

REFERENCE MANUAL CONFINED SPACE Version 10.00





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INTRODUCTION

Confined spaces present a vast range of Occupational Health and Safety risks due to the significant hazards found in or around the environment.

A high proportion of workers are injured and killed each year in confined spaces, with an estimated 60% of the fatalities due to unsuccessful rescue attempts.

A confined space can be more hazardous than regular workspaces for many reasons. Many hazards are not visible and are undetectable to the human senses. Furthermore, hazards that may not be considered as a risk in general workplaces can become dangerous in a confined space environment (e.g. rust or decaying leaf matter).

Due to the specific nature and hazards associated with confined spaces, specific procedures and assessment processes must be completed to ensure the safety of workers.

To effectively control the risks associated with working in a confined space, a Confined Space Hazard Assessment and Control Program should be implemented. This includes effective training, assessment and briefing of any workers required to work in or around confined spaces. These workers may include management, supervisors, staff and visitors to the site.

CASE STUDIES

The following case studies are taken from real incidents that occurred around the world.

Fatality from Oxygen Deficiency in a Service Station L.P.G. Tank

An L.P.G. tank was purged with nitrogen several times and left to stand for an hour. A supervisor put his head in the opening of the tank and could not detect the smell of L.P.G. so permitted an Employee to enter the tank without safety equipment. The employee entered the tank and collapsed shortly afterwards. A second person entered the tank in a rescue attempt and also collapsed. The supervisor introduced pure oxygen into the tank instead of air (which was dangerous and added to the risk of explosion) and arranged for a rescue to occur. Although there were issues that delayed the rescue, both employees were rescued from the tank. The first employee to collapse died 9 months later from bronchopneumonia and brain damage as a result of the accident. The companies involved and the supervisor were subsequently prosecuted.

Brothers Die As A Result Of Carbon Monoxide Poisoning

Two brothers aged 24 and 26 died of carbon monoxide poisoning in an underground water tank on their father's farm. They had been using two petrol driven pumps over two days to pump the water out. On the second day, when the water level was lower, it became apparent that neither of the pumps were fitted with a hose long enough to reach the bottom of the tank. To overcome the problem, one pump was lowered about a metre into the tank and secured by ropes. One brother got into the tank when it was nearly empty. He collapsed and the other brother and a friend quickly climbed in and attempted to rescue him. The second brother collapsed. The friend attempted to rescue the two brothers, but he was also affected by fumes and had to get out of the tank. Neighbours pulled the two brothers from the tank, but both were dead on arrival at the local hospital.

Tests later revealed that the petrol driven pump was discharging a very high level of carbon monoxide from its exhaust. Calculations confirmed that a lethal concentration of carbon monoxide would be generated in quite a short period of time after lowering the pump into the tank.

Hazardous Atmosphere and Oxygen Deficiency Fatality in Sewer - 1991

A district water board employee was working to clear a blocked sewer. The equipment the employee was using to unblock the sewer became caught and the employee entered the sewer to free the equipment. The clearing of the blockage produced a gush of water and release of sewerage gases and the employee collapsed as he was about to climb out of the access hole. A boy on work experience with the employee attempted to pull him out but was unsuccessful. The employee fell back into the sewer and the boy went for help. The employee was unable to be resuscitated after being pulled from the sewer.

The Magistrates' Court subsequently found that the water board had breached the Occupational Health and Safety Act 1985 by failing to provide a safe system of work and fined the board.

Employees overcome by carbon monoxide poisoning

The incident occurred when two employees were overcome by smoke while in a silo that contained smoking wood chips. The silo had a side door opening onto a landing about 3 metres above the floor, and access was provided by a steel ladder. A fire erupted in the silo and was extinguished by employees from outside the silo. 30-45 minutes after the fire had been put out, 3 employees entered the silo to shovel out the burnt wood chips. As a result of exposure to the atmosphere in the silo one employee became dizzy, and had to be given oxygen and taken to hospital. Work then continued in the silo until yet another employee became dizzy and also had to be given oxygen and hospitalised.

The Magistrates' Court subsequently found that the two companies employing the men had breached the Occupational Health and Safety Act by failing to provide safe plant and systems of work and adequate information, instruction, training and supervision. The companies were fined.

Near Miss in Sewer - 1994

Two employees entered a shaft connected to a sewer. The men were working at the bottom of the 22 metre shaft when the gas detector they carried emitted an audible alarm indicating the presence of a gas. The employees donned their self rescue units and tried to contact the stand-by employees waiting at the top of the shaft. One of the self rescue units allegedly failed and the employee wearing the unit was affected and started to become disorientated, falling over several times. After alerting personnel at the entrance to the shaft, the two employees were raised to the surface and taken to hospital for examination.

Another Lucky Escape

Employees of a contract company lining a tank with rubber were overcome by fumes. Two of the employees were inside the tank applying glue to sheets of rubber, which were then attached to the walls of the tank. The walls of the tank also had glue applied to them. The two employees were overcome by fumes generated by the glue, one collapsing and the other becoming disorientated after he removed his face mask to help his co-worker. One of the employees had to be helped from the tank, while the other was dragged out. A similar incident had also occurred the previous week.

Engulfment incident

A large bin used by a poultry feed processing firm to load poultry feed into a weighing hopper became blocked. A worker wearing a safety harness entered the bin to clear the blockage. While clearing the blockage the worker fell, went through approximately 3 metres of feed, and dropped out into the weighing hopper below. A stand-by person opened the weighing hopper to empty it of feed, and the worker was subsequently winched back out of the bin. Investigators subsequently recommended that the firm look at different feed formulation methods to reduce the number of bin blockages; that alternative methods of clearing blockages be explored; and that appropriate risk control measures be introduced for any further entries into the bins.

Degreasing fatality

A partner in a metal finishing firm was found collapsed inside a degreasing tank containing trichloroethylene. The tank measured approximately 0.7m x 2m x 2m. The partner apparently had decided to empty and de-sludge the tank while working alone. He entered the tank without breathing apparatus

(none was available) and without leaving the tank to ventilate. The tank had not been emptied in six months. The partner subsequently died.

DEFINITIONS

Airborne Contaminate

Any contaminate that may be harmful to humans and is present in the air.

Atmospheric Monitoring

The continuous testing of air quality for contaminates, toxic gases and other hazards over a constant period of time.

Atmospheric Testing

The testing of air quality for contaminates, toxic gases and other hazards at a specific time. This is not continuous monitoring.

Competent Person

Any person who has the skills, knowledge, training and experience to competently perform a task in the correct manner.

Confined Space

See page 17

Contaminate

Any vapours, fumes or dust particles, chemical or biological, or any other substance in a solid or liquid state which may be harmful to humans.

Engulfment

The envelopment of a person or persons by a solid or liquid material that is stored within or introduced to the confined space; (e.g. grain, sand, earth, coal, fertiliser and other substances that are powdered or in granular forms).

Entry (Confined Space)

Entry to a confined space is considered to be when the breathing zone of the individual passes to the inside of the confined space. Sticking your head inside an entry point would be considered entering the confined space. Placing your arm into a confined space for the purpose of atmospheric monitoring is not considered to be entering the confined space.

Entry Permit

A written permit supplied by the employer stating the conditions of entry into a confined space.

Explosive Limits

The proportion of a vapour or gas mixed with air that will allow it to flash and burn. Note. The term flammable limit and explosive limit are equivalent. AS/NZS 60079.20 and AS/NZS 61779.1 use the term flammable limit whilst other standards use the term explosive limits.

Lower Explosive Limit

The lowest proportion of a substance that, when mixed with air, will support combustion.

Upper Explosive Limit

The highest proportion of a substance that, when mixed with air, will support combustion.

Exposure Standard

The exposure of an individual to an airborne concentration of a particular substance in that person's breathing zone. The exposure standard, according to current knowledge, should not cause any adverse health effects or discomfort to most people. The exposure standard can be expressed in three forms, TWA or Time Weighted Average, STEL or Short Term Exposure Limit and Peak Exposure Limit.

TWA or Time Weighted Average

TWA is the average concentration of an airborne substance when calculated over a normal eight hour working day over a five day working week.

STEL or Short Term Exposure Limits

The STEL is a 15 minute TWA exposure that should not be exceeded at any time during a working day, even if the eight hour TWA is within the TWA exposure standard.

Exposure at the STEL should not exceed 15 minutes and should not be repeated more than four times a day. There should be at least 60 minutes between successive exposures at the STEL.

Peak Exposure Limits

A maximum concentration of an airborne substance that is determined over the shortest analytically practical period of time, not exceeding 15 minutes.

Flammable Airborne Contaminate

Any airborne contaminate, dust fumes, gas or vapour that when exposed to an ignition source can produce a flame.

Flammable Range

The concentration of an airborne contaminate (percentage by volume) in the atmosphere that when introduced to an ignition source can ignite and explode. At concentrations below or above the Flammable Range the concentration is either too rich or too lean to explode.

Hot Work

Any work being conducted that will produce any heat, sparks or fire that may increase the risk of fire or an explosion. Hot work consists of, but is not limited to, welding, thermal cutting, grinding and heating.

Impairment

The inability to complete a set task due to a reduced mental or physical condition. The task may be complex or an everyday task such as walking.

Regulatory Authority

A minister of the Crown, Government Department, Commission or other authority having power to issue regulations, orders or other instructions having the force of law in respect of any subject covered by the confined space standards or guidelines.

Safe Oxygen Range

The concentration of oxygen in the atmosphere represented as a percentage that is between 19.5% and 23.5% at atmospheric pressure. At pressures above or below atmospheric pressure expert advice must be obtained.

Self Contained Air Breathing Apparatus (SCABA)

A portable respirator that is carried by the person that supplies safe breathable air to the wearer, independent of the external atmospheric condition that the wearer encounters. SCABA have a limited duration governed by the size and type of the air cylinder and the workload of the wearer.

Shall

Indicates that the statement is mandatory and must be complied with.

Should

Indicates that the statement is highly recommended but does not necessarily need to be complied with if other factors indicate that it is not necessary or that it is dealt with by other means.

Standby Person

A competent trained person that is assigned the position to remain outside the confined space in close proximity, capable of being in continuous communication with, and where practical within visual distance of, those entering and working within the space. The Standby Person may also operate and monitor equipment from outside the space for the safety of those inside. The Standby Person is also responsible for initiating the emergency response.

The Standby person is not to enter the confined space at any time unless they are relieved of their position as Standby Person by another competent person who will assume the role.

Supplied Air Respirator

Respirator that is not self contained and relies on a supply from an external source that is not at atmospheric pressure such as a compressed air cylinder.

Task-Related Hazard

Exposure to a hazard as part of the task that is being carried out within the confined space. An example would be welding gases accumulating within a confined space.

Vapour Pressure

The vapour pressure of a liquid is the equilibrium pressure of a vapour above its liquid (or solid); that is, the pressure of the vapour resulting from evaporation of a liquid (or solid) above a sample of the liquid (or solid) in a closed container. The equilibrium vapour pressure is an indication of a liquid's evaporation rate. It relates to the tendency of particles to escape from the liquid (or solid). A substance with a high vapour pressure at normal temperatures is often referred to as *volatile*.

Volatility / Volatile Substance

Volatility is the tendency of a substance to vaporise.

Written Authority

A document that permits entry into a confined space and the tasks or work associated with that entry. The written authority is sometimes referred to as a permit to enter, entry permit, access authority or permit to work.

THE WORK HEALTH AND SAFETY ACT 2011

The WH&S Act is the overriding legislation that governs health and safety at work. It provides the framework for workplace safety and imposes severe penalties for actions or omissions that have an impact on health and safety at work. The WH&S Act outlines requirements for a person or persons conducting a business or undertaking (Employers), Workers (Employees), Controllers of Work Premises, The Plant and Substances used as well The Designers, Manufacturers and Suppliers of the plant, equipment and substances used in the workplace.

PRIMARY DUTY OF CARE

Responsibilities of a Person Conducting a Business or Undertaking.

WH&S Act Division 2 Clause 19 states;

19 Primary duty of care

- (1) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, the health and safety of:
 - (a) workers engaged, or caused to be engaged by the person, and
 - (b) workers whose activities in carrying out work are influenced or directed by the person,
 - (c) while the workers are at work in the business or undertaking.
- (2) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.
- (3) Without limiting subsections (1) and (2), a person conducting a business or undertaking must ensure, so far as is reasonably practicable:
 - (a) the provision and maintenance of a work environment without risks to health and safety, and
 - (b) the provision and maintenance of safe plant and structures, and
 - (c) the provision and maintenance of safe systems of work, and
 - (d) the safe use, handling, and storage of plant, structures and substances, and
 - (e) the provision of adequate facilities for the welfare at work of workers in carrying out work for the business or undertaking, including ensuring access to those facilities, and
 - (f) the provision of any information, training, instruction or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking, and
 - (g) that the health of workers and the conditions at the workplace are monitored for the purpose of preventing illness or injury of workers arising from the conduct of the business or undertaking.

Note. A self-employed person is also a person conducting a business or undertaking for the purposes of this section.

(4) If:

- (a) a worker occupies accommodation that is owned by or under the management or control of the person conducting the business or undertaking, and
- (b) the occupancy is necessary for the purposes of the worker's engagement because other accommodation is not reasonably available,
- (c) the person conducting the business or undertaking must, so far as is reasonably practicable, maintain the premises so that the worker occupying the premises is not exposed to risks to health and safety.
- (5) A self-employed person must ensure, so far as is reasonably practicable, his or her own health and safety while at work.

Employees' Responsibilities

28 Duties of workers

While at work, a worker must:

- (a) take reasonable care for his or her own health and safety, and
- (b) take reasonable care that his or her acts or omissions do not adversely affect the health and safety of other persons, and
- (c) comply, so far as the worker is reasonably able, with any reasonable instruction that is given by the person conducting the business or undertaking to allow the person to comply with this Act, and
- (d) co-operate with any reasonable policy or procedure of the person conducting the business or undertaking relating to health or safety at the workplace that has been notified to workers.

Duties are not transferable

Clause 14 of the WH&S Act states that;

Clause 14 Duties not transferrable

A duty cannot be transferred to another person.

WH&S REGULATIONS 2011

The Work Health and Safety Act 2011 further provides mandated requirements under the Work Health and Safety Act 2011 outlining specific requirements to high risk work.

The WH&S Regulation lists further duties specific to Confined Spaces in Part 4.3.

AUSTRALIAN STANDARDS

Australian Standards set out the standards that should be adhered to when working within their written scope. The Australian Standards do not replace the WH&S Act or the Codes of Practice but rather further assist in compliance with the Act by outlining the standards required.

Australian Standard 2865 covers Confined Spaces is intended to help designers, manufacturers, suppliers, modifiers and users of confined spaces to achieve a safety outcome. It is not exhaustive in its coverage, but it is intended to cover those areas that are of particular concern in regard to confined space safety.

CODES OF PRACTICE

Codes of Practice are approved under Clause 274 of the Work Health and Safety Act 2011. The Codes of Practice are used as a guide to complying with the Work Health and Safety requirements to which the code applies. The Codes of Practice are admissible in court proceedings under the WH&S Act as evidence of what is known about a particular hazard.

RECORD KEEPING

All risk assessments are to be retained until **at least 28 days after** the work has been completed. A copy of the confined space entry permit must be **kept until the work to which it relates is completed.** Confined Space training records are to be retained for a **minimum period of 2 years**. There may be cases where the records are required to be kept for longer periods, for example where health surveillance is required. Where an incident has occurred, the risk assessment and any associated permits must be kept for a **period of at least 2 years** from the date of incident.

Results pertaining to atmospheric monitoring must be retained for a period of **not less than 30 years**. *WH&S Regulation 2011 Clause 50 / 77*

TRAINING

Training is mandatory under the WH&S Legislation and records of the training provided must be kept for a **minimum period of 2 years**. Refresher training should be conducted at appropriate intervals to maintain competency. A 12 month refresher training program is recommended however this will depend on a number of variables such as frequency of work; i.e. a person who works in confined spaces every day would not need refresher training as frequently as someone who only works in confined spaces twice a year.

Further information on training requirements can be found in the Work Health and Safety Regulation under *Clause 76.*

WHAT IS A CONFINED SPACE

The WH&S Regulations Clause 5 describes a confined space as follows;

Confined space means an enclosed or partially enclosed space that:

- (a) is not designed or intended primarily to be occupied by a person, and
- (b) is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space, and
- (c) is or is likely to be a risk to health and safety from:
 - I. an atmosphere that does not have a safe oxygen level, or
 - II. contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion, or
 - III. harmful concentrations of any airborne contaminants, or
 - IV. engulfment,

but does not include a mine shaft or the workings of a mine.

Enclosed or partially enclosed spaces that may meet the definition criteria for a confined space are-

- storage tanks, tank cars, process vessels, boilers, pressure vessels, silos and other tank like compartments;
- pipes, sewers, shafts, degreaser and sullage pits, ducts and similar structures;
- any shipboard spaces entered through a small hatchway or entry point, cargo tanks, cellular double bottom tanks, duct keels, ballast and oil tanks, and void spaces.

A confined space may or may not have restricted means of entry and exit. Appropriately sized entry and exit points are important for the safe entry and exit or retrieval of a person(s) in an emergency. However, a restricted means of entry or exit is not a consideration in identifying an enclosed or partially enclosed space as a confined space.

Most enclosed or partially enclosed spaces are intended or designed primarily for human occupancy, e.g. offices and workshops where adequate ventilation and lighting, safe means of access and egress, etc. are provided. From time to time they may have atmospheric hazards produced by task-related activities such as welding. Such task-related hazards are not covered by this Standard and other safety systems apply. Some enclosed or partially enclosed spaces have atmospheric contaminants that are harmful to persons but are designed for persons to occupy, e.g. abrasive blasting or spray painting booths. Enclosed or partially enclosed spaces that are intended or designed primarily for human occupation and have systems

such as gaseous fire extinguishing systems (see AS 4214) or inert gas systems for beverage dispensing (see AS 5034) installed, are not confined spaces. In such cases, other safety systems such as relevant legislation, Standards or Codes of Practice apply.

A rising level of a liquid in an enclosed or partially enclosed space may cause engulfment through the inability of a person to readily exit the space. Drowning in a reservoir, dam or tank where the level of liquid is static is not considered to be drowning from engulfment.



TYPES OF CONFINED SPACES

Typical confined spaces include but are not limited to:

- storage tanks
- tank cars
- process vessels
- boilers
- pressure vessels
- silos and other tank like compartments
- pipes, sewers, shafts

- degreaser and sullage pits
- ducts and similar structures
- cargo tanks
- void spaces
- cellular double bottom tanks
- ducts, keels, ballast and oil tanks
- any shipboard spaces entered through a small hatchway or entry point

To determine whether a space is a confined space consider if:

- □ the space is enclosed or partially enclosed.
- □ the space is not designed or intended primarily to be occupied by a person.
- □ the space is at normal atmospheric pressure whilst any person is in the space.

6	5
2	4

- the space is likely to have an atmosphere that does not have a safe oxygen level.
 there is possible contaminates that may cause injury from fire or explosion.
- there may be harmful concentrations of airborne contaminates.
- □ there is a danger of engulfment within the space.

If all of the statements in section 1 are true and any one of the statements in section 2 are true for the space you are considering then the space would be considered a confined space under the WH&S Regulations and will need to be managed as such. Special procedures will need to be adopted for any persons working within or near the space; suitable training in line with current standards and industry practices will need to be adopted.

Why do people enter Confined Spaces?

People enter confined spaces for a wide variety of reasons. Due to the nature of confined spaces and the relative dangers associated, physical entry is only made when other options to achieve the task are not suitable and entry is the only way to get the task done.

Some examples why people enter confined spaces are listed below:

- For the purposes of cleaning and removing waste.
- To carry out inspections of plant or equipment.
- To install equipment.
- Painting and sand blasting.
- Taking reading off gauges.
- As part of the construction process.
- Installing or repairing cables.
- Testing or coating piping systems.
- Rescuing people from within a confined space.

Entry to confined spaces should only be made after all hazards are thoroughly assessed and the appropriate permits have been issued.



HAZARDS OF CONFINED SPACES

Inundated with potential hazards, including not only physical hazards but also atmospheric hazards and psychological hazards, confined spaces are one of the most common causes of death in the workplace. Around 60% of all deaths related to confined spaces occur during an attempted rescue of person in danger.

These hazards include restricted means of entry and exit, inadequate ventilation, contaminated or irrespirable atmospheres, engulfment, uncontrolled introduction of substances into the space as well as biological hazards, flammable or explosive atmospheres, moving parts, plant or equipment, poor lighting, noise hazards, radiation and environmental hazards. Hazards are not only confined to the space, they are also present around the space and can also be generated by the activity being conducted.

Where the confined space requires a vertical entry there is a risk that tools, objects or people could fall into the space and cause injury to themselves or occupants of the space. Take for example a worker who enters a confined space to carry out a simple task. The worker checks the atmosphere upon entry and finds that the levels are all clear. After 30 minutes working in the space the worker becomes unconscious and collapses. When the rescue team retrieve the worker they discover the oxygen levels extremely low in the confined space and have to wear BA as part of the rescue procedure. Whilst the atmosphere was clear on entry something as innocent and simple as breathing within the space reduced the oxygen levels to a dangerous level causing the worker to lose consciousness and require rescue.

Prior to commencing work assessments, checks and tests must be performed, however these checks also need to be carried out regularly during the activity and whenever the circumstances may change.

The table below identifies potential hazards that may be present in a confined space.

Electrical	Entry / Exits	Explosion
Power cables	Openings	Flammable Gas
Electrical Equipment	Entry Size / Location	Fuels
Lighting	Exit Size / Location	Potential Ignition sources
Power Adaptors	Opportunity for Rescue	Excessive Fuel Load
Conductive Surfaces	Blocked Exit	Smoke
	Structural Collapse	
Chemical	Engulfment	Thermal (Temperature)
Chemical Reactions	Flooding	Radiation
Acidic Environment	Moving Equipment	Convection
Alkaline Environment	Moving Machinery	Conduction
	Falling Objects	Extreme Cold
Biological	Barriers	Extreme Heat
Effluent	Signage	Heat from Equipment
Bacteria	Heights or Depths	
Stagnant Water		Other
Industrial Waste	Manual Handling / OHS	Effects of work or task
Industrial Waste Sludge / Mud	Manual Handling / OHS Slippery surfaces	Effects of work or task
Industrial Waste Sludge / Mud Mould	Manual Handling / OHS Slippery surfaces Trip hazards	Effects of work or task Effects on Adjacent areas Other Work Being Done
Industrial Waste Sludge / Mud Mould	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions
Industrial Waste Sludge / Mud Mould Atmospheric Hazards	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched Poor Ventilation	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue Noise	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched Poor Ventilation Flammable Atmosphere	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue Noise PPE	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched Poor Ventilation Flammable Atmosphere Toxic Gas / Vapour	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue Noise PPE Safety Equipment	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures
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Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched Poor Ventilation Flammable Atmosphere Toxic Gas / Vapour Dust Fumes from Equipment	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue Noise PPE Safety Equipment Moving parts or machinery Other occupants	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched Poor Ventilation Flammable Atmosphere Toxic Gas / Vapour Dust Fumes from Equipment Steam	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue Noise PPE Safety Equipment Moving parts or machinery Other occupants Falling objects	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures
Industrial Waste Sludge / Mud Mould Atmospheric Hazards Oxygen Deficiency Oxygen Enriched Poor Ventilation Flammable Atmosphere Toxic Gas / Vapour Dust Fumes from Equipment Steam Poor ventilation	Manual Handling / OHS Slippery surfaces Trip hazards Heavy Objects Large Objects Stress Positions Fatigue Noise PPE Safety Equipment Moving parts or machinery Other occupants Falling objects Noise	Effects of work or task Effects on Adjacent areas Other Work Being Done Weather Conditions Radioactive Hazard Communication Psychological Pressures

SIGNAGE AND SECURITY

At all times a confined space must be managed. The space should be secured against unauthorised entry and signposted as part of the requirements under Clause 66 of the WH&S Regulations. When entry and exit of a confined space is required appropriate signage and barricades should be used to assist in restricting entry to or within the vicinity of the space as stated in Regulations.





Clause 68 of the WH&S

WH&S Regulation 2011 – Clause 66 - Managing risks to health and safety

(1) A person conducting a business or undertaking must manage, in accordance with Part 3.1, risks to health and safety associated with a confined space at a workplace including risks associated with entering, working in, on or in the vicinity of the confined space (including a risk of a person inadvertently entering the confined space).

WH&S Regulation 2011 - Clause 68 Signage

- (1) A person conducting a business or undertaking must ensure that signs that comply with subclause (2) are erected:
 - a) immediately before work in a confined space commences and while the work is being carried out. and
 - b) while work is being carried out in preparation for, and in the completion of, work in a confined space.

Maximum penalty:

- (a) in the case of an individual \$3,600, or
- (b) in the case of a body corporate \$18,000.
- (2) The signs must:
 - a) identify the confined space, and
 - b) inform workers that they must not enter the space unless they have a confined space entry permit, and
 - c) be clear and prominently located next to each entry to the space.



THE RISK MANAGEMENT PROCESS



WHAT IS A HAZARD?

A hazard is a situation or thing that has the potential to harm a person. A hazard may include noise, moving plant or machinery, chemicals, electricity, working at heights, repetitive jobs, bullying and violence in the workplace.

WHAT IS A RISK?

A Risk is the possibility that harm might occur when exposed to a hazard.

IDENTIFYING HAZARDS

Hazards in the workplace can be identified by the following means;

- Workplace inspections.
- Consultation with workers (Required under Clause 47 of the WH&S Act).
- Reviewing available information.

RISK ASSESSMENTS

Prior to carrying out any activity a risk assessment should be conducted on the activity, the surrounding area and the individual tasks that are to be carried out. This also involves looking at the equipment you are going to use and any hazards that could result from its use.

A risk assessment must be conducted by a competent person or persons, must be completed in writing and distributed to all persons working or supervising on the site.

A risk assessment is required by WH&S legislation before conducting work. When conducting work within a confined space it is further called for in Clause 66 of the WH&S Regulations. A risk assessment for a confined space activity must take into account the following:

- The nature of the confined space.
- The need to enter the confined space.
- The task that is to be conducted.
- If the hazard is associated with the concentration of oxygen or airborne contaminates in the confined space any change that may occur in that concentration.
- The range of methods that the task can be conducted.
- Emergency response procedures.
- The competence and qualifications of persons conducting tasks.

The Risk Assessment

The Risk assessment outlines each step in the task and then looks at possible hazards and subsequent risks associated with conducting activities. The risk assessment must be viewed by all persons involved in the activity.

The risk assessment will be maintained onsite and a copy will be held by the supervisor. The risk assessment will need to be kept on file for a period of 28 days after the work has been completed. This may be longer where health monitoring is concerned.

Overleaf is a sample of a risk assessment for a task to be conducted within a confined space.

Risk Assessment Sheet

Confined Space

Job Number / Scope of works:

Location:

BA Completed by:	Date / Time	Number of pages
The completed by.	Date / Time	Number of pages.
Supervisor / Principal Contractor Signature:	Employee / Sub-contracto	r Signature:

Work Activity (Break down the job into steps)	Hazard (What could harm someone?)	Risk (Rating from L M	Rating n Risk Matrix) H E	Risk Control (What must be done to control the risk?)	Completion (Date/Time and sign-off)

Hazards Identification Che	ecklist				
(Ask yourself: are there, or is ther	e any possi	bility of or is	there any possible issue with)		
Physical / Structural			Chemical		
Entry Size / Location	Yes 🗆	No 🗆	Chemical Reactions	Yes 🗆	No 🗆
Exit Size / Location	Yes 🗆	No 🗆	Acidic Environment	Yes 🗆	No 🗆
Rescue	Yes 🗆	No 🗆	Alkaline Environment	Yes 🗆	No 🗆
Blocked Exit	Yes 🗆	No 🗆			
Structural Collapse	Yes 🗆	No 🗆	Biological		
Engulfment	Yes 🗆	No 🗆	Effluent	Yes 🗆	No 🗆
Flooding	Yes 🗆	No 🗆	Bacteria	Yes 🗆	No 🗆
Moving Equipment	Yes 🗆	No 🗆	Stagnant Water	Yes 🗆	No 🗆
Moving Machinery	Yes 🗆	No 🗆	Industrial Waste	Yes 🗆	No 🗆
Falling Objects	Yes 🗆	No 🗆	Sludge / Mud	Yes 🗆	No 🗆
Barriers	Yes 🗆	No 🗆	Mould	Yes 🗆	No 🗆
Signage	Yes 🗆	No 🗆			
			Atmospheric Hazards		
Manual Handling / OHS			Oxygen Deficiency	Yes 🗆	No 🗆
Slippery surfaces	Yes 🗆	No 🗆	Oxygen Enriched	Yes 🗆	No 🗆
Trip hazards	Yes 🗆	No 🗆	Dust	Yes 🗆	No 🗆
Heavy Objects	Yes 🗆	No 🗆	Flammable Atmosphere	Yes 🗆	No 🗆
Large Objects	Yes 🗆	No 🗆	Toxic Gas	Yes 🗆	No 🗆
Stress Positions	Yes 🗆	No 🗆	Vapour	Yes 🗆	No 🗆
Fatigue	Yes 🗆	No 🗆	Dust	Yes 🗆	
Noise	Yes 🛛	No 🗆	Fumes from Equipment	Yes⊔	No L
PPE	Yes 🛛	No 🗆	Steam	Yes⊔	
Safety Equipment	Yes 🛛	No 🛛	Bacteria	Yes 🛛	
Flashing			Ventilation	Yes 🗆	
			DDE Deguined		
Fower cables			PPE Required	Vaa 🗖	
Lighting					
Lighting Dower Adoptore			FI P2 F3 SCABA SAF		
Conductive Surfaces	165 []		Hand Protection		
Conductive Surfaces			Foot Protection		
Fire			Protective Clothing		
Explosion			Helmets		
Elammable Gas	Yes 🗆		Hearing Protection	Yes D	
Fuels	Yes 🗆		Harness	Yes D	
Potential Ignition sources	Yes 🗆		Rescue Line	Yes 🗆	
Excessive Fuel Load	Yes 🗆		Safety Barriers	Yes 🗆	
Smoke	Yes 🗆		First Aid Kit	Yes 🗆	
Thermal (Temperature)			Other		
Radiation	Yes 🗆	No 🗆	Effects on Adjacent areas	Yes 🗆	No 🗆
Convection	Yes 🗆	No 🗆	Other Work Being Done	Yes 🗆	No 🗆
Conduction	Yes 🗆	No 🗆	Weather Conditions	Yes 🗆	No 🗆
Extreme Cold	Yes 🗆	No 🗆	Radioactive Hazard	Yes 🗆	No 🗆
Extreme Heat	Yes 🗆	No 🗆			
Heat from Equipment	Yes 🗆	No 🗆			

THE RISK ASSESSMENT MATRIX

Once a risk has been identified it must be quantified. By quantified we mean assessed as to the likelihood and the consequence of it occurring. To quantify a risk we look to the Risk Assessment Matrix shown below.

	Li	kelihood				Consequence	
Α	Almost Certain	The event is expected	to occur	1	Insignificant	No injuries	
в	Likely	Will probably occur in circumstances	most	2	Minor	First aid require	d
с	Moderate	The event should occ time	ur at some	3	Moderate	Medical treatme	nt
D	Unlikely	The event could occu	r at some time	4	Major	Significant injury loss	with extended time
E	Rare	May occur only in exc circumstances	eptional	5	Catastrophic	Death or perma	nent disability
	AB	M	Н		н	E H	E
	Likelihood	1	2		3	4	5
	B	M	M		н	H	E
		L	M		н	н	Н
	D	L	L		М	M	н
	E	L	L		М	М	н
			Lege	nd			•
L	Low Risk	Manage thro	ugh procedure	s and p	rocesses.		
М	Moderate Risk	Attention req	uired. Person	must be	specified to	o manage risk.	
н	High Risk	Senior mana	gement must b	pe notifie	ed, conside	r stopping work	until resolved
		Stop all work	. Remove wor	kers froi	m area and	notify manager	nent. No work

Using the Risk Assessment Table

To demonstrate the use of the Risk Assessment Matrix let us firstly look at a particular task, such as cleaning the gutters on the roof of a house. One of the obvious hazards is working at height. The risk associated with working at height is falling from heights. To quantify this risk we consult our Risk Assessment Matrix.

The likelihood of falling from the roof whilst cleaning the gutters might initially seem low, but when you consider the variables such as slipping on loose tiles or slippery surfaces, losing balance and many other variables, the risk of falling from the roof is very real. After careful consideration of these factors we determine that the likelihood of a fall occurring is C Moderate. The event should occur at some time. We then look across the matrix to determine the consequence if the incident was to occur. Falling from heights is extremely dangerous and can result in death or permanent disability. This being the case the consequence would have a rating of 5.

We then quantify the risk by taking the likelihood C and moving to the right across the table until it meets the column corresponding to consequence 5. Where these two meet will be the resultant risk rating for the risk of falling from the roof.

Risk:	Falling from heights
Likelihood:	C Moderate. Should occur at some time
Consequence:	5 Death or permanent disability
Resultant Risk Rating	${\bf H}$ High Consider stopping work until control measure is applied.

This information is then entered into the risk assessment and a control measure must be applied to manage the risk. Suitable control measures could be using scaffolding or work platforms or wearing a harness as PPE for the task.

RISK CONTROL - HIERARCHY OF CONTROL

Work Health and Safety Legislation mandates a Hierarchy of Control indicating the order or preference as to which control method is to be implemented to control risks in the workplace by 3 levels. The aim of risk control is to completely eliminate the hazard where possible. If you are unable to eliminate the hazard you will continue down the Hierarchy of Control until you find a suitable and practical way of controlling the risk.

The Hierarchy of Control is listed below.

Level 1	1.	Elimination	Eliminate the risk by removing the hazard
	2.	Substitution	Substitute the risk by substituting the hazard
Level 2	3.	Isolation	Isolate the risk by restricting access or accessibility
	4.	Engineering	Design and fabricate equipment to remove the hazard
Lovel 3	5.	Administration	Adopt safe work practices or procedures and conduct training
Levers	6.	PPE	Wear and use Personal Protective Equipment (PPE)

Eliminate the Risk

- Where possible remove the risk from the workplace.
 - E.g. a petrol pump is producing toxic fumes in the workplace. You would eliminate the risk by removing the need for a pump and subsequently removing the pump.

Substitute the Risk

Substitute the risk with a less hazardous alternative.
 E.g. As with the example above if you could not eliminate the need for a pump you could substitute the petrol driven pump for an electric pump that does not produce toxic fumes.

Isolate the Risk

- Separate the hazard from the work area.
 - E.g. As with the example of the pump, if you needed to run a petrol pump because other types of pumps were not suitable you could move the pump to an alternate area where workers were not affected by the toxic fumes.

Engineering Controls

Modify machinery or another similar means to eliminate or guard against the hazard.
 E.g. If the pump could not be moved to a more suitable location then perhaps an exhaust system could be designed to remove the toxic fumes produced by the pump.

Administration Controls

- Introduce safe work practices to minimise the risk.
 - E.g. If it was not possible to design and make an exhaust system for the pump you could introduce a policy that workers were to remove themselves from the area whilst the pump was running and were not to re-enter the area until the pump was turned off and the atmosphere managed by ventilation and gas testing.

Personal Protective Equipment (PPE)

Wear appropriately approved PPE to minimise the risk associated with the hazard.
E.g. If workers had to remain in the area where the toxic fumes were being produced by the pump then they could use Personal Protective Equipment such as a supplied air respirator to protect themselves from the toxic fumes. If this were the case, then strict policies and procedures would also need to be implemented to protect the workers. Personal Protective Equipment is the last resort in controlling a risk associated with a hazard and must only be implemented when other control measures are not suitable. PPE can be used in conjunction with other methods to increase protection for the workers.

PPE must comply with WH&S Regulation 44-47

REVIEWING THE RISK ASSESSMENT

After completing the initial risk assessment and implementing the appropriate controls, the risk assessment should be reviewed or revised to include any associated or new risk that may have been introduced by the control measure.

During the activity the risk assessment shall be reviewed or revised whenever the task changes, equipment is introduced or the environment alters.

The risk assessment shall also be reviewed or revised if there is a change in crews conducting the task, a break in the continuity of the task or any other incident that occurs or is identified prior to occurring.

Factors that may alter the risks within a confined space:

- Changes in ventilation.
- Introduction of equipment or personnel to a confined space.
- Leads or hoses running introduced into a confined space.
- Installed equipment, pipe work or plant.
- Near misses or incidents that occur during the activity.
- The addition of persons into the confined space.
- The change of crews conducting the task.
- Changes in weather or time of day.
- Equipment operating outside the confined space.
- Changes in the atmosphere.
- Extension of the duration of the task.

Whenever there are changes to the task or within the operating environment, including within and surrounding the confined space, the risk assessment shall be reviewed to ensure that where possible all risks are effectively controlled. If a risk cannot be controlled then work must cease until effective control measures can be implemented.

DANGEROUS GOODS CLASSIFICATIONS AND MARKINGS

For ease of identification of dangerous goods, the international community has created a classification system. All dangerous goods are included in one of nine primary classes. In some cases it has also been necessary to sub-divide some of the classes into divisions in order to adequately provide for the dangers of the individual goods.

There is a label for each class/division to categorise the nature of the hazard. These labels must be affixed to the outside of the package when it is offered for transport and must remain on the package while it is in transit. Some examples of these are illustrated below. Further details surrounding a chemical can be obtained from the UN Number. The UN Number is a four-digit number used to identify chemicals. The UN Number is often the way that emergency services will identify a chemical by consulting a resource manual indexed by the UN Number.

	Class 1 Explosives - explosive substances, explosive articles, pyrotechnic devices. Includes ammunition, fireworks, detonators, etc
À	Class 2 Gases - transported as either compressed, liquefied, refrigerated liquefied or gas in solution. Includes aerosols. This class has three divisions:
	 Division 2.1 - flammable gases i.e. butane, propane Division 2.2 - non-flammable, non-toxic gases i.e. oxygen, liquid nitrogen, compressed air Division 2.3 - toxic gases i.e. chlorine, coal gas.
	Class 3 Flammable liquids - includes liquids with a boiling point of 35 degrees C or less o a flash point of 60 degrees C or less. Examples are Petrol, Alcohol, etc
	Class 4 Flammable solids - substances liable to spontaneous combustion and substances which, in contact with water, emit flammable gases. Class 4 has 3 divisions:
Alla,	 Division 4.1 - flammable solids such as hexamine solid fuel tablets for camping stoves; self-reactive substances and desensitized explosives. Division 4.2 - substances liable to spontaneous combustion under the normal conditions encountered in air transport - such as Phosphorus which burns by itself when exposed to air. Class 4.3 - substances which in contact with water emit flammable gases. i.e. "Dangerous when wet". Examples are sodium, zinc particles etc.
<u> </u>	Class 5.1 Oxidising substances - substances which in themselves are not necessarily combustible, but which by yielding oxygen may cause or contribute to the combustion of other material. Example is generators which produce oxygen by chemical reaction.
U	Class 5.2 Organic peroxides - these are thermally unstable substance which may undergo heat generating, self accelerating decomposition - which may be explosive, rapid, sensitive to impact or friction or react dangerously with other substances. Example is Hydrogen Peroxide
2	Class 6.1 Toxic substances - those substances which are liable to cause death or injury i swallowed, inhaled or absorbed through the skin. Examples are pesticides and poisons
~	Class 6.2 Infectious substances - those known to contain , or reasonably expected to contain, pathogens.
RADIOACTIVE	Class 7 Radioactive material
COMPOSIVE	Class 8 Corrosives - substances which, in the event of leakage, can cause severe damage by chemical action when in contact with living tissue or materially damage other freight, containers or the aircraft. Examples are Mercury, Battery acids. etc
<u>س</u>	Class 9 Miscellaneous - includes magnetic articles, which can have an impact on the aircraft's compass, Internal combustion engines, dry ice (solid carbon dioxide) etc.

WHAT IS AN SDS?

An SDS or Safety Data Sheet is a document containing important information about a hazardous chemical (which may be a hazardous substance and/or dangerous goods) and must state:

- a hazardous substances product name;
- the chemical and generic name of certain ingredients;
- the chemical and physical properties of the hazardous substance;
- health hazard information;
- precautions for safe use and handling;
- the manufacturer's or importer's name, Australian address and telephone number.

The SDS provides employers, self-employed persons, workers and other health and safety representatives with the necessary information to safely manage the risk from hazardous substance exposure.

It is important that everyone in the workplace knows how to read and interpret an SDS.

ACCESS TO SDS

Access to an SDS can be provided in several ways including:

- paper and microfiche copy collections of SDS with microfiche readers open to use by all workers;
- computerised and internet SDS databases.

The register of SDS should be used as an information tool to make sure everyone is involved in managing hazardous substances exposure at the workplace.

The SDS should be reviewed whenever there is:

- a change in formulation which:
 - (a) affects the hazardous properties of the substance;
 - (b) alters the form, appearance or mode of application of the substance;
- a change to the hazardous substance which alters its health and/or safety hazard or risk;
- new health and/or safety information on the hazardous substance such as exposure standard changes or a substance previously considered not harmful is now established to be harmful (e.g. carcinogenic);
- at least every five years.

In respect of SDS and labels, employers and self-employed persons must:

- Obtain an SDS of a hazardous substance from the supplier.
- Keep a register containing a list of all hazardous substances used at the workplace and put a copy of any SDS obtained in the register.
- Take reasonable steps to ensure the SDS is not changed other than by the manufacturer or importer.
- Keep the SDS close to where the substance is being used.
- Ensure a label is fixed to a hazardous substance container.
- Ensure warnings are given about enclosed systems containing hazardous substances.

Example of an Excerpt of an SDS for Shell E10 Unleaded

	Effective Date 08.04.20	-	Effective Date 09 04
Material Safety Data Shee	Elifetine Date oc.or.co	Material Safety D	Data Sheet
1. IDENTIFICATION OF THE SUI	BSTANCE/PREPARATION AND COMPANY/UNDERTAKING	_	prolonged exposure; see Chapter 11 for details. Target organ(s): Blood-forming organs. Peripheral nervous system. May cause heritable genetic damage. Possible risk of harm tr
Material Name Recommended Uses	 Shell Unleaded E10 Fuel for spark ignition engines designed to run on unleaded fuel. 	Signs and Syr	the unborn child. A component or components of this materia may cause cancer. This product contains benzene which may cause leukaemia (AML acute myelogenous leukaemia). Skin irritation signs and symptoms may include a burning
Other names Product Code	: GASOLINE : 002D1811		sensation, redness, swelling, and/or blisters. If material enter- lungs, signs and symptoms may include coughing, choking,
Manufacturer/Supplier	The Shell Company of Australia Limited		wheezing, amicuity in breatning, chest congestion, shortness breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure. Breathing of hig
	8 Rodfern Road Hawthorn East Victoria 3123		vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache, nausea and loss of coordination. Continued inhalation may centif unconcellurgess and death. Damage
Telephone Fax	+61 (0)3 9666 5444 +61 (0)3 8823 4800		to blood-forming organs may be evidenced by: a) fatigue and anaemia (RBC), b) decreased resistance to infection, and/or excessive bruising and bleeding (platelet effect). Peripheral
Emergency Telephone Number	: 1800 651 818 (within Australia only) +61 3 9663 2130 (International)		nerve damage may be evidenced by impairment of motor function (incoordination, unsteady walk, or muscle weakness the extremities, and/or loss of sensation in the arms and legs
2. HAZARDS IDENTIFICATION		-	Eye irritation signs and symptoms may include a burning sensation and a temporary redness of the eye. Auditory syste effect may include temporary beging loss and/or include in
HAZARDOUS SUBSTANCE. Classified as hazardous acco to the Australian Dangerous C	DANGEROUS GOODS. rding to the criteria of NOHSC, and as Dangerous Goods according soods Code.	Safety Hazards	the ears. Extremely flammable. Electrostatic charges may be generate during handling. Electrostatic discharge may cause fire. Liqui
Symbol(s)	: F+ Extremely flammable. T Toxic.	Environmental H	evaporates quickly and can ignite leading to a flash fire, or an explosion in a confined space.
R-phrase(s)	N Dangerous for the environment. R45 May cause cancer.	Environmental H	azards : Toxic to aquatic organisms. May cause long-term adverse effects in the environment. Unlike other gasoline components ethanol is miscible with water
	R46 May cause heritable genetic damage. R63 Possible risk of harm to the unborn child.	Additional Inform SUSDP Schedule	 This product is intended for use in closed systems only. Not scheduled. When packed in containers having capacity of
	R65 Harmful: may cause lung damage if swallowed. R12 Extremely flammable.	SUSDP Schedule	greater than 20 litres. S5. When packed in containers having capacity of less than
	R38 Irritating to skin. R51/53 Toxic to aquatic organisms, may cause long-term	3. COMPOSITION/JW	
S-phrase(s)	adverse effects in the aquatic environment. : S2 Keep out of the reach of children.	Preparation desc	runna i on incarebien i s
	S29 Do not empty into drains. S45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S53 Avoid exposure. Obtain special instructions before use. S61 Avoid release to the environment. Refer to secial		cycloparaffins, aromatic and olefinic hydrocarbons (including benzene at 1.0%v/v maximum), with carbon numbers predominantly in the C4 to C12 range. Contains oxygenated hydrocarbons, including ethanol or other alcohols. May also
	instructions/Safety data sheets. S62 If swallowed, do not induce vomiting: seek medical advice	Hazardous Comp	comain several additives at <0.1% viv each.
Health Hazards	Immediately and show this container or label. Vapours may cause drowsiness and dizziness. Slightly irritating to respiratory system. Irritating to skin. Moderately irritating to eyes, Harmful: may cause lung damage if means and backhild on the care or exemption domage for		
Print Date 08.04.2010	1/12	Print Date 08.04.2010	2/12
Print Date 08.04.2010	1/12 Shell Unleaded D	Print Date 08.04.2010	2/12 Shell United
Print Date 08.04.2010	1/12 Shell Unleaded E Version Effective Date 00.04.20 t	Print Date 08.04.2010	2/12 Shell United Vers Effective Date 08.0 Data Sheet
Print Date 08.04.2010 Material Safety Data Shee Chemical Identity CAS	1/12 Shell Univeded E Version Effective Date 08.04.20 It EINECS Symbol(a) R-phraso(a) Conc.	Print Date 08.04.2010	2/12 Shell United Vers Effective Date 0.6 0 Data Sheet ground and distant ignition is possible. Will float and can be
Print Date 08.04.2010 Material Safety Data Shee <u>Chemical Identity</u> CAS Gasoline, low 85290-81 boling point	1/12 Shell Unleaded Weston Unleaded Strength It EINECS Symbol(a) R-phrase(a) Conc. 5 299-20-8 F+, XL T, R12, R36; 30:00 - 100:00 % XL T, R12, R36; 30:00 - 100:00 %	Print Date 08.04.2010	2/12 Shell United Vers Data Sheet ground and distant ignition is possible. Will float and can be reignited on surface water shing : Foam, water spray or fog. Dry chemical powder, carbon
Print Date 08.04.2010 Material Safety Data Shee Chemical Identity CAS Gasoine, row 06290-81 boling point naphha Ethanol 64-17.5	1/12 Shell Unleaded E Warson Effective Date 06.04.20 M EINECS Symbol(s) R-phrase(s) Conc. 5 269-20-0 F+, XL T, R12, R48, N, R45, R46, R63, R46, 200,578-6 F, R67, F15.150, 000, 10.00 %	Print Date 08.04.2010 Print Date 08.04.2010 Material Safety I Suitable Extingui Media Ubsuitable Extingui	2/12 Shell Unleads Vers Effective Date 08.0 Tata Sheet reignited on surface water. shing : Foar, water spay or fog. Dry chemical powder, carbon doxide, sand or earth may be used for small fires only. guishing : Do not use water in a jut.
Print Date 08.04.2010 Material Safety Data Shee Chemical Identity CAS Gasoline, Jow 06290-81 boling point naphba Ethanol 64-17-6 Additional Information	1/12 Shell Unleaded E Version Elective David Claudo Elective David Claudo I Contains Tolueres, CAS # 100-41-4, Contains (Claudo F1300-200-7, Contains Naphtheleres, CAS # 9130-200-7, Contains Naphtheleres, CAS	Print Date 08.04.2010 Print Date 08.04.2010 Material Safety D Suitable Extingui Media Undeia Undeia Prototive Equip Fielghiers Additional Advio	2/12 Shell Unlead: Ves Data Sheet pound and distant ignition is possible. Will float and can be regipted on surface water. pound and distant ignition is possible. Will float and can be regipted on surface water. pound and distant ignition is possible. Will float and can be regipted on surface water. pound and distant ignition is possible. Will float and can be regipted on surface water. pound and distant ignition is possible. Will float and can be regipted on surface water. pound and distant ignition is possible. Will float and can be regipted on surface water. pound and distant ignition is possible. Will float and can be regipted on surface output of the only operating apparatus must be worn when approaching a fire in a confined space. Pound and distant in a jut. Pound and distant in a jut. Pound and distant in a jut. Pound and dista
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ISOLATION - LOCKOUT AND TAG OUT

When considering the hierarchy of hazard control (see page 23), Isolation is the 3rd preferred method for controlling a risk. Isolation is the term used to describe the safety measures used to prevent:

- The operation or activation of machinery, plant and equipment.
- The introduction of contaminates through piping, vents, drains or fire protection equipment.
- The introduction of extreme heat or cold.
- The activation of plant or machinery that is external to the confined space but still may affect the space.
- The energising of electrical equipment or machinery within or affecting the space.
- The operation of protective services such as fire sprinklers or fire suppression discharge systems.

Prior to entering the confined space all supply and services must be isolated to prevent the unintentional operation of equipment or plant, the introduction of a substance or atmospheric contaminate or the energising in any way of equipment or services.

WH&S Regulation states:

70 Specific control—connected plant and services

- (1) A person conducting a business or undertaking must, so far as is reasonably practicable, eliminate any risk associated with work in a confined space in either of the following circumstances:
 - (a) the introduction of any substance or condition into the space from or by any plant or services connected to the space,
 - (b) the activation or energising in any way of any plant or services connected to the space.

Maximum penalty:

- (a) in the case of an individual-\$3,600, or
- (b) in the case of a body corporate -\$18,000.
- (2) If it is not reasonably practicable for the person to eliminate risk under subclause (1), the person must minimise that risk so far as is reasonably practicable.

Maximum penalty:

- (a) in the case of an individual \$3,600, or
- (b) in the case of a body corporate -\$18,000.

There must be in place a system of isolation that will ensure the safety of personnel entering the confined space. Where appropriate, the isolation of the equipment, plant or services may be carried out by a competent person who will record the details of the isolation in writing on the permit, including the time of isolation, details of the person who isolated equipment, plant or service and any other relevant information. Isolation is achieved by a number of techniques consisting of, but not limited to, locking, tagging and blanking. Isolation methods should be supervised or verified by persons having immediate control of the confined space upon entry. The details of the isolation should be recorded on the entry permit and signed off by the person responsible for the isolation. The isolation must remain in place until all persons are removed from the space and the entry permit has been withdrawn.

It is important that all persons have an understanding of the systems of isolation being used onsite and their importance. This should be supported by work procedures that ensure isolation measures are not removed until all activity ceases and the permit associated with the isolation is withdrawn.

To further ensure isolation is not removed prematurely, the tagging method should be used along with, where possible, a suitable lockout system. By including a tag that identifies the reason for the lockout and the details of the person responsible for the isolation, workers can quickly identify and confirm the requirements of the equipment, plant or supply that has been locked out.

METHODS OF ISOLATION

The method of isolation should be selected from the list below or be an alternative method ensuring the same level of safety as the methods listed below.

Supply Piping

Supply piping can be isolated by one of the following methods or another method that provides the equivalent level of isolation.

Removal of a valve, a spool piece or an expansion joint

The valve, spool piece or expansion joint in piping leading to the confined space should be removed as close as possible to the confined space. Removal of the piece should, where possible, be followed by the blanking of the open end leading to the confined space. Consideration should be given to the possibility of pressure build up in the blanked off pipe.

Blanking or capping

Where pipe work is isolated using the blanking or capping method, the cap should be identified as to its purpose using a suitable tag. The blank or cap should be constructed of a material suitable to withstand the contents and the possible pressures from within the pipe. In addition to blanking or capping, the nearest valve should be isolated by closing and locking or tagging. Consideration should be given to the possibility of pressure build up in the blanked off pipe.

Insertion of a suitable full pressure spade

Where the insertion of a full pressure spade in piping between the flanges closest to the space is used, the spade must be of a type suitable for the material and pressure contents of the pipe. The spade should be identified to indicate its purpose. Consideration should be given to the possibility of pressure build up in the blanked off pipe.

Closing and locking off or tagging valves or both

When the above methods are not suitable, isolation may be achieved by closing and locking or tagging at least two valves in the pipe leading to the confined space. Where possible, to add to the safety of persons within the confined space, a drain valve between the two isolated valves should be opened to drain the contents of the pipe and locked in this position and/or tagged open to atmosphere.

Machinery or Plant

Machinery or plant should be locked out and de-energised or where possible both. Machinery and plant, including equipment, where required may be isolated by one of the following methods, or a similar method that provides the equivalent level of safety as the following:

Opening a circuit breaker and locking or tagging

Electrical circuits supplying power to the machinery or plant may be isolated by the opening of a circuit breaker or the removal of a fuse, or by removing a circuit breaker or isolating a switch. Where circuits or switches are opened, tagging or locking (or both) should be used. Where the circuit breakers are removed they should be placed in a safe place where unintentional activation cannot occur. A tag should be used to identify the reason for isolation. Once a circuit has been isolated it should always be tested to ensure that the isolation is successful.

Removal of a mechanical linkage

Where effective de-energisation is not possible, the machinery or plant may be isolated by the removal of drive belts or other mechanical linkages such as gearing mechanisms. The equipment should be tagged as to the state of the equipment and the reason for its isolation.

Chocking, blocking, chaining

When other moving equipment or parts are within the space such as agitators, blades or mixers, consideration must also be given to the free movement of these parts. These parts must be secured to prevent this free movement, using chocking, wedging, chaining or the removal of these moving parts. Stored energy within rams and other equipment must be reduced to zero to guard against the release of stored energy.

STORAGE OF KEYS DURING LOCKOUT

Where locking is used as a means of isolation, the keys should be kept on the person working within the confined space. Spare keys should not be accessible except in the event of an emergency.

THE LOCK TAG TRY METHOD

Once you have isolated, locked and tagged out a potential hazard, if possible carefully attempt to operate the valve / switch or similar to ensure that you have locked out the hazard successfully. Always consider the resultant implications of inadvertently opening or closing the valve or operating the switch and ensure that no harm or incident could be caused by its operation if it is not successfully isolated.



REMOVAL OF ISOLATION SYSTEMS

Great care needs to be taken to ensure that the isolation systems are kept in place whilst the confined space in occupied. This is enforced by proper procedures, the adherence to the permits and the appropriate paperwork being filled out by all persons involved. Only once the work within the confined space has been completed, all personnel have signed out of the space and the space has been secured, can the isolation systems be removed. Removal prior to confirming that the confined space is unoccupied and all permits have been withdrawn would constitute a severe break in procedures and as such create an extremely dangerous situation.

VENTILATION

When a space is occupied with an atmospheric contaminate above the safe entry levels the space will need to be ventilated prior to entry and perhaps during occupation. There are two main categories of ventilation, Natural Ventilation and Mechanical Ventilation.

WH&S Regulation states:

- 71 Specific control—atmosphere
- (1) A person conducting a business or undertaking must ensure, in relation to work in a confined space, that:
 - (a) purging or ventilation of any contaminant in the atmosphere of the space is carried out, so far as is reasonably practicable, and
 - (b) pure oxygen or gas mixtures with oxygen in a concentration exceeding 21% by volume are not used for purging or ventilation of any airborne contaminant in the space.

Maximum penalty:

- (a) in the case of an individual—\$6,000, or
- (b) in the case of a body corporate -\$30,000
- (2) The person must ensure that, while work is being carried out in a confined space:
 - (a) the atmosphere of the space has a safe oxygen level, or
 - (b if it is not reasonably practicable to comply with paragraph (a) and the atmosphere in the space has an oxygen level less than 19.5% by volume—any worker carrying out work in the space is provided with air supplied respiratory equipment.

Maximum penalty:

- (a) in the case of an individual—\$6,000, or
- (b) in the case of a body corporate -\$30,000.
- (3) In this clause, **purging** means the method used to displace any contaminant from a confined space.

the air inlet or ducting is placed as far as possible from the exhaust point. This will greatly reduce dead air within the space and increase the rate that the space is ventilated.

NATURAL VENTILATION

Natural ventilation occurs when the enclosed space is opened to the external atmosphere so that the atmosphere within the confined space may be driven out and replaced with clear air by external forces that may originate from either external air currents or air pressure (wind effects) or a temperature difference between the interior of the space and the ambient temperature outside the space (stack effect). Natural

ventilation is usually not reliable and not sufficient to maintain the air quality. An example of natural ventilation would be to open two doors on a vessel and allow the atmosphere to blow through the vessel removing the stored atmosphere and replacing it with fresh air.

MECHANICAL VENTILATION

Mechanical ventilation is a system of ventilation where air is forced through ducting, under pressure, into a confined space or used as an exhaust style system to drive out the contaminated atmosphere, replacing it with fresh breathable air. In most confined spaces, mechanical ventilation is more effective and faster than trying to rely on natural means. Mechanical ventilation requires a mechanical source to force the air into or out of the space such as fresh air blowers or extractors.

When conducting mechanical ventilation:

- Make sure that any mechanical or other type of equipment is suitable, especially equipment being used in flammable areas. Mechanical ventilation systems used in flammable atmospheres should be intrinsically safe.
- Make sure the ventilation system is powerful enough to be effective on the space.
- Operate the ventilation system before anyone enters the confined space and test the atmosphere to make sure it is safe.
- Ventilation systems may need to be operating continuously while workers are inside the confined space.
- This will be indicated by the risk assessment.
- Any exhaust from machinery should be vented straight out of the confined space.
- Ensure that the ventilation system is positioned so that it does not force any atmospheric contaminates into the space from tools or machinery working outside the space.

FORCED EXTRACTION

Forced Extraction is the reverse operation to Forced Ventilation where the contaminated air is extracted under mechanical force. This type of ventilation is more useful for the extraction of fumes from equipment. It can be used in conjunction with forced ventilation to improve the speed and effectiveness of the ventilation process.

SHORT CIRCUITING

Short Circuiting occurs when fresh air being delivered into a space follows a relatively short pathway back out of the space, leaving a significant portion of the space being unventilated. This usually occurs because the air inlet is too close to the exhaust location, such as when the two openings are close together or when the ducting is only placed a small distance inside the space as seen in the diagram below. To prevent short circuiting, always ensure that



Wind Direction

Natural Ventilation



Forced Extraction

COMBINATION METHOD

To increase the effectiveness of the ventilation process, both forced and extraction methods can be combined to improve the effectiveness and the time it takes to ventilate a confined space.

PURGING

WH&S Regulation states:



Purging agents, or any gas used for ventilation purposes must never be pure oxygen or any gas mixture with an oxygen content greater than 21%.

Purging is the method by which contaminants are displaced from a confined space. The confined space may be purged, for example with an inert gas such as nitrogen, to clear flammable gases or vapours before work in the confined space. After purging with inert gases the confined space should be adequately ventilated, and then re-tested. The purging of a space should be undertaken in a manner that precludes rupture or collapse of the enclosure due to pressure differentials, and the methods employed should ensure that any contaminants removed from the confined space are exhausted to a location where they present no hazard.



Purging Tank

ATMOSPHERIC MONITORING

INTRODUCTION

WH&S Regulation states:

50 Monitoring airborne contaminant levels

- (1) A person conducting a business or undertaking at a workplace must ensure that air monitoring is carried out to determine the airborne concentration of a substance or mixture at the workplace to which an exposure standard applies if:
 - (a) the person is not certain on reasonable grounds whether or not the airborne concentration of the substance or mixture at the workplace exceeds the relevant exposure standard, or
 - (b) monitoring is necessary to determine whether there is a risk to health.

Maximum penalty:

- (a) in the case of an individual—\$6,000, or
- (b) in the case of a body corporate -\$30,000.
- (2) A person conducting a business or undertaking at a workplace must ensure that the results of air monitoring carried out under subclause (1) are recorded, and kept for 30 years after the date the record is made.

Maximum penalty:

- (a) in the case of an individual—\$1,250, or
- (b) in the case of a body corporate \$6,000.
- (3) A person conducting a business or undertaking at a workplace must ensure that the results of air monitoring carried out under subclause (1) are readily accessible to persons at the workplace who may be exposed to the substance or mixture.

Maximum penalty:

- (a) in the case of an individual—\$3,600, or
- (b) in the case of a body corporate -\$18,000.

When considering atmospheric contaminates, the regulation refers to the Exposure Standards for Atmospheric Contaminates in the Occupational Environment. This standard outlines the more common respiratory hazards and the associated exposure standard.

Note: Atmospheric hazards may not always be visible, nor will all hazards have an odour. This being the case it is important to conduct a risk assessment to determine the possibility of any atmospheric contaminates and then, once a hazard is identified, test the atmosphere with the appropriate equipment to determine the concentration and type that is present. Only once the hazard has been correctly identified and quantified can the correct procedure to follow be determined.

ATMOSPHERIC COMPOSITION

The atmosphere or air that surrounds us consists of two major gases. Nitrogen is the most abundant gas at 78%. Nitrogen is a harmless gas and is not used by the body during the breathing process. Oxygen makes up 20.9% of our atmosphere. Oxygen is the gas required by all living things and dispersed throughout the body via the respiratory system and the cardiovascular system. The rest of the atmosphere consists of a small amount of Carbon Dioxide, about 0.04% and the rest is a mixture of trace gases and water vapour.



RESPIRATION

It seems a simple thing for us to breathe. We do not even think about it as we do it. But it involves quite a complicated process. When a person breathes in, air passes into the body through a series of tubes called "the upper respiratory tract". This starts with the nose. Here, particles which could be harmful to the lungs are stopped or strained out to prevent them from entering the lungs. The process of the air travelling through the nasal passages also warms the air. From the nose the air turns down through the "pharynx", or throat. From here, the air goes through two smaller tubes called "bronchi", one of which enters each lung. The lung tissue is like a fine sponge in some ways, but in the lung, there are spaces or air sacs called alveoli, and it is here that air is received from the bronchi, the oxygen is used, and unwanted gases are forced out.

The air we take in contains oxygen, nitrogen, carbon dioxide, and water vapour with small traces of other gases. Most of these same gases are present in the blood but in different amounts. When a fresh breath is drawn in, there is more oxygen in the alveoli than in the blood. So the oxygen passes through the very thin walls of the blood alveoli capillaries and into the blood. Carbon dioxide goes from the blood into the alveoli of the lung and is exhaled.

While there is much more to the process of breathing, this is the most vital part of it—the exchange of gases that enables all the cells to obtain oxygen and to get rid of carbon dioxide.

The oxygen is carried through the body by a molecule stored in the blood called Haemoglobin. Haemoglobin can transport up to 4 oxygen molecules to almost anywhere in the body. Unfortunately Haemoglobin can also carry other gases or toxins that are potentially harmful to the body. These toxins can then cause a range of adverse health effects from minor irritations to severe reactions including unconsciousness and death. Not all gases are detectable by the human senses. Toxic gases are often not noticed by workers when they come into contact with them and subsequently, being unaware, they continue to breathe the toxic atmosphere until it is too late.

ATMOSPHERIC HAZARDS

When the atmosphere or air composition varies from the graph on the previous page the air is said to be contaminated. Atmospheric hazards include the following:

- Oxygen deficient atmospheres.
- Oxygen enriched atmospheres.
- Toxic atmospheres.
- Explosive atmospheres.

OXYGEN DEFICIENT ATMOSPHERES

An oxygen-deficient atmosphere is any atmosphere containing oxygen at a concentration below 19.5%. The minimum requirement of 19.5% oxygen at sea level provides an adequate amount of oxygen for most work assignments and includes a safety factor. The safety factor is needed because oxygen-deficient atmospheres offer little warning of the danger, and the continuous measurement of an oxygen-deficient atmosphere is difficult.

At oxygen concentrations below 16%, decreased mental effectiveness, visual acuity, and reduced muscular coordination occur. At oxygen concentrations below 10%, loss of consciousness may occur, and below 6% oxygen, death will result. Often only mild subjective changes are noted by individuals exposed to low concentrations of oxygen and collapse can occur without warning.

EFFECTS OF OXYGEN AT DIFFERENT CONCENTRATIONS

pO₂ mmHg	O ₂ %	Effect
> 178.6	> 23.5	Oxygen enriched atmosphere
178.6	23.5	Maximum level for confined space entry
159.6	21.0	Normal level of oxygen in the air
148.2	19.5	Minimum level of oxygen for confined space entry
91.2 – 121.6	12 – 16	Judgment affected and fatigue
< 76	< 10	Difficulty breathing, unconsciousness and death within minutes

OXYGEN ENRICHED ATMOSPHERES

Air contains 21% oxygen, but if the amount of oxygen is increased, there is an increased risk of fire. Therefore, personnel must not be exposed to atmospheres that contain oxygen concentrations more than approximately 2% higher than air. Clothing, and even body hair and oils, are subject to flash fires if ignited in an oxygen-rich atmosphere. Therefore, matches and lighters must never be carried on the person where there is a risk of oxygen enrichment. Compared with a fire in air, a fire in an enriched oxygen atmosphere is:

- more intense;
- with higher temperatures; and
- has a greater heat output rate.

TOXIC ATMOSPHERES

Toxic atmospheres are atmospheres that are contaminated with substances that are considered poisonous or directly harmful to persons.

Toxic atmospheres include atmospheres contaminated with a number of contaminates, some of which are listed below.

Carbon monoxide - This gas is usually produced by the exhaust of an engine or heater. It is colourless, odourless, tasteless, and deadly. If the air you breathe contains carbon monoxide, the gas interferes with your body's ability to utilise the oxygen that is in your lungs. In other words, you can still breathe, but it does not do you any good. Unconsciousness, and often death, comes very quickly. Keep any fuel burning devices out of, and away from, confined and enclosed spaces.

Hydrogen sulphide - This is the colourless gas with a rotten egg smell. You may think that the smell alone would give you plenty of warning that the gas is present. Beware--it doesn't! After a whiff or two, in higher concentrations, the gas can desensitise your sense of smell, depending on the concentration, so you no longer detect the warning odour. Hydrogen sulphide is released during the decay of organic matter found in mud, sewage, etc., and is often prevalent during oil & gas drilling. It is heavier than air, so stay high if you suspect a problem and are trying to escape. Keep an eye out for blackened brass or copper pipes and

fittings. Such indications could indicate that hydrogen sulphide gas is now present, or may have been in the past.

Carbon dioxide - Decaying animal or vegetable matter can create this gas, the gas may have been used to inert a space, or it may have leaked from a fire suppression system. The gas is odourless, colourless, and displaces the oxygen within the space, which can be fatal.

Ammonia - This gas has good warning properties because it is extremely irritating to the eyes, nose and moist skin. When exposure is gradual, most people are driven from the area before injury can occur. However, if the exposure is extensive or prolonged, severe irritation to the respiratory tract can result in respiratory arrest and death. If the odour of ammonia is strong, it is a sign that a leak exists, and must be attended to before the space is entered.

Welding gases - Acetylene, oxygen, argon and helium are all gases used in welding that might find their way into a confined space and threaten your life. These all have different properties and dangers but they most often enter a confined space due to a simple error, such as leaving an unused welding hose in the space. Never leave a welding gas hose in a confined space - even if it's turned off. It is too easy for someone to turn a wrong valve by mistake and release a gas that becomes a killer.

SHORT TERM EXPOSURE LIMITS (STEL)

A Short Term Exposure Limit (STEL) is the concentration to which workers can be exposed continuously for a short period of time without suffering from:

- irritation
- chronic or irreversible tissue damage
- narcosis of sufficient degree to increase the likelihood of accidental injury, impair or reduce work efficiency.

STEL's are generally used only when toxic effects have been reported from high acute (short-term) exposures in either humans or animals. An STEL is not a separate independent exposure limit, but supplements time-weighted average limits where there are recognized acute effects from a substance whose toxic effects generally chronic (long-term) in nature.

For example, one cannot be exposed to an STEL concentration if the TWA for an 8 hour shift would be exceeded. Workers can be exposed to a maximum of four STEL periods per 8 hour shift, with at least 60 minutes between exposure periods. The STEL can be found on the Safe Work Australia Hazardous Chemical Information System (HCIS) available at *http://hcis.safeworkaustralia.gov.au/* or alternatively can usually be found on the SDS sheet supplied with the substance where a hazard exists.

TIME WEIGHTED AVERAGE (TWA)

The Time Weighted Average (TWA) expresses the airborne concentration of a material to which nearly all persons can be exposed day after day without adverse effects. The TWA is normally based on a normal 8-hour work-day or 40-hour work week. Where the worker is required to work longer shifts the formula below is used to calculate the TWA that would be applicable due to the extended daily exposure.

If a normal working day is more than 8 hours use the following formula

8 x (24 – h) x X Where h is hours worked and X is the 8 hour TWA

16 x *h*

An example for a 12 hour shift for CO $8 \times (24 - 12) \times 30ppm = 2880 = 15ppm$ 16 x 12 192

The worker can only be exposed to a TWA concentration once per day and requires an 8 hour break prior to any further exposures. The TWA can be found on the Safe Work Australia Hazardous Chemical

Information System (HCIS) available at *http://hcis.safeworkaustralia.gov.au/* or alternatively can usually be found on the SDS sheet supplied with the substance where a hazard exists.

EXPLOSIVE ATMOSPHERES

Explosive atmospheres can be caused by flammable gases, mists or vapours or by combustible dusts. Mixed with air at the right proportion it is highly volatile and requires only exposure to an ignition source to burn and subsequently explode.

Explosions can cause loss of life and serious injuries as well as significant damage. Preventing releases of dangerous substances, which can create explosive atmospheres, and preventing sources of ignition are two widely used ways of reducing the risk.



VOLATILE ORGANIC COMPOUNDS

VOC (volatile organic compounds) are chemical compounds that have high enough vapour pressures under normal conditions to significantly vaporise and enter the air. VOCs that escape into the air contribute to air pollution outdoors and inside structures. Emissions and odour are sometimes used instead of VOC but are often used to mean the same thing.

There are a wide range of carbon-based molecules (hence 'organic') that are considered VOCs such as aldehydes, ketones, and hydrocarbons. Not all organic compounds are volatile as many plastics (polymers) and other large molecules may not have significant vapour pressure at room temperatures.

The US Environmental Protection Agency has found concentrations of VOCs in indoors air to be 2 to 5 times greater than in outdoor air. During certain activities indoor levels of VOCs may reach 1,000 times that of the outside air. Studies carried out in Australia by the CSIRO have found similar results. Due to the environment within confined spaces the VOC levels can be much higher. Special VOC monitors are required where high levels of VOC are encountered.

THE BREATHING ZONE

The Breathing zone is defined as a 300 mm semi circle in front of the persons face extending back to a vertical line passing through the centre of the ears. A worker is classed as entering a confined space once their breathing zone has passed through the entrance to the space.



WORK PERMITS

"Permit to work" systems operate to describe the circumstances through which work can be safely undertaken. In many instances they are part of a broader system called the safety management system. This system provides the mechanism through which safety management, processes, reporting and permits are brought together. Permits to work operate in a hierarchy with the clear intention of categorising work and activities into groups that are based on the degree of risk attached to the work being done. For example, the degree of supervision and control is hierarchically represented through:

- (1) cold work or start work permits;
- (2) hot work or flame permits; and
- (3) confined space permits.

The levels of approval that must be sought directly relate to the degree of risk to which people are exposed. Confined space permits, for example, are a last resort since the entry of people to those spaces is never encouraged if an alternative method of achieving the job outcome can be provided.

Permit to work procedures ensure that:

- those who should be doing the work know the risks and necessary precautions;
- those who should be responsible for the work areas know about all work done in their areas;
- records are kept of the safe work procedures and precautions actually performed on each job;
- non-routine work is properly authorised, coordinated, controlled and monitored;
- areas affected by the work are clean and safe;
- all relevant isolations and inhibitors of safety systems are authorised and in place before the work is started.

WH&S Regulation states:

67 Confined space entry permit

(1) A person conducting a business or undertaking at a workplace must not direct a worker to enter a confined space to carry out work unless the person has issued a confined space entry permit for the work.

Maximum penalty:

- (a) in the case of an individual—\$6,000, or
- (b) in the case of a body corporate -\$30,000.
- (2) A confined space entry permit must:
 - (a) be completed by a competent person, and
 - (b) be in writing, and
 - (c) specify the following:
 - (i) the confined space to which the permit relates,
 - (ii) the names of persons permitted to enter the space,
 - (iii) the period of time during which the work in the space will be carried out,
 - (iv) measures to control risk associated with the proposed work in the space, and
 - (d) contain space for an acknowledgement that work in the confined space has been completed and that all persons have left the confined space.
- (3) The control measures specified in a confined space permit must:
 - (a) be based on a risk assessment conducted under clause 66, and
 - (b) include:
 - (i) control measures to be implemented for safe entry, and
 - (ii) details of the system of work provided under clause 69
- (4) The person conducting a business or undertaking must ensure that, when the work for which the entry permit was issued is completed:
 - (a) all workers leave the confined space, and
 - (b) the acknowledgement referred to in subclause (2) (d) is completed by the competent person.
 - Maximum penalty:
 - (a) in the case of an individual—\$6,000, or
 - (b) in the case of a body corporate -\$30,000.

ROLES AND RESPONSIBILITIES – WORK PERMITS

All workers should have an understanding of the following roles:

Permit issuer responsibility

The permit issuer:

- ensures that the workplace is safe for work to be carried out;
- ensures that all isolations are in place as per the lock out/tag out procedure;
- issues the work permit;
- demonstrates to the receiver all the elements of the procedure;
- checks status of work when receiving the permit back;
- notifies other sections if the job has any impact or safety considerations in relation to their operation.

Permit holder/receiver responsibility

The permit holder/receiver:

- verifies that a safe environment has been prepared for carrying out the work detailed on the permit;
- accepts the start work permit from the issuer;
- ensures that the work is performed in accordance with the conditions specified on the permit;
- ensures all electrical isolations are in place and has personally locked and tagged as per the lock out/tag out procedures;
- displays the permit in an approved plastic holder adjacent to where the work is being performed or has the permit readily available;
- hands back the permit to the issuer on completion of the job;

- ensures the workplace is maintained and left in a clean and safe condition;
- stops work and reports any changes in the original permit conditions to the issuer if likely to impact adversely on the work being carried out.

Worker's responsibility if not the receiver

The worker if not the receiver:

- verifies that a safe environment has been prepared for carrying out the work detailed on the permit;
- double checks that they are working on the correct equipment;
- ensures that the work is performed in accordance with the conditions specified on the permit;
- ensures all electrical isolations are in place and has personally locked and tagged as per the lock out/tag out procedures;
- ensures the workplace is maintained and left in a clean and safe condition;
- stops work and reports any changes in the original permit conditions to the issuer if likely to impact adversely on the work being carried out.

CHANGE OF PERMIT HOLDER

If permit holders pass their work to others, such as might be the case of persons taking a break or at a shift change, with the work continuing, such as with a priority repair or maintenance operation, the replacement personnel must understand the work and safety precautions before beginning to work and the current permit holder leaves the job. After reading and understanding the permit, replacement personnel must sign the original copy or follow whatever practice is laid down in the operating procedures for that organisation.

PREPARING THE WORK PERMIT

The preparation of a permit will take into account a number of critical factors of which the following questions should form the basis of decision making by those responsible for generating the permit:

- What type of work needs to be undertaken?
- What is the priority on the work?
- Will the proposed work take safety critical equipment out of service?
- Can the work be moved to a safe location?
- Will it interfere with other work in progress?
- Will it affect the online equipment?
- How should the work be isolated, mechanically and electrically?
- What type of process background is the work being conducted against?
- Will the persons undertaking the work be in contact with toxic material?
- How should the equipment or kit be prepared prior to work commencing?
- What tools/equipment will be required for the job?
- What personal protective equipment is required?

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Should consideration be given to the necessity to issue a hot work permit it is imperative that additional information is gathered and the types of questions to be asked should also include:

- Can the work be done without hot work?
- How can the equipment/site be isolated, purged and prepared?
- What type of materials does the equipment or site contain?
- What type of hot work is to be done?
- Is it a safe location for hot work?
- How will sparks be contained?
- How will the area be made safe?
- What will be the weather conditions?
- Who else will be working in the area?
- Are there any other risks associated, for example, setting off ultraviolet (UV) detectors and smoke detectors?

• What fire or emergency equipment is required to be on standby?

These questions must be answered in order to provide a clear demonstration that each factor is considered before the permit is generated so that the appropriate permit can be issued. They also form part of the 'evidence trail' through which the organisation records the factors supporting its permit decisions. This is a critical matter, as in the event of an incident any investigation will begin by looking at the issues surrounding the issuing of the permit. In many permit systems most questions are answered on the permit.

WORK COMPLETION

After finishing the job on the work covered by the work permit, permit holders should ensure that the worksite is clean and safe. They then sign off the permit in the hand-back section of the document and return the permit to the point of issue. Under no circumstances is it permissible for a job to be stopped and left in an unsafe condition.

CONDUCTING HOT WORK IN CONFINED SPACE

Hot work in or on the exterior surfaces of a confined space should not be commenced until a hot work permit has been issued. The hot work permit may be an integral part of the written authority to enter the confined space. When conducting hot work within a confined space the following fire preventative measures should be taken:

- All combustibles, including any dry residues, in the vicinity of the hot work should be removed to a safe place. If they cannot be moved, such items should be covered by a non-combustible blanket, flame-resistant tarpaulin, or other means to prevent ignition from heat, sparks and slag.
- Drains within 15m should be covered with a wet flame resistant blanket.
- When hot work is involved, consideration should be given to the assignment of a fire watch while the hot work is being performed and for a period of not less than 30 minutes after completion of such hot work. In many cases, the fire watch may be carried out by the stand-by person(s).
- When welding or cutting is to be performed on a tank shell or a conductive boundary of a confined space, the same precautions should be exercised inside and outside the space where the hot work is being performed.
- Before hot work is started on a surface covered with a preservative or other protective coating, the flammability and thermal decomposition products of the coating should be considered.
- Where such a coating is flammable, it should be stripped from the area of hot work to prevent ignition. A pressurised fire hose and a suitable nozzle or other suitable extinguishing equipment, or both, should be available.
- When arc welding is suspended for a substantial period of time, such as during lunch periods or overnight, the power source to the equipment should be de-energised, all electrodes removed from holders and the holders placed so that accidental contact or arcing cannot occur.
- When gas welding or cutting is suspended for a substantial period of time, such as during lunch periods or overnight, the torch and cylinder valves should be closed. The torch and hose should be removed from, and depressurised outside, the confined space.



- No compressed gas cylinders or associated manifolds, other than those used for Self Contained Air Breathing Apparatus, should be located inside the confined space.
- Flammable metal anti-corrosion anodes should be removed from the work site.

CONFINED SPACE ENTRY PROCEDURES

In order to conduct activities within a confined space a minimum of two workers are required. There must be a minimum of one worker who enters the space and one standby person. It may be necessary to have many more personnel as part of the team. This will depend on a number of considerations that will be indicated by the initial job requirements, risk assessment, the nature of the confined space as well as requirements for rescue.

A worker is considered to have entered a confined space if their breathing zone has crossed the opening of the space.

It is important that workers operating in confined spaces be physically and physiologically fit. Some employers will require persons operating within confined spaces to have a medical assessment before conducting activities within confined spaces.

The confined space entry team consists of the following personnel:

ENTRY TEAM

The workers that enter the space are called the entry team. They may consist of any number of persons from one worker to many, depending on the task, size of the space, hazards and equipment used.

STANDBY TEAM

At all times when operating within a confined space there must be at least one trained and competent person acting as standby. The number of persons required to act in the role of standby will vary and depend on the task required. To determine the required number of standby persons consider the tasks required by the standby person and the subsequent number of persons that would be required to conduct these tasks.

Duties of the Standby Person/s:

- Maintain continuous communication with persons working within the confined space.
- Maintain access and egress points and ensure that they are clear and unobstructed.
- Operate equipment that may be used on entry and exit from the space.
- Monitor and operate equipment that is used within the space (without entering the space).
- Initiate rescue procedures and notify emergency services if required.
- Maintain security of the site and prevent any unauthorised entry into the confined space.

A person acting in the role of standby must not enter the confined space under any circumstances, unless they are replaced by a trained competent person who is aware of the tasks being carried out and is up to date with the current activities. The person must also be wearing any required safety equipment.

RESCUE TEAM

Where the risk assessment or the confined space indicates the need, dedicated rescue persons should be staged outside the space in order to conduct a rescue if the need arises.

Rescue persons are responsible for the following:

- Set up all rescue equipment prior to any persons entering the confined space.
- Ensure all safety equipment is ready and accessible for the rescue team.
- Be prepared to effect the rescue plan immediately.
- Don appropriate equipment that will be required, such as BA and Harnesses; (facemasks not donned but ready).
- Set up a receiving area for injured workers including first aid and oxygen equipment where required.

COMMUNICATION WITHIN A CONFINED SPACE

Communication between the standby person and the workers must be continuous at all times whilst persons are operating within the confined space.

Communication can be maintained by the following methods:

Visual

This may be by means of visually watching the workers and using hand signals or lights, which may need to be intrinsically safe.

Tactile

Tactile communications may be used where other communication options are not suitable. Tactile communications may be as simple as tugging on a rope.

Audible

Audible communications can range from voice, radios (may need to be intrinsically safe) or whistle signals. If at any time communication is lost all persons operating within the space are to exit until suitable communication can be restored.

Communication to external persons or agencies such as the Rescue Team or the Emergency Services must also be available and tested.

EQUIPMENT

The following is an overview of equipment that is often used as part of a confined space entry. This equipment does not include equipment used to complete the task once entry has been gained. Further information and details on the use of the equipment listed below can be found throughout this manual.

TRIPODS AND DAVITS AND LADDER SYSTEMS

Tripods

Tripods are used to enable a high attachment point for vertical entry and exit to and from a confined space. Tripods come in a variety of sizes and are often adjustable.

Most modern tripods have fittings for brackets to attach winches to the legs of the tripod and a top pulley system integrated into the design



through which the winch cables can be run.

When using a Tripod it is essential that the legs are secure to prevent tipping or expanding under load.

Davits

Davits are small cranes that are used to rise and lower persons or equipment up or down, including through a vertical access point.

Davits come in a range of sizes and can be removable (the base is permanently mounted) or permanently fixed. They can be of a manual operation or can be powered.

As each type of Davit will vary, it is essential that you receive proper training in that particular type prior to use, as severe injury may result from improper use.

FALL PROTECTION

Harnesses

There is an extensive range of harnesses available in the market with varying levels of padding, wear resistance and connection points specific to use. For confined space, a harness should have confined space loops on the shoulder straps to allow the vertical raising and lowering of the worker. Harnesses should be inspected before and after every use and every 6 months by a competent person. A log should be kept for all harnesses and they should be condemned if they show signs of damage or excessive wear. All harnesses have a life of 10 years from the date of manufacture and must be condemned after this period regardless of use.



Connectors

Connectors including Karabiners, Tube connectors and Maillons are used to join ropes and equipment without the need to tie knots. They also alleviate the risk of nylon rubbing on nylon when using height

safety equipment.



and Hawser Laid.

Rope



and sizes. The two main types are Kernmantle Kernmantle rope construction is preferred for rope construction to be used for rescue. before and after every use and every 6 months

by a competent person. A log should be kept for all ropes and they should be condemned if they show signs of damage or excessive wear. All ropes have a life of 10 years from the date of manufacture and must be condemned after this period regardless of use.

Pulley Systems

Pulley Systems are used to create a mechanical advantage when hauling or lowering workers or equipment.

Type 1 Fall Arresters

Type 1 Fall Arresters come in a range of different designs used for either nylon or wire, rope or rail systems. The Type 1 Fall Arrester makes up the fall arrest component of a vertical lifeline system.

- Ensure that the device is compatible with the vertical line system installed.
- •Both temporary (removable) and permanent Type 1 Fall Arresters are available.
- Type 1 Devices are designed to limit the free fall distance to less than 600mm in a fall.
- · Under normal operation a shock absorber is not required to be used in the system, however a shock absorber may be used to reduce the impact force in the event of a fall, as long as it does not increase the distance between the harness attachment point and the

Type 1 Device to more than 300mm in length.

- A type 1 Fall Arrest Device can be attached to either the front or the rear of a full body harness.
- The distance from the Type 1 Fall Arrester to the harness attachment point must be less than or equal to 300mm.

• A type 1 Fall Arrest Device must be inspected before and after use and must be inspected by a competent person at 6 monthly intervals and a record of such inspections must be kept.

Type 2 Fall Arresters

Retracting Lanyards

Retracting lanyards operate the same way as your car seat belt. They come in a range of lengths and during normal operation they will constantly adjust to maintain the correct length and slight tension on the lanyard. If a fall occurs the Fall Arrester locks off immediately, minimising the fall distance and subsequent shock force received by the worker.

- Retracting Lanyards range in length from 1m to 6m.
- They offer the best protection and are therefore safest when anchored overhead within a 60° cone from the anchor point.
- Retracting lanyards should not to be used horizontally unless recommended by the manufacturer, as they may not be able to withstand the free fall forces placed on equipment during a fall.
- Fall clearances required for safe operation of the retracting lanyard will vary depending on the manufacturer and model of the device.
- · A Retracting Lanyard should be withdrawn from service if:
 - The lanyard has locked up.
 - The lanyard does not extend or retract smoothly.
 - The fall indicator is visible indicating that the device has been subjected to a significant force and therefore potentially may not function as designed.
 - The shock absorber is deployed also indicating the device has received forces equivalent to a fall.
- Operators should consult the manufacturer's instructions prior to use and when calculating fall clearances.
- Operators should inspect the device before and after use. The device should be inspected every 6 months by a competent person, recording the results in a log book and usually, depending on the manufacturer's recommendations, the device should be returned to the manufacturer for service every 12 months or withdrawn from service after a period of time.

Inertia Reels

Inertia reels operate in the same fashion as retracting lanyards utilising a steel cable or webbing strap. They provide most of the requirements of a fall protection system in one unit with the worker only being required to add a harness and suitable anchor for a complete fall arrest system.

- Range in length from 5m to 42m.
- Incorporates shock absorption that reduces the forces in the event of a fall.
- Are not designed for horizontal use and should only be used overhead within a 60° cone from the anchor point.
- Condemn if:
 - The reel has locked up and will not retract or extend.
 - The lanyard does not extend or retract smoothly.
 - The fall indicator is visible indicating that the device has been subjected to a significant force and therefore potentially may not function as designed (the fall indicator is usually incorporated into the hook).
- Operators should inspect the device before and after use. The device should be inspected every 6 months by a competent person recording the results in a log book and usually, depending on the manufacturer's recommendations, the device should be returned to the manufacturer for service every 12 months.



Type 3 Fall Arresters - Recovery Reels

Type 3 Fall Arresters or Recovery Reels are Type 2 Fall Arresters with an added emergency winch mechanism. The attachment of the winch mechanism allows the cable to be winched up or down raising or lowering the worker in an emergency. As the winch mechanism is only designed for an emergency recovery it is not built to withstand the forces applied by the regular use of the winch and will subsequently fail if used for winching tasks on a regular basis.

- Same as a type II Fall Arrester but contains an emergency integrated winch system
- Are not designed for horizontal use and should only be used overhead within a 60° cone from the anchor point.
- Always check manufacturer's recommendations when calculating fall clearances as these will vary depending on the model.
- Condemn if:
 - The reel has locked up and will not retract or extend.
 - The lanyard does not extend or retract smoothly.
 - The fall indicator is visible indicating that the device has been subjected to a significant force and therefore potentially may not function as designed (the fall indicator is usually incorporated into the hook).
- Operators should inspect the device before and after use. The device should be inspected every 6 months by a competent person recording the results in a log book and usually, depending on the manufacturer's recommendations, the device should be returned to the manufacturer for service every 12 months.

Spreader Bars

Used to attach the lifeline (Rope) or winch cable to the worker in a vertical confined space entry. This allows the worker to hang vertically and reduces the risk of the worker getting snagged on the entry / exit.

Spreader Bars should be inspected before and after every use and every 6 months by a competent person. A log should be kept and they should be

condemned if they show signs of damage or excessive wear. All Spreader Bars have a life of 10 years from the date of manufacture and must be condemned after this period regardless of use.

Stretchers

Stretchers may be used in confined space rescue to safely and effectively remove an injured or unconscious worker form a confined space. Stretchers can be used vertically or horizontally depending on the type of stretcher used.

RESPIRATORY PROTECTION

Supplied Air Respirators (Long Line)

Supplied Air Respirators provide the wearer with breathable air from independent air supply sources. Air is

usually supplied through an air supply hose from an airline connected to a cylinder bank and pressurised with breathable air from an electric or petrol driven air compressor. The air line is attached to an air distribution block mounted on a belt worn by the worker. This stops the hose pulling on the facemask as the worker moves around.

Supplied air respirators protect workers whilst occupying areas of irrespirable atmospheres. As the breathable air is supplied from external air sources, supplied air respirators serve as an effective solution to protect workers for an extended duration.







Self Contained Air Breathing Apparatus - SCABA

Self Contained Air Breathing Apparatus, or SCABA, sometimes referred to as a Compressed Air Breathing Apparatus (CABA), an air pack, or simply Breathing Apparatus (BA) is a device worn by rescue workers,

firefighters, and other industry professionals to provide breathable air in an irrespirable atmosphere. When not used underwater, they are sometimes called industrial breathing sets. The term "self-contained" means that the breathing set is not dependent on a remote supply (e.g. through a long hose). If the unit is designed for use under water, it is called SCUBA (self-contained underwater breathing apparatus). A SCABA typically has three main components: a highpressure cylinder (e.g. 200 to 300 Bar), a harness and back plate and a face mask.



There are two kinds of SCABA: open circuit and closed circuit.

Closed-Circuit

The closed-circuit type SCABA or Re-breathers filter, replace used oxygen and then recirculate the exhaled gas. It is used when a longer-duration supply of breathing gas is needed, such as in mine rescue and when conducting tasks over an extended duration. Before open-circuit SCABA's were developed, most industrial breathing sets were Re-breathers. Re-breathers do not expel any air or gas into the atmosphere.

Open-circuit

Open-circuit industrial breathing sets are filled with filtered, compressed air, rather than pure oxygen. Typical open-circuit systems have two regulators: a first stage regulator to reduce the pressure of air to allow it to be carried to the mask, and a second stage regulator to reduce it even further to a level just above standard atmospheric pressure. This air is then fed to the mask via either a demand valve (activating only on inhalation) or a continuous positive pressure valve (providing constant airflow to the mask).

An open-circuit rescue or firefighter SCABA has a full face mask, regulator, air cylinder, cylinder pressure gauge, and a harness with adjustable shoulder straps and waist belt which lets it be worn on the back. The air cylinder usually comes in one of three standard sizes: 4 litres, 6 litres, or 6.8 litres.

Calculating the working duration of the compressed breathing air cylinders

The duration of the cylinder can be calculated using the following formulae:

FP (fill pressure in BAR) x WC (water content in litres) divided by average air consumption per minute (40LPM). (FP x WC) / 40 = Cylinder Duration

The relative fitness of the wearer, combined with the level of exertion, often results in variations of the actual usable time that the SCABA can provide air. This can often reduce the working time by up to 50%.

Air Cylinders

Air cylinders can be made of aluminium, steel or a composite construction (usually carbon-fibre wrapped.) The composite cylinders are the lightest in weight and are therefore preferred by most wearers, but they also have the shortest lifespan and must be taken out of service after 15 years. Air cylinders must be hydrostatically tested every 3 years for composite cylinders, and every 5 years for metal cylinders. During extended operations, empty air cylinders can be quickly replaced with fresh ones and then the empty cylinders refilled from a larger cylinder bank or from an air compressor.

Full-face masks

The full-face masks of breathing apparatus may have a big full-face window, or small eye windows. The mask may incorporate a two-way radio communicator and will usually have a small orinasal face cup inside, reducing breathing dead space.

Full-face masks are designed for use out of water. Most are designed in a way that makes them unsuitable for use under water. The seal at the edge of the mask is a wide tube with thin, flexible walls running around the edge of the mask, full of air at atmospheric pressure. On the surface it pushes against the edges of the wearer's face, causing a tight seal. At more than a few feet underwater this seal collapses, making the mask leak. The Full faced mask may be used in an emergency but due to the curved window would severely distort the image underwater.

Positive pressure (preventing inward leaking)

Open circuit SCABAs utilise either "positive pressure" or "negative pressure" operation.

A "negative pressure" SCABA operates by air being delivered to the wearer only when he breathes in, or in other words, reduces the pressure in the mask to less than outside pressure, hence the name "negative pressure". The limitations of this are obvious, as any leaks in the device or the interface between the mask and the face of the wearer (caused for example by small face skin wrinkles) would reduce the protection offered.

"Positive pressure" SCABA addresses this limitation. By careful design, the device is set to maintain a small pressure inside the face piece. Although the pressure drops when the wearer breathes in, the device always maintains a higher pressure inside the mask than outside of the mask. Thus, even if the mask leaks slightly, there is a flow of clean air out of the device, automatically preventing inward leakage under most circumstances.

Although the performance of both types of SCABA may be similar under optimum conditions, this "fail safe" behaviour makes a "Positive pressure" SCABA preferable for most applications. As there is usually no air usage penalty in providing positive pressure, the older "Negative pressure" type is, in most cases, an obsolete configuration and is only seen with older equipment.

Some users refuse to use positive pressure technology as, in case of damage to or loss of the face piece, the air will be released uncontrolled. The leakage rate can be so high that a fully charged SCABA will be drained in less than three minutes, a problem that does not happen with "negative pressure" SCABA systems.

Industrial users will often be supplied with air via an air line, and only carry compressed air for escape or decontamination purposes. See Supplied Air Respirators.

Particulate Respirators P1, P2 or P3?

P1 is the rating given to a respirator which meets the Australian Standard AS/NZS1716 for filtering mechanically generated particles e.g. particles formed by crushing, grinding, drilling, sanding, cutting etc., including asbestos fibres and silica.

P2 is the rating given to a respirator which meets the Australian Standard AS/NZS1716 for filtering mechanically and thermally generated particles e.g. those from welding fumes. These are also the recommended type for use against biological particles.

P3 is the rating given to a respirator that is suitable for use against all particles including highly toxic contaminants / materials / particles.

The Australian Standard AS/NZS1715 provides guidance in the selection, use and maintenance of respiratory protective devices. Particulate Respirators are not suitable protection against gases or vapours.

As a brief overview, P1 stops 80% of particles, P2 stops 94% and P3 stops 99.95%.

The Flow Valve is a one way valve designed to reduce heat and moisture build-up within the respirator to offer comfortable protection, particularly in hot and humid conditions. Disposable Respirators are available in valved or un-valved versions.





Oxygen Self Rescuers

Self-contained self-rescue device, SCSR, or oxygen self-rescuer is a portable oxygen source for providing breathable air when the surrounding atmosphere lacks oxygen or is contaminated with toxic gases, e.g. carbon monoxide. A SCSR is usually a closed-circuit breathing apparatus with a chemical oxygen generator or a compressed oxygen cylinder and a carbon dioxide absorber. SCSRs are most commonly used in mining, are intended for one person and usually supply at least one hour of oxygen.

Powered Air Purifying Respirators – PAPR

The purpose of this type of respirator is to take air that is contaminated with one or more types of pollutants, remove a sufficient quantity of those pollutants and then supply the air to the user. The units consist of a powered fan which forces incoming air through one or more filters then delivers the air to the

user for breathing. The fan and filters may be carried by the user or, with some units, the air is fed to the user via tubing while the fan and filters are remotely mounted.

The type of filtering must be matched to the contaminants that need to be removed. Some respirators are designed to remove fine particulate matter such as the dust created during various woodworking processes. When used in combination with the correct filters they are suitable for working with volatile organic compounds such as those used in many spray paints.

Chemical cartridge respirators

Chemical cartridge respirators use a cartridge to remove gases, volatile organic compounds (VOCs), and other vapours from breathing air by adsorption, absorption, or chemisorption. A typical organic vapour respirator cartridge is a metal or plastic case containing from 25 to 40 grams of sorption media such as activated charcoal or certain resins. The service life of the cartridge varies based, among other variables, on

the carbon weight and molecular weight of the vapour and the cartridge media, the concentration of vapour in the atmosphere, the relative humidity of the atmosphere, and the breathing rate of the respirator wearer. When filter cartridges become saturated or particulate accumulation within them begins to restrict air flow, they must be changed.

ATMOSPHERIC MONITORING EQUIPMENT

Types of atmospheric monitoring equipment

There is a range of atmospheric testing equipment consisting of Gas Detectors, Gas Tubes, dust and particle Detectors etc., designed to test the atmosphere for a wide variety of dangerous or flammable gases, particles or vapours within the sampled atmosphere.

Atmospheric testing equipment needs to be specific to the hazard that you are trying to detect and therefore the type of equipment required will be identified by completing a risk assessment on the work area prior to selecting the appropriate monitoring equipment.

The Electronic Gas Detector

The most common system for detecting hazards with confined spaces is the Four Head Gas Detector. The Four Head Gas Detector consists of 4 sensors that detect 4 different atmospheric conditions as follows:



% O₂ Oxygen concentration as a percentage of the atmosphere



% LEL Explosive Levels as a percentage of the upper explosive limit

H₂S ppm Hydrogen Sulphide in parts per million

CO ppm Carbon Monoxide in parts per million

Gas detectors can be used to sample or monitor an atmosphere during operations. When used for monitoring, the gas detector is usually worn by the worker or placed between the worker and the potential hazard or both. When worn by the worker the detector should be placed as close to the breathing zone as possible.

Gas Sampling Pumps

Gas sampling pumps are either a mechanical or manually operated pump used to collect a sample of the atmosphere in a tube from a selected area and pump that sample up to the gas detector for sampling. This allows the worker to sample an atmosphere without entering the area being sampled.

OPERATION OF GAS DETECTORS

Challenge Testing

Prior to use, the gas detector must be challenge tested. This is where the gas detector is exposed to a specific gas atmosphere called Cal Gas or Calibration Gas specially designed to test the gas detector. When challenge tested the readings on the gas detector must be within a specified range stated on the outside of the Calibration Gas cylinder.



Calibration

If a Gas detector fails its challenge test then it may be field calibrated using the Calibration Gas. When exposed to the Cal Gas the detector will recalibrate the detector to the known concentrations for the Cal Gas used. It is important that the correct Cal Gas is used for the specific type of detector being used. Once a field calibration has been completed the detector must once again be challenge tested. If the detector subsequently fails challenge testing again then it should be returned to the manufacturer for service.

Peak readings

The peak readings on the gas detector are the maximum readings achieved by the detector when sampling the atmosphere. This is important because if you insert the detector into a space it will read the gas levels correctly at the time however once you bring it out into the clear atmosphere the readings will return to normal. It is always important to check the peak readings to determine what the readings were within the space tested.

Clearing Peaks

Due to the peak readings being retained by the detector it is important that the gas detector's peak readings be cleared prior to testing an atmosphere. To clear peak readings consult the manual supplied with your gas detector.

Zeroing

The gas detector can be zeroed in fresh air to calibrate the gas detector to the fresh air levels. This must be conducted in an atmosphere containing 20.9% oxygen and zero atmospheric contaminates. This process is completed without the use of Cal Gas. This essentially calibrates the detector to fresh air levels with no atmospheric contaminates.

GAS SAMPLING TUBES

Gas sampling tubes such as those made by Drager or QA can be used to measure a range of gases accurately. The operation of the tubes and air pump are simple. The pump draws a measured amount of air through the tube. The gas in the air reacts with a chemical lining inside the tube, causing the chemical to change colour. The degree of colour change corresponds to the level of gas in the atmosphere.



Testing an Atmosphere using Gas Sampling Tubes

1. Set up the equipment

Use a pair of pliers to carefully snip only the tips of each end. Insert one end of the glass sampling tube into the flared open end of the air pump. **Make sure the direction of the arrow on the gas sampling tube points toward the air pump.** Remember, air is pulled through the gas sampling tube by the air pump and exhausted into the atmosphere through the rubber one-way valve on the air pump. The arrow points in the direction of this airflow.

2. Sample the air

Pull 1 litre (1,000 ml) of air through the CO₂ tube with the plastic air pump. Since the pump can draw a maximum volume of 140 millilitres, you must use 10 strokes of 100 millilitres each to draw a total of 1 litre of air. The scale of many CO₂ gas-sampling tubes is calibrated for 1 litre of air. Pull each stroke with a slow, deliberate, even pressure on the plunger of the pump so that it reaches the 100 ml mark in 10 seconds. Hold the plunger there for approximately 10 more seconds, at which point the plunger should no longer be pulling back against you. At this point, all the air for that stroke has been pulled through, and the plunger is ready for the next stroke.

3. Interpret the results

After pumping 1 litre (1,000 ml) of air through the gas sampling tube, disconnect the tube from the air pump and determine how far up the tube the colour change extends. Read the value of gas on the scale at the colour transition. This is a qualitative measurement. You will need to use your judgment. Different people will see the colour change in slightly different places. To get a more reproducible result, have workers independently look at the tube and determine the reading then take a group average.

PERSONAL PPE

Helmets

When entering, exiting or working within a confined space, a worker is at risk of injury resulting from slips, trips and falls as well as blunt force trauma from hitting their head on one of the many obstacles present. To protect the worker from these risks a helmet should be worn when conducting confined space operations. The helmet used should be of a solid construction with adequate protection to the back of the head and the temple region. The helmet should be secured to the wearer by means of a three-point harness similar to helmets worn by climbers and mountaineers.



Safety Glasses



Confined spaces are often dimly lit confines with many potential hazards. When the risk assessment does not require the use of full face breathing apparatus there is no protection to the workers eyes in the event of an object striking the eye or a similar incident occurring. To protect the worker in this scenario all workers working in or around confined spaces should wear clear safety glasses to protect their eyes from possible injury.

Hearing Protection



There are many types of hearing protection available on the market. Some of these are pictured herewith. If the risk assessment indicates that there is excessive noise within the space due to operating equipment or machinery, the operation of tools or excessive noise being produced nearby, appropriate hearing protection should be worn by all workers working within the area.

Suitable Footwear

When operating in Confined Spaces suitable footwear should be worn: boots complete with an anti slip surface and leather sides that extend up to protect the ankle. These boots should also have a reinforced toe.

Gloves



Gloves used in Confined Space work will vary depending on what task is being carried out inside. The requirements for gloves and the type necessary will be indicated by the risk assessment conducted prior to carrying out the task.

Elbow and Knee Pads

As a lot of work in confined spaces is conducted from the kneeling position, it is highly advisable to wear suitable knee and elbow pads to protect the worker from annoying short term, as well as incapacitating long term, injuries as a result of crawling and kneeling on hard surfaces.

Distress Signalling Unit

A DSU or distress signalling unit is a small device that clips usually to a workers belt or on their breathing set. The device monitors the workers movement and emits an audible pre alarm when the worker has stopped moving for a period of time. If the worker does not react to this pre alarm the unit will assume

that the worker is injured or unconscious and will go into a full alarm, emitting a very loud alert tone to attract the attention of other workers indicating the need for assistance. Each unit will have a key that usually will have a tally of some kind that records the wearer's information. The tag is usually placed in a control board of some kind used to monitor entry and exit to the confined space.



DSU in monitoring mode

DSU in alarm mode

Coveralls / Protective Clothing



Depending on the work being carried out, suitable coveralls may be worn to reduce the contamination of clothing worn by the worker. Contamination may be from dirt or similar products. If the contamination is from a more hazardous substance then more appropriate clothing may be worn from a simple chemical splash suit to a fully encapsulated gas tight suit.

ves

There are a range of atmospheric conditions that can be a hazard for the worker. This includes heated atmospheres, oxygen deficient or toxic atmospheres and atmospheres containing smoke. The mnemonic HOTS outlines the times where the use of SCABA may be required:

H Heated Atmospheres
O Oxygen Deficient Atmospheres (<19.5%)
T Toxic Gases
S Smoke

There are two major application areas for SCABA: fire fighting and industrial use. Historically, mining was an important area, and in Europe this is still reflected by limitations on use, in the construction of SCABAs, of metals that can cause sparks. Other important users are petrochemical, chemical, and nuclear industries. The design emphasis for industrial users depends on the precise application and extends from the bottom end which is cost critical, to the most severe environments where the SCABA is one part of an integrated protective environment which includes gas tight suits for whole body protection and ease of decontamination. Industrial users can also be supplied with air via an air line, (supplier air respirator) and only carry compressed air for escape or decontamination purposes.

Positive and Negative Pressure

A "negative pressure" SCABA may be used with a type of full-face mask which could be used as a gasmask (with a filter canister on the face piece's air inlet) or with an open-circuit breathing set connected to the air inlet. Air is delivered to the wearer when he breathes in, or in other words, reduces the pressure in the mask to less than outside pressure, hence the name "negative pressure". The limitations of this are obvious, as any leaks in the device or the interface between the mask and the face of the wearer (caused for example by small face skin wrinkles) would reduce the protection offered.

"Positive pressure" SCABA addresses this limitation. By careful design, the device is set to maintain a small pressure inside the face piece. Although the pressure drops when the wearer breathes in, the device always maintains a higher pressure inside the mask than outside of the mask. Thus, even if the mask leaks slightly, there is a flow of clean air out of the device, automatically preventing inward leakage under most circumstances. Although the performance of both types of SCABA may be similar under optimum conditions, this "fail safe" behaviour makes a "Positive pressure" SCABA preferable for most applications. As there is usually no air usage penalty in providing positive pressure, the older "Negative pressure" type is, in most cases, an obsolete configuration and is only seen with older equipment. However some users refuse to use this technology as, in case of a damage or loss of the face piece, the air will be released uncontrolled. The leakage rate can be that high that a fully charged SCABA will be drained in less than three minutes, a problem that does not happen with "negative pressure" SCABA systems.

Air Cylinder

SCABA air cylinders were made of steel in the past, but steel is no longer used because of its weight. Modern air cylinders are made of aluminium, aluminium wrapped in fibreglass or a Kevlar/ carbon composite material. The 1976 introduction of the fibreglass aluminium composite air tank cut the weight of the SCABA in half. The addition of Kevlar and carbon fibres provided an even lighter and stronger air cylinder. High-pressure cylinders must accept pressures up to 4,500 pounds per square inch (PSI), and low-pressure cylinders



between 2,216 and 3,000 psi. Each cylinder should have a rated duration, which is a predictable length of time the air in the tank will sustain its user. Rated durations are typically 30, 45 or 60 minutes.

SCABA Cylinder Duration

The duration of the cylinder can be calculated using the following formulae:

FP (fill pressure in BAR) X WC (water content (capacity) in litres) divided by average air consumption per minute (40LPM).

(FP x WC) / 40 = Cylinder Duration

SCABA Working Duration

The working duration of a SCABA is calculated as follows.

Working duration = Cylinder duration - (the time to get in + (2 x the time it will take to get out))

E.g. if it takes 5 minutes to get in to where you are conducting your work and your cylinder duration is 40 minutes you would have a working duration of 25 minutes. $40 - (5 + (2 \times 5))$.

Backpack Assembly

The backpack assembly is the framework that carries the weight of the SCABA. Both the framework and the harness straps must be made of materials that will not fail in the environment where they are used, which in most cases means they should be fire proof and impervious to corrosive chemicals. The straps are adjustable allowing the user to optimise the distribution of the SCABA's weight.

Regulator Assembly

As their name suggests, regulators regulate the pressure of the air delivered to the user, reducing it from the pressure in the tank to a practical pressure for delivering breathing air. Regulators can be attached to the facemask (mask-mounted) or to the belt or backpack (belt-mounted), and are available for low-pressure or high-pressure uses.

The regulator assembly also includes a low-pressure warning device, sometimes referred to as a Personal Alert Safety System (PASS) that notifies the user when air pressure drops to about 500 PSI.

Facemask

The face mask or face piece has a transparent lens made of material that can survive the hazardous environments where it is used, including heat and corrosive materials. It also must form a tight seal around the face to prevent noxious gases from entering. In the more expensive models the facemask assembly may also include a radio communications device that includes a microphone and a speaker.

PRE-OPERATIONAL CHECK SCABA

A Pre Operational Check of the Self Contained Air Breathing Apparatus must be conducted every time the equipment is used. The Pre Operational Check is designed to highlight any flaws or issues with the equipment prior to wearing in an atmosphere that poses a risk to the wearer.

The steps of the Pre Operational Check are as follows:

- 1. Conduct a visual inspection of all components.
- 2. Conduct an operational test of the equipment.
- 3. Test the alarm functions of the equipment.

The testing procedure will vary slightly with each different SCABA model. For specific test requirements contact the SCABA manufacturer.

To assist in the Pre Operational Check you may use a form similar to the one over the page. If the set does not pass the inspection it must be tagged and sent in for service and another set used for the task.

POST OPERATIONAL SERVICING

Once the task is completed the SCABA should be visually inspected as in the preoperational check. All straps should be extended and the cylinder replaced with a cylinder that is full.

Cleaning the face mask

The face mask should be cleaned with a suitable disinfectant recommended by the manufacturer of the SCABA. The cleaning procedure may vary depending on the product used however a good guide is the following:

- R Rinse the facemask in cool water
- Spray with the manufacturer's recommended disinfectant
- Leave for 10 minutes so the disinfectant can kill any germs
- R Rinse the facemask thoroughly
- D Dry with a lint free cloth or wipes

Cleaning the back plate and harness assembly

The back plate and harness assembly can be washed with warm soapy water and allowed to dry in a well ventilated environment out of direct sunlight.

Storage

The SCABA should be stored in a well ventilated area, suitably covered to prevent contamination from dust and other airborne particles and out of direct sunlight.

CONFINED SPACE RESCUE

WH&S Regulation states:

74 Emergency procedures

- (1) A person conducting a business or undertaking must:
 - (a) establish first aid procedures and rescue procedures to be followed in the event of an emergency in a confined space, and
 - (b) ensure that the procedures are practised as necessary to ensure that they are efficient and effective.

Maximum penalty:

- (a) in the case of an individual \$6,000, or
- (b) in the case of a body corporate -\$30,000.
- (2) The person must ensure that first aid and rescue procedures are initiated from outside the confined space as soon as practicable in an emergency.

Maximum penalty:

- (a) in the case of an individual \$6,000, or
- (b) in the case of a body corporate \$30,000.
- (3) The person must ensure, in relation to any confined space, that:
 - (a) the entry and exit openings of the confined space are large enough to allow emergency access, and
 - (b) the entry and exit openings of the space are not obstructed, and
 - (c) plant, equipment and personal protective equipment provided for first aid or emergency rescue are maintained in good working order.

Maximum penalty:

- (a) in the case of an individual-\$6,000, or
- (b) in the case of a body corporate \$30,000.

Note. See Part 3.2 for general provisions relating to first aid, personal protective equipment and emergency plans.

3 P's – THE REQUIREMENTS FOR CONFINED SPACE RESCUE PROCEDURES

Planned

The actions in the event of an incident occurring must be pre planned to enable a quick effective response. When things don't go according to plan it is essential that the safe and effective removal of persons within the confined space occur immediately without any further risk to rescue teams or workers at the site.

To enable an effective rescue in a timely manner it is important to pre-plan rescue procedures. Pre planning does not just consist of pre deciding what to do. It includes documenting procedures and techniques that will be used to affect the rescue if required. Equipment and manpower must also be considered.

Prior to entry of a confined space, the rescue plan must be set up including all personnel and equipment including PPE for all personnel so that in the event of an incident the rescue plan can be put into place immediately and the safe and efficient rescue of all endangered workers can be affected.

Where possible the rescue plan should not involve committing further workers to a

Pre-prepared

A rescue plan is not effective unless it can be conducted the moment it is required. A Rescue is performed to quickly remove a person from harm. Any delay that occurs could potentially have a drastic effect on the outcome for the casualty. To reduce the time it takes to affect a rescue all equipment should be set up and prepared prior to entry.

Practiced

A rescue plan, in order to meet the 'real world' requirements must be practiced to ensure that it is possible. Only when we put the plan into place and physically carry out a simulated rescue can we confirm that the plan is plausible and that we can carry it out safely and effectively.

When an emergency occurs, it is not the time to be working out how to conduct the rescue. A practiced plan enables all members the opportunity to revise the procedures and ensure that they know exactly what to do when a real emergency occurs.

Appendix 1 Confined Space Entry Permit



Details of Work

Location of Work

LPG Storage Cylinder

Description of work permitted:

Purge, Ventilate, Enter and Weld small hole in rear of the LPG Storage Cylinder.

Permit Authorisation and Validity Period (To be completed by the Permit Issuer)						
Fro m	Date:	12th September	Until	Date:	13th September	Signed (Must be signed by permit issuer)
	Time:	0800		Time:	1700	la -

Permit Extension (Only to be completed by permit issuer)					
Until	Date:	Until	Date:	Signed (Must be signed by permit issuer)	
	Time:		Time:		

Other Permits Required (Must be attached before commencing work)	Permit Numbers
Hot Work Permit Required	PERM 100987

The risk control measures and precautions appropriate for the safe entry and execution of the tasks required within the confined space have been implemented and the persons required to enter the confined space have been advised of and understand the requirements of this written authority.

Name (Person issuing the permit)	Signature:	Date:	Contact #
John Issuer	Az-	12/09/12	0435 456 765

Notes

Acceptance of Permit (To be completed by the Permit Receiver)

I have read and am satisfied with the permit conditions as stated within this permit and agree to comply with the these requirements. I have been advised the hazards and understand the control measures and precautions to be observed within the confined space.

Name (Person receiving the Permit)	Signature:	Date:	Contact #
Michael Turner	Jezz-	12/9	0426253470

Hazards (Complete Hazard Assessment sheet prior to filling in this section. Refer work method statement)

Hazard / Risk	Control method required	Actione d
Vehicular traffic	Traffic control and barricades to be implemented.	
Pinch Hazards from door	Door to be secured prior to entry	
Slips Trips and Falls	All trip hazards to be prominently marked	
Flammable atmosphere	Purge the storage cylinder with Nitrogen and then ventilate the space. Carry out Atmospheric testing prior to entry (See sect 7)	
Heat Exhaustion	The temperature in the container must be below 40 Deg or all work is to cease.	
High Pressure Gas Pipe	To be isolated	
Electricity	To be isolated	

Isolation Requirements (List all Services, Plant and Equipment that requires isolation)

Item requiring isolation	Details: N/A if not applicable (if additional pages required attach at rear)	Tick when Isolated
Pipelines (Water / Gas / Steam etc)	High pressure gas pipe to be isolated prior to entry	
Mechanical / Electrical Drives		
Hydraulic Services / Plant		
Electrical Services / Plant	Electrical switch to be isolated	
Automatic Fire Systems		
Sludge / Deposit /Waste		

Emergency Plan / Rescue Plan

Emergency Requirements	Tick when Actioned
Rescue equipment is available and assembled as required	
Entry and exit points unobstructed and will permit rescue during operations	
All personnel have been briefed in emergency and rescue procedures	
Rescue procedures have been tested and are deemed effective	

Details of the Rescue Plan

Standby person to activate the alarm and remove worker from space without entering using the lifeline if horizontal entry techniques are used or the 4:1 Pulley System if vertical entry is conducted. The standby person will be responsible for calling 000 to notify the emergency services.

Personal Protective Equipment Requirements

РРЕ Туре	Required	Specify Details
Respiratory protection	Yes 🗆 No 🗆	
Eye protection	Yes 🗆 No 🗆	Welding shield for welding process.
Hearing protection	Yes 🗆 No 🗆	Hearing Protection to be worn at all times inside container
Hand protection	Yes 🗆 No 🗆	Leather gloves for normal work / Welding gloves for welding
Footwear	Yes 🗆 No 🗆	Steel capped safety boots
Protective clothing	Yes 🗆 No 🗆	General cotton drill work clothing is suitable
Head protection	Yes 🗆 No 🗆	Helmets with chin straps must be worn at all times

Personal atmospheric monitor	Yes 🗆 No 🗆	Atmospheric testing will occur prior to entry	
Harness and life line	Yes 🗆 No 🗆	A Lifeline to be attached to the worker for entry	
Knee / elbow pads	Yes 🗆 No 🗆		
Personal lighting	Yes 🗆 No 🗆		
Communication equipment Yes I No I		Communication will be verbal	
Atmospheric Testing (Initial Test before entry.)			

Is Atmospheric Testing Required?

Yes No 🗆

Initial Atmospheric Test Results

Initial test conducted	Date	12/9	Time	0800	Tested By	Dave smith
Gas	Range	Initial Result	Com	nents		
O ₂ Oxygen	19.5 – 23.5	20.8				
H ₂ S Hydrogen Sulphide	< 10 PPM	0				
LEL Explosive Level	< 5% LEL	2	Small	amount withir	n allowances	
CO Carbon Monoxide	< 35 PPM	0				

Is continued atmospheric monitoring of the space required whilst occupied?

Yes No 🗆

No 🗆

Yes

Ventilation (Enter any details of ventilation required)

Is ventilation of the space required

Details of Ventilation Required

The cylinder is to be purged with nitrogen prior to being ventilated with air. Gas testing must be carried out prior to ventilating to check LELs and then prior to entry.

Continual ventilation is required during work activity due to fumes from the welding process.

Atmospheric Monitoring (This is where you record further atmospheric tests and monitoring)

Date	Time	Within safe limits	Comments / action taken.
12/9	0845	Yes No 🗆	Found to be within safe limits
		Yes 🗆 No 🗆	
		Yes 🗆 No 🗆	
		Yes 🗆 No 🗆	
		Yes 🗆 No 🗆	

Notes

Confined Space Entry Log (To be completed as work is carried out)

Personnel acting as Standby

I have been advised the hazards and understand the control measures and precautions to be observed within the confined space. I am also appropriately trained to act in the role of Standby for work in confined spaces.

Standby On Watch				Standby Off Watch			
Name	Date	Time On	Signature	Name	Date	Time Off	Signature
Dave Smith	12/9	0800	190				

Personnel required to Enter Confined Space

I have been advised the hazards and understand the control measures and precautions to be observed within the confined space. I am also appropriately trained to work in confined spaces.

	Entry	/ Log			Exit Log	J	
Name	Date	Time in	Signature	Name	Date	Time out	Signature
Mike Towers	12/9	0830	1900	Mike Towers	12/9	0900	19-5
Adrian Walsh	12/9	0832	19-5-				
Tony Cavalier	12/9	0835	19-5				

Withdrawal Of Permit (To be completed when work is complete)

I declare that the space has been inspected by me and found to be in a secure, safe and serviceable condition. All workers have signed out of the Confined Space, all services have been returned to normal (as applicable) and all work in the area relating to this permit has been completed.

Name:	Signature:	Date:	Time:
Comments:			

		Pre	e Operational (
on cor	npleted by:	Signed:Service/ Test	Date:
Serial	Number:	Date:In date D Servic	e Required D
		PA upper model with (without outinder attached	
	SCA	BA unassembled with / without cylinder attached	
	Visual inspection	Back plate	Pass 🗆 Fail 🗆
		Webbing Harness (Straps extended)	Pass 🗆 Fail 🗆
		Buckles and fittings and connections	Pass 🗆 Fail 🗆
		O-rings	Pass Fail
		Hose lines	
р 1		Gauge	
Ste		Orinasal cun	
		Exhaust valve	
		Face mask straps (Extended)	
		Demand valve (In park mode)	Pass 🗆 Fail 🗆
		Unit is within service requirements	Pass D Fail D
		Cylinder and Valve	Pass 🗆 Fail 🗆
	Attach	cylinder and turn on slowly with gauge facing down.	1
	Pressure Test	Cylinder contents (80% min)	Pass D Fail D
		Audible leak check	
\sim		Static High pressure leak test (<10 BAR in 1 min)	Pass 🗆 Fail 🗆
tep		Operation of demand valve	Pass 🗆 Fail 🗆
Ś		Air quality test	Pass Fail
		Face Seal test	
		Positive pressure check	
		Turn off cylinder	
ი	Audible Alarm Test	Low pressure warning whistle	Pass 🗆 Fail 🗆
tep		Personal Distress Unit warning alarm	Pass 🗆 Fail 🗆
Ŋ		Personal Distress Unit distress alarm	Pass 🗆 Fail 🗆
Comm	hents / required attentic	'n	

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