# AS 2865 – 1995

**Australian Standard®**
**Worksafe Australia National Standard**

# Safe working in a confined space

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# PREFACE

This Standard was prepared jointly by representatives of the National Occupational Health and Safety Commission and the Standards Australia Committee on Work in Confined Spaces to supersede AS 2865-1986. The group developing this Standard took into consideration the Victorian Occupational Health and Safety Commission's draft regulation and code of practice.

The National Occupational Health and Safety Commission is a tripartite body established by the Commonwealth Government to develop, facilitate and implement a national occupational health and safety strategy.

This includes standards development, the development of hazard-specific preventive strategies, research, training, information collection and dissemination and the development of common approaches to occupational health and safety legislation.

The National Commission comprises representatives of the peak employee and employer bodies - the Australian Council of Trade Unions and the Confederation of Australian Industry - as well as the Commonwealth, State and Territory governments.

Consistent with the National Commission's philosophy of consultation, tripartite standing committees have been established to deal with issues relating to standards development, research and the mining industry. Expert groups and reference groups may be established to provide advice to the standing committee on those issues with which the National Commission is concerned.

The Standard is formulated in such a way that, depending on jurisdictional requirements, the Clauses highlighted in boxes may be used as the basis of regulations and the remaining Clauses form a code of practice. Alternatively, the Standard may be called up in its entirety in a legislative framework.

The common essential requirements are those contained in boxes. An organisation which does not comply with the Standard in all respects would still be required to meet the requirements in the boxes.

The Standard was prepared to meet the need for requirements and procedures for the prevention of occupational illness, injuries and fatalities associated with persons entering and working in a confined space. It is designed not only to ensure that confined spaces are made safe for those entering them, but also to highlight the likely hazards associated with such work areas and the relevant safe work processes necessary to deal with these hazards.

The Standard emphasizes the responsibilities for safety before entry and during the entire operation. Such responsibilities cover conditions of work for an organisation's own employees as well as for any contractors or other persons on the premises. This Standard requires that adequate steps be taken to eliminate or control hazards. It also requires that all persons involved in the entry of a confined space be trained and instructed on the nature of the hazards and the precautions to be followed.

The significant changes made in this edition are as follows:

(a) An increase in the level of flammable contaminant permitted to be present in the atmosphere of a confined space before evacuation of the confined space becomes necessary from 5 percent of the lower explosive level (LEL) to 10 percent of the LEL, provided that a continuous monitoring flammable gas detector is in use.

(b) A requirement to perform a risk assessment of confined spaces before carrying out any work which requires entry to the confined space. Where a number of identical confined spaces are present, a single (generic) assessment is permitted where the risks are considered to be the same for each space.

(c) The use of an entry permit as the form of approval for entry to the confined space. The use of documented standing orders had not reached widespread acceptance.

(d) An increase in the minimum concentration of oxygen in the atmosphere within a confined space from 18 percent to 19.5 percent by volume. In addition, a maximum concentration of oxygen in the atmosphere within a confined space of 23.5 percent by volume has been specified.

Appendices are included to provide guidance for the conduct of specific tasks in a confined space (for example, cleaning and hot work). These recommendations list only the special additional precautions that need to be followed when such tasks are undertaken in a confined space.

During development of this Standard, reference was made to the documents listed below and acknowledgment is made of the assistance received therefrom:

1. INTERNATIONAL LABOUR OFFICE (ILO), *Encyclopaedia of Occupational Health and Safety - Confined Spaces*.

2. *Entering Tanks and Other Enclosed Spaces*, CIS Information Sheet No. 6.

3. *Safety Requirements for Working in Confined Spaces*, ANSI Z117.1 - 1977.

4. *Criteria for a Recommended Standard - Working in Confined Spaces*, United States National Institute for Occupational Safety and Health (NIOSH).

5. UNITED KINGDOM HEALTH AND SAFETY EXECUTIVE, Guidance Note GS5.

6. NATIONAL OCCUPATIONAL HEALTH AND SAFETY COMMISSION. *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1991)], Australian Government Publishing Service, Canberra, 1991.

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STANDARDS AUSTRALIA/WORKSAFE AUSTRALIA

# Australian Standard

# Safe working in a confined space

**1 SAFE WORKING IN A CONFINED SPACE** This Standard may be cited as the *Joint National Standard for Safe Working in a Confined Space.*

**2 OBJECTIVES** The objectives of this Standard are to provide guidance to:

(a) eliminate or, where this is not practicable, minimize the need to enter confined spaces; and

(b) provide for the health and safety of all persons who need to enter or work in confined spaces by preventing exposure to hazards which may otherwise be experienced when working in a confined space, and thereby prevent collapse, injury, illness or death arising from exposure to those hazards.

**3 SCOPE** This Standard sets out the particular requirements and procedures for designers, manufacturers, suppliers, modifiers, employers, persons in control and employees to ensure the health and safety of persons required to enter or work in a confined space. For the purpose of this Standard, a person whose upper body or head is within a confined space is considered to have entered the confined space.

NOTE: This is not intended to prevent a person from inserting their hand or arm while holding a test instrument or probe into a confined space as part of the evaluation prior to entry.

Requirements and procedures for ensuring general occupational health and safety, for example, welding safety and prevention of slips and falls are dealt with in other Standards and regulations rather than being specifically addressed in this Standard. It should be noted that a confined space may exacerbate other hazards, for example, noise or heat stress.

This Standard is framed to help designers, manufacturers, suppliers, modifiers and users where confined spaces are involved to achieve a high safety standard. It is not exhaustive in its coverage, but it is intended to cover those areas which are of particular concern in the workplace. It will be necessary for persons who require further information to research various other legislation, standards, codes and guidance notes.

This Standard is not intended to cover situations which are not at atmospheric pressure, such as work in decompression chambers. At pressures significantly higher or lower than the normal atmospheric pressure, expert guidance should be sought.

Specific workplaces, for example, dangerous goods storage areas, may be subject to other standards, regulations or code of practice.

**4 APPLICATION** This Standard is applicable to confined spaces as defined in Section 6.2. The Standard does not apply to underground mining and tunnelling construction, nor does it apply to work which is carried out at other than normal atmospheric pressure.

Emergency services are exempted from the written procedures for the duration of the emergency.

**5 REFERENCED DOCUMENTS** A list of referenced documents is given in Appendix A.

**6 DEFINITIONS** For the purpose of this Standard, the definitions below apply.

**6.1 Competent person** - a person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to perform correctly a specified task.

**6.2 Confined space –** an enclosed or partially enclosed space which:

(a) is at atmospheric pressure during occupancy;

(b) is not intended or designed primarily as a place of work;

(c) may have restricted means for entry and exit; and

(d) may -

(i) have an atmosphere which contains potentially harmful levels of contaminant;

(ii) not have a safe oxygen level; or

(iii) cause engulfment.

Confined spaces include but are not limited to -

(A) storage tanks, tank cars, process vessels, boilers, pressure vessels, silos and other tank-like compartments;

(B) open-topped spaces such as pits or degreasers;

(C) pipes, sewers, shafts, ducts and similar structures; and

(D) any shipboard spaces entered through a small hatchway or access point, cargo tanks, cellular double bottom tanks, duct keels, ballast and oil tanks, and void spaces, but not including dry cargo holds.

**6.3 Contaminant** - any dust, fume, mist, vapour, gas or other substance in liquid or solid form, the presence of which may be harmful to health and safety.

**6.4 Employee** - an employee as defined by the principal occupational health and safety legislation in each jurisdiction.

**6.5 Employer** - an employer as defined by the principal occupational health and safety legislation in each jurisdiction.

NOTE: An employer includes the self-employed which means a person who works for gain, other than under a contract of employment, apprenticeship or traineeship, whether or not that person employs others.

**6.6 Exposure standard** - an airborne concentration of a particular substance in the person's breathing zone, exposure to which, according to current knowledge, should not cause adverse health effects nor cause undue discomfort to nearly all persons. The exposure standard can be of three forms: time-weighted average (TWA), short-term exposure limit (STEL) or peak exposure limit.

The following terms are used in calculating levels of atmospheric contaminants:

(a) *Time-weighted average* (TWA) The average airborne concentration of a particular substance when calculated over a normal eight-hour work day, for a five-day working week.

(b) *Short-term exposure limit* (STEL) A l5 minute TWA exposure which should not be exceeded at any time during a workday even if the eight-hour TWA average is within the TWA exposure standard. Exposure at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day. There should be at least 60 minutes between successive exposures at the STEL.

(c) *Peak* A maximum or peak airborne concentration of a particular substance determined over the shortest analytically practicable period of time, which does not exceed 15 minutes.

NOTE: For further information refer to the National Occupational Health and Safety Commission's *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1991)].

**6.7 Flammable range -t**he range of flammable gas or vapour (percentage by volume) in air in which an explosion can occur upon ignition. Expressed by lower explosive limit (LEL) and upper explosive limit (UEL).

NOTE: the concentration of the flammable contaminant in air either below the LEL or above the UEL propagation of a flame does not occur on contact with an ignition source.

**6.8 Hot work** - welding, thermal or oxygen cutting, heating, and other fire-producing or spark-producing operations that may increase the risk of fire or explosion.

**6.9 Lower explosive limit (LEL)** - in relation to a flammable contaminant, the concentration of the contaminant in air below which the propagation of a flame does not occur on contact with an ignition source.

**6.10 Purging** - the method by which contaminants are displaced from a confined space.

**6.11 Regulatory authority** - a Minister of the Crown, a 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 this Standard.

**6.12 Safe oxygen level –** a minimum oxygen content in air of 19.5 percent by volume under normal atmospheric pressure (equivalent to a partial pressure of oxygen ($pO_2$) of 19.8 kPa (148 mm Hg)), and a maximum oxygen content in air of 23.5 percent by volume under normal atmospheric pressure (equivalent to a partial pressure of oxygen ($pO_2$) of 23.9 kPa (179 mm Hg)).

At pressure significantly higher or lower than the normal atmospheric pressure, expert guidance should be sought.

**6.13 Shall** - indicates that a statement is mandatory.

**6.14 Should** - indicates a recommendation.

**6.15 Stand-by person** - a competent person assigned to remain on the outside of, and in close proximity to, the confined space and capable of being in continuous communication with and to observe those inside, if practicable. In addition, where necessary, initiate rescue procedures and operate and monitor equipment used to ensure safety during entry and work in the confined space.

## 7 DESIGN, MANUFACTURE, SUPPLY AND MODIFICATION

**7.1 A person who designs, manufactures or supplies a confined space shall ensure that, where practicable, the design eliminates the need for persons to enter the confined space.**

**7.2 Where there is a need for persons to enter the confined space the person who designs, manufactures or supplies the confined space shall ensure that:**

**(a) where practicable, the confined space is designed to minimise risks to persons entering or working in the confined space; and**

**(b) the confined space is provided with safe means of entry and exit when entry may be required.**

**7.3 A person who modifies a confined space shall ensure that any alterations to the confined space do not detrimentally affect the safe means of entry and exit.**

NOTE: See Appendix B for more details.

## 8 CONSULTATION

**8.1 In implementing this regulation an employer shall consult with employees and/or their representatives in accordance with relevant provisions of the occupational health and safety legislation in each jurisdiction.**

## 9 HAZARD IDENTIFICATION

**9.1 For any work proposed, the employer shall identify any confined spaces and the hazards associated with working in those confined spaces.**

**9.2 Signposting** Where practicable, the employer should signpost and secure the confined space.

**9.3 Hazards** Fatalities or severe injuries may occur as a result of the following:

(a) Oxygen deficiency in the confined space which may be caused by -

(i) slow oxidation reactions of either organic or inorganic substances;

(ii) rapid oxidation (combustion);

(iii) the dilution of air with an inert gas;

(iv) absorption by grains, chemicals or soils; or

(v) physical activity.

(b) Oxygen excess in the confined space which may be caused by a leaking oxygen supply fitting such as in gas cutting or heating equipment.

(c) The presence of contaminants on surfaces or in the atmosphere. Contaminants may be in the form of solids, liquids, sludges, gases, vapours, fumes or particulates. The sources of atmospheric contaminants encountered may include -

(i) the manufacturing process;

(ii) the substance stored or its by-products (for example, disturbing decomposed organic material in a tank can liberate toxic substances such as hydrogen sulphide, while biological hazards such as bacteria, viruses or fungi may also be present); and

(iii) the operation performed in the confined space (for example, painting with coatings containing toxic or flammable substances, and welding or brazing with metals capable of producing toxic fumes).

(d) Operation of moving equipment (for example, being trapped by augers, crushed by rotating or moving parts such as conveyor belts).

(e) Uncontrolled introduction of steam, water, or other gas or liquid.

(f) Suffocation by solids (for example, grain, sand, flour and fertilizer).

(g) Electrocution.

(h) Explosion or fire.

**9.4 Additional factors** Undertaking work in confined spaces may greatly increase the risk of injury from hazards, such as –

(a) noise, which may be caused by hammering or the use of equipment within the confined space;

(b) temperature, either high or low, which can result from the work process or the weather conditions, or where appropriate ventilation or appropriate clothing is not supplied or worn;

(c) radiation within a confined space (for example, from X-rays, radiation gauges, isotopes, lasers and welders);

(d) manual handling; and

(e) falls, trips and slips.

## 10 RISK ASSESSMENT

**10.1 An employer shall ensure that a risk assessment is undertaken by a competent person before carrying out work involving entry into a confined space. As far as practicable the assessment shall be in writing and take into account at least the following:**

**(a) the nature of the confined space;**

**(b) the work required to be done, including whether it is necessary to enter the confined space;**

**(c) the range of methods by which the work can be done;**

**(d) the hazards involved and associated risks;**

**(e) the actual method selected and plant proposed; and**

**(f) emergency and rescue procedures.**

**10.2 The employer shall ensure that the assessment is revised whenever there is evidence to indicate that it is no longer valid.**

**10.3 Risk factors** Factors to consider when undertaking a risk assessment include -

(a) arrangements for rescue, first aid and resuscitation;

(b) the number of persons occupying the space;

(c) the number of persons required outside the space to maintain equipment essential for the confined space task, to ensure adequate communication with and observation of the persons within the confined space, and to properly initiate rescue procedures (see also Section 13.9);

(d) all proposed operations and work procedures, particularly those that may cause a change in the conditions in the confined space;

(e) the soundness and security of the overall structure and the need for illumination and visibility;

(f) the identity and nature of the substances last contained in the confined space;

(g) the steps needed to bring the confined space to atmospheric pressure;

(h) the atmospheric testing to be undertaken and the parameters to be assessed before the entry permit is issued;

NOTE: A sample risk assessment is shown in Appendix C.

(i) all hazards which may be encountered (for example, entrapment);

(j) the status of fitness and training of those persons involved in confined space work;

(k) adequate instruction of those persons in any work procedure required, particularly those which are unusual or non-typical, including the use and limitations of any personal protective equipment and mechanical or other equipment to be used;

(l) the availability and adequacy of appropriate personal protective equipment, protective clothing and rescue equipment for all persons likely to enter the confined space;

(m) whether signs -

(i) comply with Australian Standard AS 1319, and

(ii) indicate that entry is permitted only after signing the entry permit, in a manner appropriate to the persons at the workplace;

(n) the need for additional protective measures, for example -

(i) prohibition of hot work in adjacent areas,

(ii) prohibition of smoking and naked flames within the confined space and, where appropriate, the adjacent areas,

(iii) avoidance of contamination of breathing atmosphere from operations or sources outside the confined space, such as from the exhaust of an internal combustion engine, and

(iv) prohibition of movement of equipment such as forklifts in adjacent areas, and

(v) prohibition of spark generating equipment, clothing and footwear;

(o) whether cleaning in the confined space is necessary; and

(p) whether hot work is necessary.

**10.4 Risk assessment examples** Two examples of risk assessments are given in Appendix C.

**10.5 Generic assessment** Where the employer is responsible for multiple, similar confined spaces in which similar work is performed, there are identical risk factors and where it is not practicable to undertake a separate risk assessment for each of these similar confined spaces, a generic risk assessment may be appropriate. The generic risk assessment should identify any differences in the condition or location of the confined space or the work performed in it, which could result in a change to the risk factors.

**10.6 Assessment frequency** The period between risk assessments should be determined by the employer in consultation with employees and their representatives. Risk assessments should be revalidated whenever a significant change in the risk is likely to result from –

(a) installation or modification of plant;

(b) a change in equipment operating conditions;

(c) a change in the atmosphere or working environment; or

(d) a change in working arrangements or procedures.

NOTE: Where new plant is involved, designers and manufactures of equipment which incorporates confined spaces should take steps to ensure that risk assessments take place at appropriate intervals in consultation with the current users of the plant. The users of the plant may vary according to the phase in the life cycle of the plant.

## 11 CONTROL MEASURES

**11.1 If a risk assessment identifies a risk to health or safety arising from work involving entry into a confined space, the employer shall eliminate or minimise the risk.**

**11.2 Hierarchy of control measures** A hierarchy of control measures to eliminate or minimise the risk should be followed in the priority order listed and consists of -

(i) elimination;

(ii) substitution;

(iii) isolation;

(iv) engineering controls;

(v) administrative controls; and

(vi) use of personal protective equipment.

**11.3 Implementation** The hierarchy lists the control measures that the employer should implement in the workplace in priority order. Consequently, complete elimination of the need to enter the confined space should be the first consideration. It is only if this is not practicable that consideration should be given to the second measure in the hierarchy, that is, substitution. Examples of substitution include the use of -

(a) a non-flammable solvent in place of a flammable solvent;

(b) a detergent in place of a chlorinated solvent for cleaning;

(c) a water-based paint in place of an organic solvent-based paint;

(d) brush application of paint rather than aerosol application; and

(e) pastes instead of powders.

**11.4 Combining control measures** The employer should work through the hierarchy of controls and apply each as far as is practicable. This process of progressively applying the elements of the hierarchy of controls should continue until the risks have been reduced to acceptable levels. It may be necessary to use a combination of control measures to eliminate or minimise the risk to employees.

**11.5 Use of personal protective equipment** Personal protective equipment shall only be used as a last resort when all of the other control measures (singly or in combination) have failed to adequately control the risk.

**11.6 Precautions** The procedures for work in confined spaces are summarized in Figure 1.

NOTES:
1 Guidelines for specific precautions and methods of work for particular tasks in a confined space are set out in Appendices D and E.
2 A checklist of major consideration is given in Appendix F.

**11.7 Review of control measures** Control measures should be carefully reviewed and improved, extended or replaced as necessary to ensure adequate control. Reviews should take place at regular intervals or as indicated by the assessment report, in the event of any significant change to plant or process.

**11.8 Prior to any person entering a confined space, the employer shall ensure that where practicable all potentially hazardous services, including all process services, normally connected to that space are isolated in order to prevent:**

**(a) the introduction of any materials, contaminants, agents or conditions harmful to people occupying the confined space; and**

**(b) the activation or energizing in any way of equipment or services which may pose a risk to the health or safety of persons within the confined space.**

**11.9 Isolation requirements** It may be necessary for employers to withdraw a confined space from service before it is prepared for entry. Employers should ensure that all persons who may be involved with the repair, maintenance or operation of the confined space are advised.

**11.10 Isolation factors** The employer shall ensure that positive steps are taken to achieve the following:

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

Attention is drawn to hazards which may arise from the operation of some protective services in an occupied confined space (for example, fixed fire extinguishing systems, (see Appendix E)).

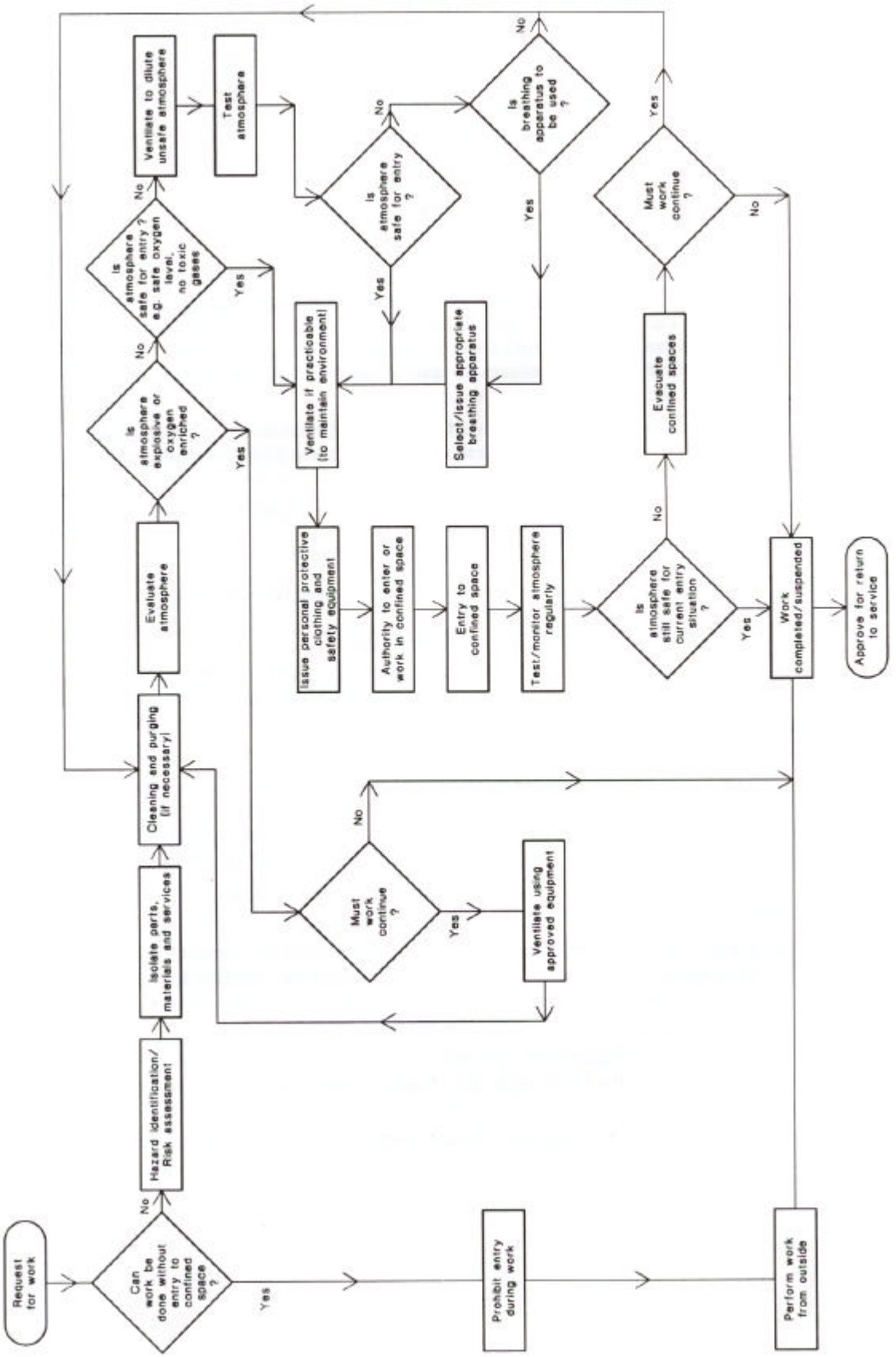


FIGURE 1 SUMMARY OF PROCEDURES FOR CONFINED SPACE ENTRY

(b) De-energisation and lockout, or if lockout is not practicable then tagout, or both lockout and tagout, of machinery, mixers, agitators or other equipment containing moving parts in the confined space.

This may require additional isolation, blocking or de-energising of the machinery itself to guard against the release of stored energy (for example, springs).

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

**11.11 Methods of isolation from contaminants** Where required by Clause 11.8, a confined space should be isolated before entry is permitted. The method of isolation should be in accordance with one of the following methods or by an alternative method ensuring equivalent security:

(a) Removal of a valve, spool piece, an expansion joint in piping leading to, and as close as practicable to, the confined space and blanking or capping the open end of the piping leading to the confined space. The blank or cap should be identified to indicate its purpose. Blanks or caps should be of a material that is compatible with the liquid, vapour or gas with which they are in contact. The material should also have sufficient strength to withstand the maximum operating pressure, including surges, which can be built up in the piping.

(b) Insertion of a suitable full-pressure spade (blank) in piping between the flanges as close as practicable to the confined space. The full-pressure spade (blank) should be identified to indicate its purpose.

(c) Where neither of the methods described in Items (a) and (b) is practicable, isolation by means of closing and locking, or closing and tagging, or both, of at least two valves in the piping leading to the confined space. A drain valve between the two closed valves should also be locked open or tagged open to atmosphere as part of this method.

**11.12 Methods of isolation from moving parts** Before entry is permitted to any confined space that in itself can move, or in which agitators, fans or other moving parts which may pose a risk to personnel are present, the possibility of movement should be prevented by using one of the methods described below or by alternative methods offering equivalent security. Equipment or devices with stored energy, including hydraulic, pneumatic, electrical, chemical, mechanical, thermal or other types of energy, should be reduced to a zero energy condition.

The person entering the confined space should proceed as follows:

(a) The person entering the confined space or a competent person authorised in writing by the employer should place a lock or tag, or both, on the open circuit breaker or open isolating switch supplying electric power to equipment with hazardous moving parts, to indicate that a person is in a confined space and that such isolation should not be removed until all persons have left the confined space. When a lock is used, the key should be kept in the possession of the person making entry or the competent person. Spare keys should not be accessible except in cases of emergency.

(b) Where a power source cannot be controlled readily or effectively, a belt or other mechanical linkage should be disconnected and tagged to indicate that a person is in a confined space and that the belt or linkage should not be reconnected until all persons have left the confined space.

(c) Where the methods described in Items (a) and (b) are not practicable, moveable components should be locked, and switches, clutches or other controls should be tagged to indicate that a person is in a confined space and that the locks and tags should not be removed until all persons have left the confined space.

(d) Where more than one person is in the confined space, the isolating device should be either -

(i) locked or tagged, or both, by each person entering the confined space, or

(ii) locked or tagged, or both, by a competent person authorised in writing by the employer.

(e) Where the locking or tagging is undertaken by a competent person authorised in writing by the employer, all persons entering the confined space should verify, or have it verified to them, that isolation is effective prior to their entry.

**11.13 Removal of means of isolation** The locks, tags, blanks or other protective systems should only be removed after the competent person, authorised in writing by the employer, ensures that work has been suspended or completed and all persons have vacated the confined space.

**11.14 Cleaning prior to entry** Where practicable, all substances, which are likely to present a hazard to persons who enter the confined space, should be removed prior to any entry to the confined space.

**11.15 Need for entry** Where practicable, a confined space should be cleaned without entry. Where entry is necessary for the purposes of cleaning, an entry permit is required.

**11.16 Location of contaminants** Potentially hazardous levels of contaminants may be trapped in sludge, scale or other deposits, brickwork or behind loose linings, in liquid traps, or in instrument fittings, and may be released only when, for example, it is disturbed or heat is applied. Similarly, such material may lodge in joints in vessels or in bends of connecting pipes or other places where removal is difficult.

**11.17 Recommendations** Additional recommendations for cleaning confined spaces are listed in Appendix D.

**11.18 The employer shall ensure that, where appropriate, the confined space shall be cleared of contaminants by use of a suitable purging agent. An employer shall ensure that pure oxygen or gas mixtures with oxygen in a concentration greater than 21 percent by volume is not used for purging or ventilation.**

**11.19 Pressure differentials** Care should be taken in the purging of a confined space to preclude rupture or collapse of the enclosure due to pressure differentials.

**11.20 Flammable contaminants** When flammable contaminants are to be purged, purging and ventilation equipment designed for use in hazardous locations (see AS 2430.1 and AS 2430.2) should be used and precautions taken to eliminate all sources of ignition.

**11.21 Static electricity** Where necessary, reference should be made to AS 1020 to guard against static electricity discharge.

**11.22 Exhaust location** The methods employed should ensure that any contaminants removed from the confined space are exhausted to a location where they present no hazard.

**11.23 Ventilation** Ventilation of a confined space should be by natural, forced or mechanical means to establish and maintain a safe breathing atmosphere. This ventilation should be continued throughout the period of occupancy.

**11.24 Contamination generating operation** During operations likely to generate contaminants, mechanical ventilation equipment may not be adequate or sufficiently reliable to maintain a safe breathing atmosphere.

**11.25 Mechanical ventilation** Where the maintenance of a safe breathing atmosphere in a confined space is dependent on mechanical ventilation equipment, for example, a fan, the equipment should -

(a) be continuously monitored while the confined space is occupied; and

(b) have the controls (including any remote power supply) clearly identified and tagged to guard against unauthorised interference.

**11.26 Exhaust location** Exhaust facilities should be arranged to ensure that any contaminated air removed from the confined space does not present a hazard to persons or equipment. Combustion engines providing power for compressed air or any other use associated with the work being done in the confined space should be located so that their exhaust emissions cannot enter within the confined space or contaminate air being supplied to the confined space.

**11.27 Ventilating with oxygen** Pure oxygen or gas mixtures with oxygen in concentration greater than 21 percent by volume shall not be used to ventilate a confined space.

## 12 SAFETY OF THE ATMOSPHERE

**12.1 The employer shall ensure that no person enters a confined space without an entry permit.**

**12.2 The employer shall ensure, before a person enters a confined space, that where practicable:**

**(a) the confined space contains a safe oxygen level;**

**(b) the atmospheric contaminants in the confined space are reduced to below the relevant exposure standards;**

**(c) the confined space is free from extremes of temperature; and shall ensure**

**(d) the concentration of flammable contaminant in the atmosphere of the confined space is below 5 percent of its LEL.**

**12.3 The employer shall ensure that atmospheric testing and monitoring is carried out consistent with the hazards identified and the risk assessment.**

**12.4 The employer shall ensure that where it is not practicable to provide a safe oxygen level, or atmospheric contaminants cannot be reduced to safe levels, no person enters the confined space unless they are equipped with suitable personal protective equipment including air supplied respiratory protective equipment.**

**12.5 Exposure standards** Although exposure standards have been set for a large number of chemicals, these still represent only a small fraction of all chemicals. Compliance with an exposure standard is mandatory where a relevant standard has been incorporated into legislation. Where there is no exposure standard, professional advice should be obtained.

**12.6 Atmospheric evaluation** An evaluation of the atmosphere and a survey of other hazards should be performed from outside the confined space before any entry occurs. The results should be recorded on the entry permit.

It is intended that entry into, or work in a confined space, the atmosphere of which has been established and maintained as being acceptable for entry, be still in compliance with the requirements of this Standard.

**12.7 Test required** The evaluation of the atmosphere should include testing by scientific means for –

(a) oxygen content;

(b) airborne concentration of flammable contaminants; and

(c) airborne concentration of potentially harmful contaminants, unless suitable personal protective equipment including air supplied respiratory protective equipment is worn during entry and occupation of the confined space.

**12.8 Evaluation of remote regions** Evaluation of more remote regions within the confined space may be performed once the area adjacent to the point of entry to the confined space has been proven acceptable for entry. Evaluation of these remote regions may need to be undertaken by persons wearing supplied-air respiratory protective equipment.

**12.9 Retest or monitoring after entry** Where considered necessary, for example, as indicated from the evaluation in Clauses 12.6 and 12.7 or because of the potential for later release of contaminants, arrangements should be made to monitor or retest (at appropriate intervals) the atmosphere within the confined space.

**12.10 Where the concentration of flammable contaminant in the atmosphere of a confined space has been found to be greater than 5 percent of its LEL and less than 10 percent of its LEL, persons in the confined space shall be removed unless a continuous-monitoring suitably calibrated flammable gas detector is used in the confined space at all times while persons are present.**

**12.11 Where the concentration of flammable contaminant in the atmosphere of a confined space has been found to be 10 percent of its LEL or greater, persons in the confined space shall be removed.**

**12.12 Gas detectors** The continuous-monitoring flammable gas detector should be fitted with latching, visible and audible alarms which should activate at a contaminant concentration of not greater than 10 percent of the LEL.

**12.13 The employer shall ensure that no entry or work is carried out within the confined space or upon the outside surface of the confined space:**

**(a) if there may be a risk to health and safety of persons occupying the confined space or working upon its surface; or**

**(b) when a risk of fire or explosion exists.**

## 13 RISK CONTROL

**13.1 Subject to review of the risk assessment completed in accordance with Section 10, the employer shall provide written approval, in the form of an entry permit, prior to work in a confined space being carried out.**

**13.2 The employer shall ensure that no person enters a confined space without an entry permit and that:**

**(a) the entry permit includes any precautions or instructions necessary for safe entry and execution of the work**

**(b) the entry permit is provided to the person responsible for the direct control of the work in a confined space, and records which persons enter the confined space; and**

**(c) the persons involved in the work are advised of, understand and comply with the contents of the entry permit.**

**13.3 An employer shall ensure and acknowledge, in writing, that work in the confined space has been completed and that all persons involved in the work have left the space before authorization for the return to service of the confined space is made.**

**13.4 Issue of entry permit** The entry permit should state the period of its validity and should be revalidated whenever it becomes evident that the duration of work will involve one of the following:

(a) A change in the person responsible for the direct control of the work in a confined space.

(b) A significant break in work continuity.

(c) A significant change in atmosphere or work to be performed.

**13.5 Display of entry permit** The entry permit should be displayed in a prominent place to facilitate signing and clearance. A copy should be held by the employer.

**13.6 Typical entry permit** The sample entry permit should serve as a guide, but the subject matter of an entry permit need not be limited to the areas mentioned.

NOTE: A typical entry permit is shown in Appendix G.

**13.7 Recording persons entering a confined space** The name of each person entering a confined space and each person required for stand-by purposes should be recorded.

**13.8 Completion of entry permit** The employer should be responsible for ensuring that the entry permit is completed. The following areas and actions should be considered as a basis for an entry permit (see also the sample permit listed in Appendix G):

(a) Location and description of the work to be done.

(b) Hazards that may be encountered.

(c) Isolation checklist.

(d) Atmospheric test readings as appropriate, for example -

  (i) oxygen level ;

  (ii) flammability or explosive levels;

  (iii) atmospheric contaminant levels;

  (iv) temperature and humidity; and

  (v) radiation levels.

  NOTE: Recommendations for atmospheric monitoring are given in Appendix H.

(e) Need for continuing review of ventilation and atmospheric conditions.

(f) Working conditions, including -

  (i) awareness that conditions (physical or chemical) may change and may need continuing review;

  (ii) the possibility of heat stress from task-generated heat, ambient temperature or the effect of wearing protective clothing; and

  (iii) the likely levels of noise within the confined space.

(g) Clothing and equipment including -

  (i) the types of equipment and clothing required for the task;

  (ii) the need for respiratory protective device;

  (iii) the need for safety harness and line;

  (iv) the need for emergency lighting (for example, a torch); and

  (v) means of communication.

(h) Personnel including -

  (i) the number of persons to enter the confined space;

(ii) stand-by personnel for communication and operation of essential equipment;

(iii) personnel for rescue and first aid; and

(iv) adequacy of personnel training and understanding of the hazards.

(i) Other precautions including -

(i) the need for signposting or barricading;

(ii) the need for prohibition of smoking or naked flame within the confined space or surrounding area; and

(iii) need for communication between stand-by personnel and backup personnel.

(j) Emergency precautions including -

(i) emergency procedures established;

(ii) provision and location of rescue equipment including emergency services;

(iii) location of first aid equipment; and

(iv) provision of firefighting equipment.

**13.9 The employer shall ensure that where the risk assessment indicates a risk to health and safety, no person enters a confined space unless stand-by person(s) are present outside the confined space.**

**13.10 Provision of stand-by person** The employer should provide stand-by person(s) wherever the risk assessment indicates that -

(a) there may not be a safe oxygen level;

(b) atmospheric contaminants are present or may be present in concentrations above the exposure standards;

(c) there may be a risk of fire or explosion;

(d) there may be a risk of entrapment or engulfment;

(e) the work to be performed may generate risk to health or safety;

(f) equipment or conditions outside the confined space require control or monitoring to ensure the health and safety of persons in the confined space (for example, ventilation, respirator air supply, vehicles and weather); or

(g) there may be other risks to the health or safety of persons entering the confined space.

**13.11 Communication** Employers should ensure that communication and, where practicable, observation between those in the confined space and the stand-by person(s) are capable of being constantly maintained. Communication can be achieved, dependent on the conditions existing in the confined space, in a number of ways, including voice, radio, hand signals and other appropriate means. For example, where visual or oral communication is not possible, then a system of rope signals could be devised. Microwave, long wave or low wave radio equipment can be used in confined spaces where normal radio is unsuitable.

**13.12 Alternating entry and stand-by persons** Where it is expected that the person entering the confined space and the stand-by person may change places, the employer may authorize either to (stand by) while the other person is inside the confined space.

**13.13 Number of stand-by persons** The minimum number of stand-by persons required should be recorded on the entry permit, (see Clause 13.8).

**13.14 The employer, prior to any person entering a confined space, and during any occupancy of the confined space, shall ensure appropriate signs and protective barriers are erected to prevent entry of people not involved in the work.**

**13.15 An employer shall provide suitable equipment, including, where necessary, equipment for:**

**(a) personal protection;**

**(b) rescue;**

**(c) first aid; and**

**(d) fire suppression.**

**13.16 The employer shall ensure that the equipment is appropriate to the work to be carried out in the confined space, and maintained in a proper working condition. The employer shall ensure that personal protective equipment and rescue equipment is selected and fitted to suit the individual.**

NOTE: For further guidance on this topic see Appendix I.

**13.17 Respiratory protective devices** Suitable supplied-air respiratory protective devices complying with AS/NZS 1716, or otherwise approved by the regulatory authority, should be worn where -

(a) the results of the assessment or monitoring indicate that a safe atmosphere cannot be established or may not be maintained; or,

(b) the nature of the work procedure within the confined space is likely to degrade or contaminate the atmosphere in the confined space (for example, hot work, painting or removal of sludge).

**13.18 Source of breathing air** The source of breathing air should be in accordance with AS/NZS 1715.

**13.19 Selection and use** Respiratory protective devices should be selected, fitted, used, stored, maintained and inspected in accordance with AS/NZS 1715.

**13.20 Safety harnesses and lines** Suitable safety harnesses and safety lines or rescue lines, complying with AS 1891, should be worn where -

(a) there is a hazard of falling during ascent or descent; or

(b) rescue by a direct route, either vertical or horizontal, is practicable.

**13.21 Precautions for use** It is not always desirable to specify the use of a safety harness, safety line or rescue line as this may be impracticable. When considering specifying the wearing of such equipment, care should be exercised to ensure that such equipment would not introduce a hazard or unnecessarily hinder free movement within a confined space. In the event of free movement being hindered, alternative plans should be arranged, for example, for rescue and fall arrest.

**13.22 Rescue considerations** Removal of unconscious persons from confined spaces is extremely difficult. The use of hand-operated lifting equipment should be considered and, where appropriate, be on site before entry to the confined space is permitted.

**13.23 Selection** The selection of the type of safety harness or safety line or rescue line should be in accordance with AS 2626 and should take account of the possible hazards/rescue arrangements. The equipment should be stored, maintained and inspected in accordance with Australian Standard AS 2626.

**13.24 Electrical equipment** All electrical equipment which is to be used in a confined space and is connected to an external supply should comply with AS 3100 and, where required, installed in accordance with AS 3000.

**13.25 Portable electrical equipment** The portable electrical equipment should -

(a) be connected, individually or collectively, to earth-free, extra-low voltage supply from an isolating transformer(s) complying with AS/NZS 3108, with the transformer(s) being located outside the confined space;

(b) be protected through a residual current device complying with AS 3190, with the device being located outside the confined space; or

(c) be air driven.

**13.26 Supply cable** Additionally, the equipment should be fitted with a flexible supply cable not inferior to a heavy duty type complying with AS 3191. The cables should be located, suspended or guarded to minimize accidental damage.

**13.27 Double-insulated tools** Where available, it is recommended that double-insulated electrical tools be used.

**13.28 Ignition sources** Where a flammable atmosphere is likely to exist, precautions should be taken to eliminate all sources of ignition. (See also AS 2380.7, AS 2430.1 and AS 2430.2.)

**13.29 Gas cylinders** Where practicable, no cylinder of compressed or liquefied gas, other than those used for self-contained breathing apparatus, should be taken into a confined space. The compressed or liquefied gas supply to equipment in the confined space should be turned off at the cylinder valve when not in use. These gas cylinders should be secured. Hoses supplying gas-operated equipment used in a confined space should be located, suspended or otherwise guarded to avoid accidental damage. In addition, these hoses should be tested for leaks prior to installation.

**13.30 Portable ladders** Where a portable ladder is used, particular care should be taken to ensure it is firmly secured to prevent movement. Portable ladders should comply with AS 1892 Part 1 or Part 2, as applicable.

## 14 EDUCATION AND TRAINING

**14.1 The employer shall provide training for all persons required to work within or on a confined space in all relevant activities related to entering and working in or on confined spaces.**

**14.2 The training program shall include at least the following:**

**(a) the hazards of confined spaces;**

**(b) assessment procedures;**

**(c) control measures;**

**(d) emergency procedures; and**

**(e) the selection, use, fit and maintenance of safety equipment.**

**14.3 Initial training** Initial training and retraining at appropriate intervals should be provided. The training specified should be provided as close as practicable, in time, prior to commencing work in the confined space and be relevant to the specific task and procedure.

**14.4 Trainer skills** Training should be conducted by persons knowledgeable in all relevant aspects of confined space entry, hazard recognition, use of safety equipment and methods of rescue.

**14.5 Level of competence** Training should be continued until the employer is satisfied that each person has been trained to an acceptable standard of competence. Details of such training should be suitably recorded, for example, in a personnel file.

**14.6 Content of training for employees** While the emphasis placed on different aspects will depend on the target group, training for all target groups should include the following content:

(a) The provisions of the relevant regulations.

(b) The provisions of this Standard which are directly relevant to their work.

(c) Physical, chemical and biological hazards relating to work in or near confined spaces in general and the particular confined space.

(d) Established healthy and safe work practices in the workplace, including lockout and isolation procedures.

(e) Emergency procedures in the workplace and relating to the confined space, including rescue drills and the use of safety equipment.

(f) Selection, distribution, use, fit and maintenance of personal protective equipment.

(g) Risk identification and assessment.

(h) Emergency entry and exit procedures.

(i) Communications.

(j) Recognition of any hazards specific to the activity.

(k) First aid and cardio-pulmonary resuscitation.

(l) Fire protection and suppression.

**14.7 Training shall be given to persons who:**

**(a) perform work in or on confined spaces;**

**(b) perform confined space assessments;**

**(c) issue entry permits;**

**(d) design and lay out the workplace;**

**(e) manage and/or supervise persons working in or near confined spaces, including any contractors;**

**(f) maintain equipment used for and during confined space entries;**

**(g) purchase, distribute, fit, wear and maintain personal protective equipment;**

**(h) are on stand-by; and**

**(i) are involved in rescue and first aid procedures.**

**14.8 General precautions** Entering or working in a confined space can be hazardous and may impose extra physiological demands. Therefore the aptitude and physical competence of persons who are to conduct such entry or work and those who are to be appointed to stand-by duties outside the confined space, should be appropriately evaluated by the employer or their representative with regard to the tasks envisaged and type of confined space.

**14.9 Review of training** Training should be evaluated and reviewed in consultation with relevant employees or their representatives, in order to ensure that the content of the training programs is clearly understood by all employees and the overall objectives of the training programs have been achieved, as well as to identify when further training is required.

**14.10 The employer shall record the training which is provided to employees.**

**14.11 Records of training** Records of training should include -

(a) the names of employees receiving training and dates of attendance;

(b) the title of the training course and an outline of its contents;

(c) the duration of training;

(d) the names, qualifications and experience of the person providing the training; and,

(e) whether the training program is registered or accredited by any statutory body, government department, educational institution or other association or organisation.

## 15 RESCUE AND FIRST AID

**15.1 General** The need for the rescue of personnel from a confined space and the provision of first aid, either in the confined space or after rescue from the space, may arise. This may include the involvement of the emergency services.

**The employer shall ensure that appropriate rescue and first aid procedures and provisions are planned, established and rehearsed.**

**15.2 Procedures** All persons who may be involved in any way with rescues from a confined space should be made aware that -

(a) well-planned and well-rehearsed rescue procedures are essential and are to be followed at all times; and

(b) in an emergency, the spontaneous reaction to immediately enter and attempt a rescue from a confined space may lead to the deaths or serious injury of those attempting the rescue.

**15.3 General** All personnel likely to form part of a rescue team should be trained in accordance with Clause 14, particularly in cardio-pulmonary resuscitation techniques.

**15.4 An employer shall ensure that:**

**(a) openings for entry and exit to a confined space are of adequate size to permit rescue of all persons who may enter a confined space; and**

**(b) the openings are not obstructed by fittings or equipment which could impede rescue, or, where this is not practicable, that a suitable alternative means of rescue is provided.**

## 16 RECORD KEEPING

**16.1 The employer shall keep and maintain:**

**(a) entry permits for one month;**

**(b) the current recorded risk assessment reports for work in a confined space for five years from the time of their validity; and**

**(c) training records for the term of the employee's employment;**

**unless longer periods are necessary, as in the case of health surveillance being required.**

**16.2 All records shall be made available to the employee and the regulatory authority inspectors on request.**

APPENDIX A

# LIST OF REFERENCED DOCUMENTS

(Normative)

**REFERENCED DOCUMENTS**

| | |
|---|---|
| AS | |
| 1020 | The control of undesirable static electricity |
| 1210 | Unfired Pressure Vessels (known as the SAA Unfired Pressure Vessels Code) |
| 1228 | Boilers – Water-tube |
| 1270 | Acoustics - Hearing protectors |
| 1319 | Safety signs for the occupational environment |
| 1336 | Recommended practices for eye protection in the industrial environment |
| 1657 | Fixed platforms, walkways, stairways and ladders - Design, construction and installation |
| 1674 | Safety in welding and allied processes |
| 1674.1 | Part 1: Fire precautions |
| 1680 | Interior lighting |
| 1680.1 | Part 1: General principles and recommendations |
| 1797 | Boilers - Fire-tube, shell, and miscellaneous |
| 1800 | The selection, care and use of industrial safety helmets |
| 1801 | Industrial safety helmets |
| 1891 | Industrial safety belts and harnesses |
| 1892 | Portable ladders |
| 1892.1 | Part 1: Metal |
| 1892.2 | Part 2: Timber |
| 2225 | Insulating gloves for electrical purposes |
| 2275 | Combustible gas detection instruments for use in explosive atmospheres |
| 2275.1 | Part 1: General requirements for explosion protection of electrical apparatus and systems |
| 2380 | Electrical equipment for explosive atmospheres – Explosion-protection techniques |
| 2380.7 | Part 7: Intrinsic safety i |
| 2381 | Electrical equipment for explosive atmospheres – Selection, installation and maintenance |
| 2381.1 | Part 1: General requirements |
| 2430 | Classification of hazardous areas |
| 2430.1 | Part 1: Explosive gas atmospheres |
| 2430.2 | Part 2: Combustible gases |
| 2626 | Industrial safety belts and harnesses - Selection, use and maintenance |
| 3000 | Electrical installations – Buildings, structures and premises (known as the SAA Wiring Rules) |
| 3100 | Approval and test specification - General requirements for electrical equipment |

| | |
|---|---|
| AS | |
| 3190 | Approval and test specification - Residual current devices (current-operated earth-leakage devices) |
| 3191 | Approval and test specification - Electric flexible cords |
| AS/NZS | |
| 1200 | Pressure equipment |
| 1337 | Eye protectors for industrial applications |
| 1715 | Selection, use and ma intenance of respiratory protective devices |
| 1716 | Respiratory protective devices |
| 3108 | Approval and test specification – Particular requirements for isolating transformers and safety isolating transformers |

**RELATED DOCUMENTS**

WELDING TECHNOLOGY INSTITUTE OF AUSTRALIA. *Health and Safety in Welding*. Technical Note 7.

NATIONAL OCCUPATIONAL HEALTH AND SAFETY COMMISSION. *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1991)]. Australian Government Publishing Service, Canberra, 1991.

NATIONAL OCCUPATIONAL HEALTH AND SAFETY COMMISSION. *Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:3008(1991)]. Australian Government Publishing Service, Canberra, 1991.

INTERNATIONAL MARITIME ORGANIZATION. Resolutions A272(VIII) and A330(IX) and Code of Safe Practice for Solid Bulk Cargoes.

APPENDIX B

# GENERAL DESIGN CONSIDERATIONS

(Informative)

**B1 DESIGN AND INSTALLATION** Hazards involved in working in a confined space should be minimized at the design stage and during initial installation of equipment. Where practicable, the design for a confined space should eliminate the need to enter the confined space for maintenance or other purposes.

The features, aimed at enhancing the safety of persons working in a confined space, which should, where practicable, be incorporated at the design and installation stages (consideration should be given to the type of work, the frequency and duration of the tasks) are as follows:

(a) Provision of adequate and convenient means of entry and exit of persons who may be required to wear personal protective equipment, including breathing apparatus, and clothing (see also Paragraph B2).

Note: Legislation and guidance notes on specific installations may specify minimum dimensions for entry and exit.

(b) Provision of outlets and facilities for cleaning to remove or minimize the need for entry.

(c) Provision of ventilation facilities to avoid the build-up of any contaminants or combustible atmospheres.

(d) Provision for persons to work in other than stooped or cramped positions.

(e) Use of cladding or lining materials that are durable, require minimal cleaning and do not react with materials contained in the confined space.

(f) Design of structure and mechanical parts to provide for safe and easy maintenance without the need for persons to enter.

(g) Provide levels of illumination complying with AS 1680.1 which will be sufficient to permit safe entry, conduct of work and exit.

(h) Provision of fixed ladders, platforms and walkways complying with AS 1657.

(i) Provision of signs in a manner appropriate to the workplace complying with AS 1319 at each entry to the confined space warning against entry by persons other than those who are listed on the entry permit and who are signatories thereto.

(j) Provision of effective means of isolating energy sources.

(k) Provision of drain valves or other means of positive isolation in pipework to reduce risk of possible pressurization and incursion of contaminants to the confined space.

**B2 MEANS OF ENTRY AND EXIT** Except for boilers and pressure vessels, each confined space should be provided with at least:

(a) one entry having an aperture not less than 450 mm long by 400 mm wide, if rectangular, or not less than 450 mm in diameter, if circular, or having major and minor axes not less than 450 mm and 400 mm respectively, if elliptical; or

(b) other suitable means of entry and exit meeting the intent of Item (a).

NOTES:

1. Dimensions of openings in boilers and pressure vessels, including the means of entry into and exit from, are specified in other Standards. (for example, Australian Standards AS 1200, AS 1210, AS 1228 and AS 1797) and in regulations.

2. Guidance to the dimensions of access openings to cargo tanks and water ballast spaces on ships will be found in Resolutions A272 (VIII) and A330 (IX) of the International Maritime Organization.

The means of ingress to and egress from a confined space need to be kept free from any encumbrances. Accordingly, when the atmospheric contaminants or the nature of the work to be performed in a confined space may require such things as power lines, hoses and ventilation ducts to pass through an access hole, the provision of a second access hole is recommended.

APPENDIX C

# SAMPLE RISK ASSESSMENTS

(Informative)

**Cl GENERAL** The following sample risk assessments provide appraisals of considerations that may apply to work in a confined space. These risk assessments are general in nature and may apply to work in confined spaces, such as boilers, pressure vessels, silos, pits, pipes, sewers, shafts or ducts.

## C2 SAMPLE RISK ASSESSMENT (SIMPLE)

**Part 1 The work to be undertaken:**

Determine whether the valve in the confined space is in the open or closed position.

**Part 2 The range of possible work methods which could be used:**

Method (a): Direct observation from the access opening without entering the confined space. This is not our option due to the valve being a gate valve nota butterfly valve and the position of the handle cannot be relied upon.

Method (b): Introduce water downstream of the gate valve, under pressure, and by observation; see if any fluid enters the confined space.

Method (c): Enter the confined space and physically verify the status of the valve.

**Part 3 The hazards present:**

| | | **Estimated level of risk** LOW - - > HIGH |
|---|---|---|
| **Chemical agents:** | | |
| (a) | Combustible gases or vapours | X __ __ __ __ |
| (b) | Potentially explosive dusts | X __ __ __ __ |
| | Oxygen deficiency or excess | X __ __ __ __ |
| **Physical agents:** | | |
| (a) | Thermal extremes | X __ __ __ __ |
| (b) | Noise | X __ __ __ __ |

**Part 4 Details of the actual method to be used for the particular work:**

Method (c): Continuous mechanical ventilation and gas detection.

**Part 5 Procedures for emergency and rescue:**

Standard rescue procedures apply.

## C3 SAMPLE RISK ASSESSMENT (MORE COMPLEX)

**Part 1 The work to be undertaken:** Inserting and welding a side junction into a pipeline approximately 10 metres from the entry point to the confined space.

**Part 2 The range of possible work methods which could be used:**

Method (a): Perform the work from outside the confined space. This is not an option due to the remoteness of the work site.

Method (b): Access the confined space to perform the work using forced mechanical ventilation taking care not to recirculate exhaust gases. Employ continuous gas monitoring.

Method (c): Access the confined space to perform the work using supplied-air respiratory devices. Employ continuous gas monitoring.

**Part 3 The hazards present:**

| | | Estimated level of risk<br>LOW - - > HIGH |
|---|---|---|
| **Chemical agents:** | | |
| (a) | Harmful levels of hydrogen sulphide from disturbing sediments | __ __ __ X __ |
| (b) | Combustible gases or vapours from decomposition of organic material or infiltration of flammable materials through broken sections of pipes | __ __ X __ __ |
| (c) | Potentially explosive dusts | X __ __ __ __ |
| | Oxygen deficiency from rusting processes | __ __ __ X __ |
| **Physical agents:** | | |
| (a) | Flooding from failure of the outlet pipe and associated structures | __ __ X __ __ |
| (b) | Thermal extremes | X __ __ __ __ |
| (c) | Noise | __ X __ __ __ |

**Part 4 Details of the actual method to be used for the particular work:**

Method (b) will be used with the following specific details to be noted and observed:

(a) Provide forced mechanical ventilation through the tunnel (confined space) at a flow of 1500 litres per second.

(b) Prevent recirculation of exhaust gases.

(c) Open all hatches.

(d) Divert flow to one side while work is being conducted on the other.

(e) Block off small intermittent flow adjacent to entry point.

(f) Insert blanking piece at valve between pumped line and gravity line.

(g) Disconnect pipe from valve on gravity flow line and insert blanking piece.

(h) Flush clean prior to working on steelwork.

(j) Monitor gas conditions continuously as follows:

(i) If any flammables occur, consider sealing the distribution channels with plywood and silastic before any hot work.

(ii) Use specialist gas tester for hot work clearance associated with removal of existing steelwork.

(iii) If any gas alarm occurs, stop work and evacuate.

(k) If significant oxycutting is necessary or welding fumes linger due to ineffective mechanical ventilation, supplied-air respiratory devices must be supplied and worn during the work process.

**Part 5 Procedures for emergency and rescue:**

(a) Tripod and safety harness must be used for access. Wear safety harness and other PPE, as appropriate, while working.

(b) Carry oxygen self-rescuers.

(c) Communication must be available to standby person and emergency services either by radio or telephone.

(d) Standby and competent persons must be fully trained in rescue procedures and first aid.

**C4 SAMPLE RISK ASSESSMENT FORM**

**Part 1 The work to be undertaken:** . . . . . .

. . . . . .

**Part 2 The range of possible work methods which could be used:**

Method (a) . . . . . .

Method (b) . . . . . .

Method (c) . . . . . .

Method (d) . . . . . .

**Part 3 The hazards present:**

| | **Estimated level of risk** |
|---|---|
| | LOW - - > HIGH |
| **Chemical agents:** | |
| (a) Combustible gases or vapours | __ __ __ __ __ |
| (b) Potentially explosive dusts | __ __ __ __ __ |
| (c) Oxygen deficiency or excess | __ __ __ __ __ |
| **Physical agents:** | |
| (a) Thermal extremes | __ __ __ __ __ |
| (b) Noise | __ __ __ __ __ |

**Part 4 Details of the actual method to be used for the particular work:**

. . . . . .

**Part 5 Procedures for emergency and rescue:** . . . . . .

. . . . . .

. . . . . .

APPENDIX D

# ADDITIONAL RECOMMENDATIONS FOR THE CLEANING OF CONFINED SPACES

(Informative)

**Dl GENERAL** This Appendix lists recommendations for undertaking cleaning tasks in a confined space. The recommendations are in addition to the requirements specified in all work in a confined space.

Procedures and processes to be used to clean the inside of a confined space should be reviewed and authorised prior to entry. The method to be used will depend upon the material in the confined space and the potential hazards that may be created by the cleaning process itself. Contaminants should be disposed of in a manner that will not constitute a hazard.

NOTE: Attention is drawn to the requirements of regulatory authorities governing particular operations/use of equipment, which may exceed these guidelines.

The following general practices should be observed where practicable:

(a) Initial cleaning should be performed from outside the confined space. Such initial cleaning, including drainage and scale removal, should continue until the hazard of atmospheric contaminants has been reduced as far as possible.

(b) Each person entering the confined space should be provided with suitable protective suits, suitable safety footwear, a safety helmet with face shield, appropriate eye and face protection, protective gloves and, where necessary, an appropriate respiratory protective device.

(c) Hose-couplings should be of such a design that they are unable to loosen or be accidentally dislodged during operation.

## D2 HYDROJETTING

**D2.1 General** The following general precautions should be observed when hydrojetting is undertaken in a confined space:

(a) Hydrojetting should always be carried out by trained personnel.

(b) Warning signs complying with AS 1319 and indicating that hydrojetting is in progress should be displayed in conspicuous locations outside the confined space.

(c) The area affected by the hydrojetting should be barricaded while work is in progress.

(d) Where there is a possibility of a flammable environment, the nozzle of the hydrojetting equipment should be earthed to decrease the generation of static electricity (see also AS 1020).

(e) Nozzle operators should have direct visual or audible communication with the pump operators.

(f) Removal of fluids from the confined space should be continuous during the operation, especially in the case of such work as that in ships' tanks, fuel tanks.

(g) A high-pressure/low volume gun should be used to intermittently clean, rather than operating continuously, thus allowing adequate replacement of air.

**D2.2 Equipment** All high-pressure cleaning equipment should be fitted with actuating devices which require positive effort by the operator, hand or foot, to keep the supply valve open. In addition, the following recommendations for hoses should be observed:

(a) Hoses used for high pressure cleaning should have a bursting pressure of at least twice that of intended operating pressure.

(b) Hoses should be tagged to indicate working pressure and age.

(c) Hoses with exposed reinforcing wire should be disposed of immediately.

(d) Care should be taken when laying out hydrojet hoses on the ground to avoid constant pulsation damage, especially from corners.

**D.3 STEAM CLEANING** Where a confined space is to be cleaned by steam, the following precautions should be observed:

(a) Where there is a possibility of a flammable environment, the pipe or nozzle of the steam hose should be bonded to the confined space enclosure to prevent the build up of static electricity (see also AS 1020).

(b) Where there is a possibility of a flammable environment in the confined space, steam temperatures should be significantly lower than the auto-ignition temperature of previously stored products.

(c) The confined space should be allowed to return to an acceptable thermal environment prior to entry.

**D4 ABRASIVE BLASTING** Cleaning by abrasive blasting should only be undertaken where suitable air-supplied respirators are used and regulations for the particular jurisdiction are followed.

Consideration should also be given to the need to provide the following:

(a) Illumination and visibility adequate to allow safe working to continue.

(b) Protection of the breathing air-line to the respirator.

(c) Escape equipment.

(d) Actuating devices which require positive effort by the operator to keep the blasting apparatus supply valve open.

**D5 CHEMICAL CLEANING** In addition to creating toxicity hazards, chemicals used in cleaning operations may also be capable of producing a flammable atmosphere. Accordingly, the safety of the atmosphere should be re-evaluated after cleaning and prior to the commencement of further work.

APPENDIX E

# ADDITIONAL RECOMMENDATIONS FOR THE CONDUCT OF HOT WORK IN CONFINED SPACES

(Informative)

**E1 GENERAL** Information should be provided on the possibility of hot work reducing the oxygen level and that hot work itself may release hazardous substances.

NOTES:

1. Hot work is defined in Clause 6 and is used in industry to describe welding, thermal or oxygen cutting, heating and other fire-producing or spark-producing operations.
2. Attention is drawn to the requirements of regulatory authorities governing particular operations/use of equipment, which may exceed these guidelines, and to the relevant provisions of AS 1674.1 and of the Welding Technology Institute of Australia's Technical Note 7.
3. Welding in a confined space should be conducted in accordance with the requirements of AS 1674.1 and the recommendations of this Appendix.

**E2 PERMITS** Hot work in, or on the exterior surfaces of, an occupied 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 entry permit to the confined space.

The hot work permit should certify that appropriate precautions have been carried out and should list the frequency of any tests necessary to ensure that safe conditions are maintained.

Aspects to be taken into account when considering the issue of a permit include the following:

(a) When a confined space or a space adjacent thereto has contained a flammable liquid, vapour or gas, in addition to the requirements of Paragraph E3, the permit should be issued only after inspection and testing have ensured that the following factors have been considered:

  (i) The concentration of flammable vapours or gases in the atmosphere.

  (ii) The liquid and solid residues have been removed as necessary to prevent the release of flammable substances that will raise the concentration of flammable substances in the atmosphere.

  (iii) The concentration of flammable vapour or gas within any piping within the confined space or connected to it.

(b) In a confined space having last contained dry material that creates an explosive atmosphere when dispersed in air, the permit should be issued only after inspection has ensured that loose dust has been removed from the confined space and all appropriate surfaces have been cleaned or the material has been rendered safe (for example, by wetting grain dust).

(c) Where fixed fire-extinguishing equipment employing an extinguishant which may affect the safety of the environment protects the confined space, such equipment should be positively isolated when the space is occupied, regardless of whether it has manual or automatic activation controls. It should be noted that the discharge of certain fixed extinguishing systems can rapidly cause the atmosphere in a confined space to become dangerous to life. In such cases, alternative fire protection should be provided in the confined space by adequate numbers of the appropriate size and type of portable fire extinguishers.

**E3 FIRE PREVENTION** The following fire preventative measures should be taken:

(a) 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.

(b) 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).

(c) 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.

NOTE: Sparks from direct penetration or heat transfer may also create an explosion or fire hazard in the adjacent spaces outside the confined space.

(d) 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 pressurized fire hose and a suitable nozzle or other suitable extinguishing equipment, or both, should be available.

(e) 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-energized, all electrodes removed from holders and the holders placed so that accidental contact or arcing cannot occur.

(f) 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. Where practicable, the torch and hose should be removed from and depressurized outside the confined space.

(g) Where practicable, no compressed gas cylinders or associated manifold, other than those used for self-contained breathing apparatus, should be located inside the confined space.

(h) Where practicable, remove flammable metal anti-corrosion anodes from work site.

**E4 CONTROL OF FUMES** Fumes should be controlled as follows:

(a) Before hot work is started on a metal surface which is coated, the atmosphere in the confined space should be tested to ensure that the concentration of flammable vapours, dusts or gases from coatings having flashpoints below the ambient temperature, do not exceed the safety requirements for the LEL. During such hot work, periodic tests should be conducted to ensure that these limits are not exceeded.

(b) In a confined space, all surfaces covered with coatings that would decompose or volatilize under hot work into toxic, corrosive or irritant components, should be stripped from the area of heat application. Coatings should also be removed for a sufficient distance from the area to be heated in order to minimize the temperature increase of the unstripped metal. Additionally, artificial cooling of the metal surrounding the hot work area may be necessary to limit the size of the area required to be cleaned.

NOTE: Typical coatings which may pose a hazard include zinc, cadmium, lead paints, certain other paints and plastics.

(c) Means should be provided to exhaust contaminated air from the confined space. The exhaust suction point should be located as close as possible to the source of contamination within the confined space (for example, welding). Such exhaust should be directed to a location where it presents no hazard and will not accidentally be recirculated into the confined space.

APPENDIX F

# TYPICAL CHECKLIST

(Informative)

The following checklist provides a ready reference of the major considerations that apply to work in a confined space. This list, or an alternative list designed for a particular confined space or industry, should be used in order to minimize the risks involved in confined space work.

**F1 PRE-ENTRY** The pre-entry considerations should be at least as follows:

(a) Employee selection, including evaluation of an employee's aptitude and fitness for task and confined space entry.

(b) Employee training should include at least the following:

- (i) Emergency entry and exit procedures.
- (ii) Use of applicable respiratory protective devices.
- (iii) First aid including cardio-pulmonary resuscitation (CPR).
- (iv) Lockout procedures.
- (v) Safety equipment use.
- (vi) Rescue drills.
- (vii) Fire protection.
- (viii) Communications.

(c) Actions required are as follows:

- (i) Coordinate planning of work.
- (ii) Coordinate supervising of work.
- (iii) Implement emergency rescue plan.
- (iv) Initiate safe work practices.
- (v) Signpost work area.
- (vi) Isolate confined space.
- (vii) Evaluate confined space environment.
- (viii) Comparison of initial test results with existing standards to determine ventilation and/or personal protection requirements.
- (ix) Ventilate and/or provide personal protection.
- (x) Provide for monitoring of confined space during work.
- (xi) Ensure that standby staff are available for rescue and operation of essential equipment.
- (xii) Ensure rescue equipment is readily available and in order.
- (xiii) Authorise entry by permit.
- (xiv) Suspend work/evacuate space if conditions change to present real/potential danger.

(d) Recognition of potential hazards. The hazards to be considered should include at least the following:

(A) Physical agents:

(i) Thermal extremes.

(ii) Radiation.

(iii) Noise.

(iv) Flooding.

(B) Chemical agents:

(i) Combustible gases or vapours.

(ii) Toxic gases or vapours.

(iii) Combustible or toxic liquids or solids.

(iv) Potentially explosive dusts.

(C) Oxygen deficiency or excess

(D) Potential hazards during work

**F2 DURING ENTRY AND RE-ENTRY** The considerations during entry and re-entry should be at least the following:

(a) A comparison of initial test results with an existing standard to determine whether ventilation or personal protective equipment will be used.

(b) Continuous or periodic monitoring of confined space atmosphere.

(c) Ensure safe work practices followed.

(d) Reissue permit after absence from area or if conditions change.

(e) Confirmation that all persons and equipment are accounted for.

**F3 AFTER EXIT** The consideration after exit should include at least the following:

(a) Ensure safe work practices followed.

(b) Review of operation - comment on any unsatisfactory aspects.

(c) Acceptance of completed job.

(d) Secure the entry point to the confined space.

(e) Clean equipment and store away as appropriate.

APPENDIX G

# SAMPLE PERMIT FORM FOR CONFINED SPACE ENTRY

(Informative)

**1 NAME AND ADDRESS**

. . . . . .
(a) Employer s Name

. . . . . .
(b) Location of Work

. . . . . .
(c) Employees Assigned

. . . . . .
(d) Outside Contractors

**2 DESCRIPTION OF WORK TO BE UNDERTAKEN**

. . . . . .

. . . . . .

The whole of the remaining detail of this permit must be signed by the competent person before work is to proceed and only work listed may be done.

**3 ISOLATION OF CONFINED SPACE** The items ticked below have been isolated or made safe:

(a) Pipelines (water, steam, gas, etc.)

(b) Mechanical/electrical drives

(c) Sludges/deposits/waste

(d) Harmful materials

(e) Electrical services

(f) Warning notices, locks or tags have been fixed to means of isolation

(g) Radiation services

Competent person. . . . . .

**4 HOT WORK** The precautions ticked below must be observed:

(a) Area clean and free of all readily combustible materials within 15 metres.

(b) All drains within 15 metres covered with wet fireproof blanket.

(c) Appropriate fire extinguishers on site near source of ignition.

(d) A water hose run to job site and tested/left running.

(e) All sparks from work more than 2 metres above ground contained completely by use of a suitable enclosure which shall be inspected before commencing work.

(f) Welding machine/gas cylinders located (not within 8 metres of any drain).

(g) Welding machine earthed directly to equipment being welded as close to welding point as possible.

(h) Power leads not draped across pipelines or access ways.

Electrical trace on pipes isolated hot work is/is not permissible inside the space (delete as appropriate).

(j) Competent person. . . . . .

**5 HAZARDS LIKELY TO BE ENCOUNTERED**

. . . . . .

**6 ATMOSPHERIC TEST REQUIREMENT**

The test equipment has been calibrated and the atmosphere has been tested to ensure safe oxygen levels, no flammability and/or explosive levels and for the following contaminants. (Fill in details and results of tests).

Continuous monitoring of the atmosphere is/is not required (delete as appropriate). The atmosphere is safe for entry under the conditions ticked:

☐ With a supplied air-respiratory protective device.

☐ With an air purifying (non air-supplied) respiratory protective device.

☐ Without a respiratory protective device.

Testing time . . . . . .

Date. . . . . .

Competent person. . . . . .

**7 USE OF CHEMICAL AGENTS** (Details to be completed.) No chemical agents other than those listed below may be taken into the confined space.

(a) . . . . . .

(b) . . . . . .

(c) . . . . . .

(d) . . . . . .

**8 STAND-BY PERSONNEL AND RESCUE ARRANGEMENTS**

(a) Stand-by persons are . . . . . .(identify).

(b) Rescue and emergency procedures are understood and have been posted.

Competent person. . . . . .

**9 PRECAUTIONS** The following (ticked) have been implemented:

☐ Warning notices/barricades are in position.

☐ Smoking has been banned in the confined space.

☐ Special precautions (indicate).

Competent person. . . . . .

**10 PERSONAL PROTECTIVE EQUIPMENT**

The following personal protective equipment (ticked) shall be worn:

☐ Supplied-air respirators.

☐ Air purifying respiratory protective devices.

☐ Safety harness and/or safety line or lifeline/rescue.

☐ Eye protectors.

☐ Hand protection.

☐ Foot protection.

☐ Protective clothing.

☐ Hearing protectors.

☐ Safety helmets.

Competent person. . . . . .

**11 AUTHORIZATION** (to be completed)

(a) The confined space described above is in my opinion in a safe condition for the work to be done, provided that the precautions above are fully observed.

Competent person . . . . . .

Time. . . . . .

Date. . . . . .

Valid until . . . . . .

Time. . . . . .

Date. . . . . .

(b) I/We understand the procedures required for entry and work in the confined space and the protective measures and equipment to be used.

Signed. . . .Time. . . ..Date

Valid until Time. . . ..Date

**12 PERSONS ENTERING/VACATING**

This section is to be used each time a person enters or leaves the confined space during the life of this permit.

Person. . . . in/out

Date. . . . . Time. . .

Person. . . . in/out

Date. . . . . Time. . .

**13 SIGNING OUT** All persons have left confined space and further entry should not be permitted unless a new entry permit is signed.

Competent person . . . . . .

**14 WORK COMPLETED/SUSPENDED** All persons/equipment have been withdrawn, the work has been completed and any plant/machinery is/is not fit for use (Delete as appropriate).

The following observation(s) of unsatisfactory aspects of the operation in the confined space are noted for attention prior to undertaking similar operations (attach separate sheet if necessary).

. . . . . .

Competent person. . . . . .

**15 ACCEPTANCE OF COMPLETED JOB** I accept that the work as defined in Section 2 of this permit has been completed

Competent person. . . . . .

APPENDIX H

# ADDITIONAL RECOMMENDATIONS FOR ATMOSPHERIC MONITORING

(Informative)

**H1 GENERAL** Employers should ensure that monitoring of the atmosphere when required and a survey of other hazards are performed from outside the confined space and from as many access holes, nozzles and openings as are available before any entry occurs. The results should be recorded on the entry permit. The tests should be performed in the order listed and should include those for oxygen content, flammability, atmospheric contaminants (for example, carbon dioxide, carbon monoxide and dusts, and thermal extremes).

Monitoring of more remote regions within the confined space, away from entries or manholes, may be performed once the area adjacent to the point of entry to the confined space has been made acceptable for entry.

Monitoring of these remote regions should be undertaken by persons wearing supplied air respiratory protective equipment. Normal stand-by requirements should apply during this testing as this is an entry into a confined space.

Special notice should be taken of the following:

NEVER TRUST YOUR SENSES TO DETERMINE IF THE AIR IN A CONFINED SPACE IS SAFE! YOU CANNOT SEE OR SMELL MANY TOXIC GASES AND VAPOURS, NOR CAN YOU DETERMINE THE LEVEL OF OXYGEN PRESENT.

Only when the test results show the confined space is safe, should normal entry be considered.

The normal means of assaying the air for fitness for breathing is to test it for specific materials with a suitable portable analyser. There are many different kinds of analysers available but the results are only as good as the operator's skill and the state of analyser maintenance. For example an explosimeter, used for measuring the percent LEL in a confined space, should be tested against a known standard gas both before and after a test for vessel entry. This is to ensure an accurate reading is obtained.

Other test equipment such as chemical detector tube pumps, should be regularly checked for leaks to avoid low readings. The detector tubes themselves also have a finite shelf-life beyond which their accuracy may be suspect. For large confined spaces, portable analysis with audible alarms should be inserted using appropriate non-sparking equipment.

**H2 GAS INDICATORS** Flammable gas indicators should comply with AS 2275.1.

The competent person is to have a thorough knowledge of the electronic gas indicator measurement strategy to be used. Factors to be taken into account include the following:

(a) Properties of the gas/vapour.

(b) Humidity and temperature in the space.

(c) Presence of airborne contaminants that may reduce the accuracy of the reading or (poison) the sensor.

(d) Presence of corrosive gases and mists which may damage the sensor and give misleading results causing a false zero reading.

(e) Calibration, adjustment and maintenance requirements.

(f) Need for recalibration during testing.

(g) Condensation and/or absorption of gas into the walls of sampling lines where these are used.

(h) Response of the instrument to high and low concentrations of flammable gas or vapours (for example, false zeros).

(j) Oxygen deficiency causing a false flammable gas reading.

(k) Oxygen enrichment where the instrument may act as an ignition source causing an explosion.

(l) Differences in atmospheric pressure which may cause erroneous readings in some sensors.

Equipment for monitoring of flammable gases, dusts and vapours should be intrinsically safe. All electronic equipment for monitoring should be equipped with an audible or visual alarm. Instruments used for testing the atmosphere in a confined space should be selected for their functional ability to measure hazardous concentrations. Instruments should be calibrated in accordance with the manufacturer's guidelines or manuals.

After air purging has been completed, forced draft devices, such as inductors or fans should be turned off for a sufficient time to allow for a normal atmospheric condition to exist for the gas testing of the confined space. If an acceptable result cannot be obtained without continuous forced draft ventilation, then the ventilation device should be suitably tagged and/or locked to ensure it is not disconnected while the inspection or other work is in progress. The stand-by person is responsible for monitoring the proper operation of the forced draft ventilation device.

Testing of the confined space should be carried out before the entry permit is issued. The tests should check on the presence of gas or fumes, on chemical deposits, and, where appropriate, on the adequacy of the supply of oxygen. A satisfactory result should be obtained before proceeding further.

**H3 RETESTING AND MONITORING** Retesting and continuous monitoring of the atmosphere may be necessary; for example, as indicated from the testing of the atmosphere or because of the potential for later release of hazardous material from sludge, scale or other deposits, brickwork or behind loose linings, liquid traps, instrument fittings, joints, bends, and the like. The hazardous material may be released if disturbed or if heat is applied.

The employer should arrange for repeat tests for oxygen and hazardous gases at intervals which take account of the likelihood of a change in conditions. No set time can be applied for all circumstances, but periods between tests should be set conservatively, not more than 24 hours apart. There should not be a significant delay between tests and the first entry to the confined space.

The frequency for retesting should be determined by the employer having knowledge of the equipment and processes. Use of continuous monitors with alarms is the most conservative approach.

If there is a significant break in occupancy of a confined space, the atmosphere should be retested before re-entry.

**H4 INTERPRETATION OF MEASUREMENT RESULTS** It is necessary for the employer to ensure that measurements on all relevant airborne contaminants and interpretation of results have been performed by a competent person. The results of measurements should be compared with the relevant exposure standard and with the LEL if the substance is flammable or combustible. Clause 12.2 requires that no entry into a confined space be permitted if the concentration of the flammable contaminant in the atmosphere exceeds 5 percent of its LEL. A measurement less than 5 percent of the LEL may still result in airborne contaminants exceeding occupational exposure standards.

Where persons have entered a confined space and are using continuous monitoring, they may remain in the confined space at concentrations of flammable contaminant in the atmosphere of less than 10 percent of its LEL before evacuation of the confined space is necessary. (See Clause 12.10.) Care should be taken to ensure that the level of airborne contaminants does not exceed occupational exposure standards.

This Standard requires an employer to compare the results with the relevant exposure standards and ensure that exposure does not exceed the exposure standard. The interpretation and intended use of exposure standards is described in NOHSC:3008(1991).

Where no exposure standard exists the employer is to ensure that a competent person develops a guideline based on the available scientific data.

Data on LELs for many flammable/combustible substances may be found in Australian Standards AS 2381.1 and AS 2430.2. Where a substance is not listed, then an information search is to be undertaken to identify the LEL.

APPENDIX I

# ADDITIONAL RECOMMENDATIONS FOR PROVISION AND USE OF PROTECTIVE AND SAFETY EQUIPMENT

(Informative)

**I1 GENERAL** Personal protective equipment should only be used as a last resort when all of the other control measures in the hierarchy are either inadequate or impractical.

Employers should ensure that the competent person decides on the appropriate protective equipment to be used in the confined space. All personal protective equipment should fit the individual who uses it. The following points should at least be considered:

(a) The assessment as required under Clause 10.1.

(b) Results of the evaluation of the atmosphere including testing.

(c) The process to be conducted within the confined space.

(d) The contaminants that may be encountered.

(e) The extra load placed on workers when wearing personal protective equipment.

Items normally used to protect against njury include safety glasses, hardhats, footwear and protective clothing.

**I2 EYE AND FACE PROTECTION** Employers should ensure that for persons who wear corrective spectacles, plano-goggles or visors are provided. Additionally if eye-irritating chemicals, vapours or dusts are present, appropriate safety goggles are necessary. If both the face and eyes are exposed to a hazard, as during scraping scale or cutting rivets, a full-coverage face shield with goggles should be used. During welding operations appropriate goggles or shields should be worn.

Eye protectors should comply with the requirements of AS/NZS 1337 or be approved. Guidance on eye protection is given in AS 1336.

**I3 HEAD PROTECTION** Industrial safety helmets should comply with AS 1801 or be approved. Guidance on selection care and use is given in AS 1800.

**I4 FOOT PROTECTION** Safety footwear should comply with the requirements of AS/NZS 2210.

**I5 BODY PROTECTION** Employers should ensure that all persons entering a confined space wear full-coverage work clothing as specified by the competent person. Gloves and clothing made of materials providing appropriate protection should be worn to protect against toxic or irritating substances. Such clothing should comply with AS 3765. If the hazards are heat or cold, protection from over-exposure to these hazards should be worn. Other body riveting (heat resistant) and abrasive blasting (abrasion resistant) protection should be provided to ensure worker safety. The weight and restriction of body protection, however, can become hazards themselves.

**I6 HEARING PROTECTION** Employers should ensure that where the assessment indicates it is necessary, hearing protection, complying with AS 1270 or as approved, is provided. Emergency alarm frequencies should be distinguishable when hearing protection is worn. Where the potential for explosion exists, the sound level meters should be intrinsically safe in accordance with AS 2380.7.

**I7 RESPIRATORY PROTECTIVE EQUIPMENT** Employers should ensure that the competent person determines the appropriate respiratory protection equipment based upon conditions and test results of the atmosphere with the confined space, and the work activity to be performed. Employers should also ensure that breathing apparatus fits properly and is safe to use. Care needs to be taken in the selection of equipment (for example, when employees wear beards) and in its use.

Respiratory protection equipment should comply with the requirements of AS/NZS 1716 or be approved.

The minimum service time of self-contained breathing apparatus should be calculated on the entry time plus the maximum work period, plus twice the estimated escape time as a safety margin.

**I8 HAND PROTECTION** Employers should provide, if hands are exposed to rough surfaces or sharp edges, the appropriate degree of protection ranging from canvas to metal mesh gloves, depending on the material handled. Gloves made of a suitable resistant material are to be worn to protect against toxic or irritating materials. Heat protective gloves are required when employees handle objects with temperatures greater than 60°C (140°F). Where a current flow through the body of more than 5 mA may result from contact with energised electrical equipment, employees should wear insulating gloves that have been visually inspected before each use. Above 5,000 V, rubber gloves in accordance with AS 2225 should be worn.

**I9 SAFETY HARNESS, SAFETY LINE RESCUE LINE** It is not always practicable to specify the wearing of a safety harness or safety line and/or rescue line. Employers should ensure that when considering specifying the wearing of such equipment care be exercised to ensure that such equipment would not introduce a hazard or unnecessarily hinder free movement within a confined space.

Removal of trapped, injured or unconscious people from confined spaces is extremely difficult. The use of mechanical lifting equipment should be considered and, where appropriate, be on site before entry to the confined space is permitted.

The selection of the type of safety harness or safety line or rescue line should be in accordance with AS 2626 and should take account of the possible hazards/rescue arrangements. The equipment should be stored, maintained and inspected in accordance with the requirements of AS 2626.

**I10 MAINTENANCE OF EQUIPMENT** The employer should establish a procedure to ensure that regular maintenance is carried out to ensure that the efficiency of the control measures is not reduced. Maintenance includes visual checks, inspections, testing of equipment, preventive maintenance and remedial work.

Any measures used to secure the confined space should be effectively maintained to ensure that entry into the confined space is prevented or adequately controlled. Safe working practices should be properly supervised to ensure their on-going effectiveness. Personal protective equipment should be cleaned, stored and maintained properly, and its use effectively supervised.

**I10.1 Personal protective equipment** The employer should ensure that proper maintenance is an integral part of any personal protective equipment program to ensure that the user receives the required level of protection at all times. Failure to provide proper cleaning and maintenance can have serious health effects.

In some cases, disposable protective equipment will remove the need for cleaning and maintenance. However, the employer should take great care to ensure that such equipment will offer the appropriate level of protection, and was not chosen simply because it can be thrown away after a single use, thus removing the need to provide maintenance facilities.

A proper maintenance program should include the following procedures:

(a) Regular cleaning and disinfecting of the equipment. Equipment worn by more than one worker should be cleaned and disinfected after each use.

(b) Drying the equipment.

(c) Inspection for any defects.

(d) Identification and repair or replacement of any used, consumed, worn or defective components and/or equipment.

(e) Clean storage of equipment when not in use.

(f) Employees to report damaged, defective or lost equipment to a competent person responsible for repair or replacement.

(g) Ensuring that supplies of disposable protective equipment are continually available to all users of the equipment.

Some items of personal protective equipment, such as eye protectors or gloves, are relatively easy for the user to clean and properly maintain, provided that the employer provides the appropriate training, cleaning equipment and storage facilities. However, the cleaning and maintenance of more complex equipment, such as non-disposable respiratory protective devices, requires specialised knowledge and equipment. It is usually necessary to set up a centralised cleaning and servicing section for this type of equipment.

All breathing apparatus, safety harnesses, lifelines, reviving equipment and any other equipment provided for use within, or in connection with entry into, confined spaces, and for use in emergencies, should be properly maintained and thoroughly examined regularly and as soon as possible after every occasion on which it has been used.

As a minimum, the equipment manufacturer's advice should be followed regarding proper maintenance of protective equipment. Refer also to the appropriate sections in the relevant Australian Standards. The employer should ensure that all respiratory protective equipment is used and maintained in accordance with AS/NZS 1715 as amended from time to time.

When and where appropriate, spare full cylinders of air and/or oxygen should be kept. These should also be regularly checked, and should be safely stored.

**I10.2 Testing equipment** Atmospheric testing and sampling equipment, oxygen meters, explosimeters, any special ventilating equipment should also be regularly maintained, and, where applicable, calibrated. Where a manufacturer's recommendation is available, these should be followed as a minimum maintenance program. It is particularly important that gas detectors and explosimeters are well maintained and frequently calibrated.

**I.ll MAINTENANCE RECORD** The regular examination of the equipment should be made by a competent person and details on testing, maintenance and repairs recorded in the form of a register. The information from the register should be readily accessible and kept near the equipment. A tag on the equipment, or accessing a computer record, may be appropriate.

**I.12 COMMUNICATION** Any communication procedures should be in a manner appropriate to the workplace and level of risk.