must be handled with care and should be visually inspected for damage daily.

Gas cylinders must not be taken into confined spaces except for fire extinguisher and Self Contain Breathing Apparatus (SCBA). Cutting and welding equipment shall be removed from confined spaces during breaks and at the end of the working day.

2.2 Flammability, Fire and Explosion

Fires and explosions can result from accumulations of flammable vapours and/or dust in the presence of a source of ignition.

Mixtures of flammable vapours and air can only be ignited if the hydrocarbon to air ratio is within the flammable range i.e. between the Lower Explosion Limit (LEL) and the Upper Explosion Limit (UEL). LEL and UEL are identical to the Lower and Upper Flammable Limits (LFL, UFL) used elsewhere.

In general, if the oxygen content in hydrocarbon air mixtures can be maintained below 8% by volume, a fire/explosion cannot occur.

However, certain chemical compounds contain chemically bonded oxygen (e.g. nitrates, peroxides, HC-oxides) thus the advice of specialists is essential, since these substances can release oxygen resulting in a combustible atmosphere.

Explosive/flammable mixtures may develop typically during the emptying of vessels or tanks and the opening of confined spaces, due to air entering and mixing with the residual gases.

A source of ignition can be any heat source having enough energy to ignite a flammable gas/air mixture or to raise the temperature above the auto-ignition temperature. In addition to naked flames, other possible sources of ignition include:

- Sparks or arcs produced by electrical equipment, lightning and electrostatic charges.
- Hot surfaces raising the temperature above the auto-ignition temperature (e.g. hot pipes, hot exhausts);
- Thermite reactions from aluminium or other alloy tools striking against rusted iron or steel;
- Heat of friction during drilling or other non-flame cutting operation;
- Pyrophoric materials (e.g. iron sulphide);
- Any other highly reactive material capable of producing sufficient heat for combustion (e.g. strong oxidising substances such as hydrogen peroxide used in waste treatment facilities, or chemicals undergoing self-accelerating exothermic reactions when a critical temperature is reached, such as ethylene oxide).

Note: No one shall enter the confined space if the gas detector reading is equal to or greater than 10% LEL (see Sections 4.5.1 and 4.5.2).

Hot work in confined space is not allowed if the gas detector reading exceeds 1% LEL.

2.3 Chemical Hazards

Chemical substances can be toxic. Toxic substances can cause injury, acute or long-latency illness, or death, depending on the concentration and duration of exposure and the characteristics of the substances.

A toxic substance can cause harm by inhalation, ingestion, skin or eye contact. It can affect the tissue at the point of contact, or organs remote from the point of contact.

Corrosives destroy the tissue and may leave permanent injury or scars.

Toxicity information (e.g. Material Safety Data Sheets) about specific substances should be sought from the employer, supplier of materials, and local, state, and federal governments, and be available on site. Advice is also available from PETRONAS.

The Permissible Exposure Limits (PEL) referred to USECHH Regulations 2000 (OSHA 1994) or those published annually by the American Conference of Governmental Industrial Hygienists (ACGIH) or any other local requirement. It is recommended that a level not greater than 50% of the relevant published occupational exposure limit is adopted, as an additional safety margin when based on regular spot sampling.

Typical toxic substances are CO, H₂S, hydrocarbon gases, lead/anti-knock compounds, mercury, benzene, polycyclic aromatics, hydrofluoric acid, sulphuric acid, ammonia, chlorine, hydrazine, biocides, and caustic substances such as lye (sodium hydroxide).

The hazard of contaminated personal protective equipment should not be neglected.

The confined space must be cleared of flammable materials, including any deposits which might release or regenerate flammable or other vapours hazardous to health. Particular care is necessary to ventilate dead 'legs' and pockets within the space and to remove any paint blisters which might contain hazardous and/or flammable materials beneath.

2.4 Physical Hazards

Physical hazards may exist in confined spaces and include:

- Structural failure, e.g. the internal floating cover or roof may not support a worker's weight;
- Falling tools and materials; e.g. refractory;
- Improper shoring, e.g. cave-ins may occur while personnel are working in trenches or excavated areas;
- Engulfment, i.e. surrounding of a person by liquid or finely divided solid substances that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing;
- Failure to positively isolate confined spaces, e.g. blank off or break pipe connections;
- Failure to isolate, disconnect or make inoperative electrical or mechanical equipment;
- Migration of gases from adjacent places e.g. waste tips;
- Restricted working space and obstructions;
- Slippery surfaces;
- Inadequate lighting;
- Inadequate or faulty personal protective equipment
- Noise levels in excess of published standards
- Extreme temperature
- Radioactive substances which are used for level gauges or might be present in certain crude oils or condensates.
- Trapped hazardous materials (liquid or solid) inside the confined space

2.5 Biological Hazards

Biological hazards may exist in confined spaces due to contamination, water, waste water, soiled, unattended piping etc.

These hazards may come in the form of:

- Biological infection from bacteria, virus, fungi, etc.
- Potential attack from animals/insects.
- Biological processes which consumed oxygen, produces toxic gasses (Sulphur reducing bacteria) and flammable gasses

2.6 Other Hazards

These include:

- Poor visibility; e.g. due to misty or dusty conditions;
- Psychosocial; e.g. claustrophobia (fear of closed space)
- Persons being trapped in the event of an accident or loss of consciousness;
- Live electrical contacts (circuits) with the risk of electrocution;
- Hydraulic pressures;
- Odours.

3. MANAGEMENT CONTROLS

3.1 General

Entry into a confined space shall only be contemplated as a last resort, after all other possible options have been ruled out. Tasks to be carried out in a confined space shall be subject to a Risk Assessment at the planning stage. If all other options for completing the work without confined space entry are ruled out, task-specific controls should be implemented to ensure:

- a) All sources of danger have been isolated or removed;
- b) A competent person tests the atmosphere (AGT) as per the required frequency.
- c) Levels of oxygen, flammable and toxic substances are kept within acceptable ranges, OR special control measures are applied;
- d) Only competent personnel are allowed entry, and will have safe access & egress;
- e) Personnel in the confined space can communicate at all times with those outside;
- f) A competent standby person (attendant) is on duty outside while work is in progress;
- g) Unauthorized entry is prevented;
- h) An effective plan is in place to rescue anyone who gets into difficulty.

3.2 Written Policy/Procedures

Management shall maintain a system of authority and responsibility by establishing written procedures covering work in confined spaces, in order to:

- Create an entry permit system;
- Familiarise personnel with the hazards that may be present in confined spaces;
- Train personnel to employ the appropriate safeguards for controlling those hazards;
- Train personnel in the use of test equipment for monitoring those hazards;
- Provide for qualified and authorised supervision (see Section 3.3) of work in confined spaces to ensure that work is conducted safely;
- Establish emergency plans with appropriate level of training including first aid;
- Verify that contractors follow the same precautions and procedures laid down for company employees.

It is management's responsibility to verify the requirements for entry into confined spaces are complied with and that the necessary skills are maintained by regular refresher training and training records are kept.

3.3 Supervision

Management must ensure that qualified and authorised personnel are available to control, approve and supervise work in confined spaces. By instruction, training and experience, such responsible persons must be familiar with:

- The tasks to be performed;
- The potential hazards that may be encountered in confined spaces;
- The safety and health requirements for work in confined spaces;
- The entry permit procedure and emergency plans.

3.4 Roles and Responsibilities

3.4.1 Employer or Owner of Industry

When an employer arranges to have his employees/a contractor to perform work that involves confined space entry, the employer shall fulfill his duties as stipulated under regulatory requirement. The employer shall:

- a. inform his employees and contractor that confined space entry is allowed only through compliance with the confined space entry programme stipulated under these Industry Code of Practice;
- b. inform his employees and contractor of the previously identified hazards and the employer's experience with the confined space;

- c. inform his employees and contractor of any precautions or procedures that the employer has implemented for the protection of employees in or near confined spaces where his employee or contractor's employee will be working;
- d. co-ordinate entry operation with the contractor, when both the employee and the contractor's employee will be working in or near confined spaces; and
- e. ensure that the contractor, permit issuer, entry supervisor, authorised gas tester, authorised entrants and stand-by person fulfill their duties specified under paragraph 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.6 and 3.4.7 respectively.

3.4.2 Contractor

Each contractor who is engaged to perform confined space entry operations shall:

- a. obtain all available information regarding confined space hazards and entry information from the owner of industry;
- b. cooperate with owner of industry when both the owner of industry's personnel and the contractor's personnel will be working in or near confined spaces;
- c. brief the owner of industry on their implementation of the confined space entry programme;
- d. inform the owner of industry of any hazards confronted or created during the entry operation in confined spaces, through a debriefing;
- e. if the contractor possesses the site, then they shall comply with the duties of the employer; and
- f. ensure that the permit issuer, entry supervisor, authorised gas tester, authorised entrants and stand-by person fulfill their duties specified under paragraph 3.4.3, 3.4.4, 3.4.5, 3.4.6 and 3.4.7 respectively.

3.4.3 Permit Issuer

Each permit issuer shall:

- a. update his knowledge on hazards that may be faced during entry, including information on the mode, signs and symptoms, and consequences of the exposure;
- b. identify all hazards and recommends control measures to ensure safe entry;
- c. ensure there is no other incompatible activity in the vicinity of the confined space;
- d. authorise the permit to work; and
- e. endorse the cancellation and closure of the permit to work.

3.4.4 Entry Supervisor

Each entry supervisor shall -

- a. Update his knowledge on hazards that may be faced during entry, including information on the mode, signs and symptoms, and consequences of the exposure;
- b. Supervise all the activities before, during and after entry operation;
- c. Verify by checking that the appropriate entries have been made on the permit to work, that all tests specified by the permit to work have been conducted and that all procedures and equipment specified by the permit to work are in place before the permit issuer authorise the permit to work and allow entry to begin;
- d. Terminate the entry and cancel the permit to work if the acceptable entry condition cannot be maintained;
- e. Close the permit to work at the completion of the entry;
- f. Verify that rescue services are available before any entry and that the means for summoning them are operable;
- g. Remove unauthorised individuals who enter or who attempt to enter the confined space during entry operations;

- h. Determine that entry operations remain consistent with terms of the permit to work and that acceptable entry conditions are maintained, wherever responsibility for a confined space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space;
- i. Brief the entry team on the hazards; permit to work requirement and emergency procedures;
- j. Conduct a debriefing session with the contractor or his employees at the conclusion of the entry operations regarding the confined space entry programme and any hazards confronted or created in confined spaces during entry operations;
- k. Ensure means to restrict unauthorised entry are made available;
- l. Be in charge of communication during emergency; and
- m. avoid a conflict of interest by not performing 2 roles - When an entry supervisor is required to be a permit issuer for a permit to work, he cannot be the entry supervisor for the work described in that permit to work.

3.4.5 Authorized Gas Tester (AGT)

The Authorized Gas Tester shall:

- a. Update his knowledge on the hazards that may be faced during entry, including information on the mode, signs and symptoms, and consequences of the exposure;
- b. Identify all hazards and recommends control measures to ensure safe entry;
- c. Be familiar with all confined space entry equipment used, for example gas detector, emergency breathing apparatus, man riding winch, tripod, etc; and
- d. Test and interpret the reading level of gaseous in the confined space.

3.4.6 Standby Person

Each standby person shall:

- a. have the knowledge of the hazards that may be faced during entry, including information on the mode, signs and symptoms, and consequences of the exposure;
- b. be aware of possible behavioural effects to authorised entrants due to exposure to hazard;
- c. continuously maintain an accurate count of authorised entrants in confined spaces and also ensure that the means used to identify authorised entrants accurately identifies who is in the confined space;
- d. make sure that the number of authorised entrant tally with the permit to work list;
- e. remain within his assigned work area outside the confined space during entry operations until relieved by another stand-by person;
- f. communicate with authorised entrants and/or fire watch if available regularly to monitor entrant status and to alert entrants of the need to evacuate their space;
- g. monitor activities outside and inside of every confined space to determine if it is safe for entrants to remain in the confined space and orders the authorised entrants to evacuate a confined space immediately under any of the following circumstances –
- h. if the stand-by person detects a prohibited condition;
 - i. if the stand-by person detects the behavioural effects to any authorised entrant due to exposure to hazard;
 - ii. if the stand-by person detects a situation outside the space that could endanger the authorised entrants;
 - iii. if the stand-by person cannot effectively and safely perform all the duties; or
 - iv. if any alarm is activated.
- i. summons rescue and other emergency services as soon as he determines that authorised entrants may need assistance to escape from confined space;