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Australian Standard[®]

Confined spaces



This Australian Standard® was prepared by Committee SF-037, Work in Confined Spaces. It was approved on behalf of the Council of Standards Australia on 13 August 2009. This Standard was published on 4 September 2009.

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 - Australian Industry Group
 - Australian Institute of Industrial Hygienists
 - Australian Manufacturing Workers Union
 - Australian Maritime Safety Authority
 - Australian Steel Institute
 - Department of Labour New Zealand
 - Energy Networks Association
 - Engineers Australia
 - NSW Department of Primary industries, Mineral Resources
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 - Local Government Association of Queensland
 - Safe Work Australia
 - Safety Institute of Australia
 - Water Services Association of Australia
-

This Standard was issued in draft form for comment as DR 05564.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard[®]

Confined spaces

Originated as AS 2865—1986.
Previous edition AS/NZS 2865:2001.
Revised and designated as AS 2865—2009.

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Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7337 9236 7

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-037, Work in Confined Spaces to supersede AS/NZS 2865:2001, *Safe working in a confined space*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

This Standard outlines the minimum requirements for establishing a safe system for entry and the conduct of tasks in or on a confined space. These requirements are consistent with industry best practice and are considered mandatory for reducing the risks associated with confined spaces and for establishing safe entry to them. Mandatory requirements of this Standard are highlighted in bold type and contained in boxes.

The purpose of this Standard is to provide safety requirements and procedures for persons entering and conducting tasks in a confined space. It is intended to ensure that confined spaces are made safe for those entering them, and to highlight the likely hazards associated with such spaces and the relevant risk control measures necessary to deal with these hazards.

This Standard emphasizes responsibilities for safety and sets out steps that need to be taken to eliminate or control risks that may arise during confined space operations. It also requires that all persons involved in the entry of a confined space be trained, assessed as competent, and instructed on the nature of the hazards and the risk control measures to be followed.

Significant revisions in this edition of the Standard are as follows:

- (a) The criteria that constitute a confined space have been clarified in the definition.
- (b) Guidance diagrams have been provided for identifying a confined space.
- (c) Recommendations for training and competency have been introduced.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard
Confined spaces

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out the particular requirements and risk control measures for the safety of persons entering or conducting tasks associated with a confined space.

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

NOTE: Further information may be found in legislation, Standards, Codes of Practice and guidance notes.

Requirements and controls for general occupational health and safety risks (e.g. welding safety, prevention of slips and falls) are dealt with in other Standards and regulations and are not specifically addressed in this Standard.

This Standard does not cover underground mining, tunnelling, excavation work, trenching, abrasive blasting or spray painting. In such cases, other safe systems of work apply.

This Standard is not intended to cover confined spaces that are not at atmospheric pressure. At pressures significantly higher or lower than the normal atmospheric pressure, expert guidance should be sought.

Many enclosed or partially enclosed spaces are not confined spaces in accordance with the definition in this Standard. Specific areas such as dangerous goods and hazardous substances storage areas are subject to their own legislation, Standards or Codes of Practice.

NOTE: A flow diagram for entry and conduct of tasks in a confined space is given in Appendix A.

1.2 OBJECTIVE

The objective of this Standard is to provide designers, manufacturers, suppliers, modifiers and users of plant equipment and services that contain confined spaces with the means to reduce the risks to health and safety of those working in or near confined spaces, by prescribing techniques and procedures covering entry to, and working in or on a confined space.

In addition, the Standard sets out to—

- (a) define the criteria for identifying a confined space;
- (b) provide guidance in recognizing the hazards associated with confined spaces;
- (c) outline the requirements for establishing a safe system for entry and the conduct of tasks in or on a confined space;
- (d) highlight the minimum requirements that are consistent with industry best practice and are considered mandatory for reducing the risks associated with confined spaces and for establishing safe entry to confined spaces; and

- (e) recognize the need for training of persons whose tasks are associated with confined spaces.

1.3 APPLICATION

This Standard is intended for use by designers, manufacturers, suppliers, modifiers and users of confined spaces as defined in Clause 1.5.5.

NOTE: The need to prepare a written risk assessment and written authority for entry may be waived only for the duration of an emergency.

The mandatory requirements of this Standard are contained within boxes and printed in bold type. An organization that does not follow the Standard in all respects would still be required to meet the mandatory requirements in the boxes.

1.4 REFERENCED DOCUMENTS

A list of referenced and related documents is given in Appendix B.

1.5 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.5.1 Airborne contaminant

Any contaminant present in the air that may be harmful to persons.

1.5.2 Atmospheric monitoring

The continuous measurement of oxygen concentration or airborne contaminants over an uninterrupted period of time.

1.5.3 Atmospheric testing

The measurement of oxygen concentration or airborne contaminants that is not continuous.

1.5.4 Competent person

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

1.5.5 Confined space

An enclosed or partially enclosed space that is not intended or designed primarily for human occupancy, within which there is a risk of one or more of the following:

- (a) **An oxygen concentration outside the safe oxygen range.**
- (b) **A concentration of airborne contaminant that may cause impairment, loss of consciousness or asphyxiation.**
- (c) **A concentration of flammable airborne contaminant that may cause injury from fire or explosion.**
- (d) **Engulfment in a stored free-flowing solid or a rising level of liquid that may cause suffocation or drowning.**

NOTES:

- 1 Enclosed or partially enclosed spaces that may meet the definition criteria for a confined space are—
 - (a) storage tanks, tank cars, process vessels, boilers, pressure vessels, silos and other tank-like compartments;
 - (b) pipes, sewers, shafts, degreaser and sullage pits, ducts and similar structures; and
 - (c) any shipboard spaces entered through a small hatchway or entry point, cargo tanks, cellular double bottom tanks, duct keels, ballast and oil tanks, and void spaces.

- 2 A confined space may or may not have restricted means of entry and exit. Appropriately sized entry and exit points are important for the safe entry and exit or retrieval of a person(s) in an emergency. However, a restricted means of entry or exit is not a consideration in identifying an enclosed or partially enclosed space as a confined space.
- 3 Most enclosed or partially enclosed spaces are intended or designed primarily for human occupancy, e.g. offices and workshops where adequate ventilation and lighting, safe means of access and egress, etc. are provided. From time to time they may have atmospheric hazards produced by task-related activities such as welding. Such task-related hazards are not covered by this Standard and other safety systems apply.
- 4 Some enclosed or partially enclosed spaces have atmospheric contaminants that are harmful to persons but are designed for persons to occupy, e.g. abrasive blasting or spray painting booths. Enclosed or partially enclosed spaces that are intended or designed primarily for human occupation and have systems such as gaseous fire extinguishing systems (see AS 4214) or inert gas systems for beverage dispensing (see AS 5034) installed, are not confined spaces. In such cases, other safety systems such as relevant legislation, Standards or Codes of Practice apply.
- 5 A rising level of a liquid in an enclosed or partially enclosed space may cause engulfment through the inability of a person to readily exit the space. Drowning in a reservoir, dam or tank where the level of liquid is static is not considered to be drowning from engulfment.

1.5.6 Contaminant

Any dust, fume, mist, vapour, biological matter, gas or other substance in liquid or solid form, the presence of which may be harmful to persons.

1.5.7 Engulfment

The immersion or envelopment of a person by a solid or liquid (e.g. grain, sugar, flour, sand, coal, fertilizer and other substances in a powder or granular form) that is stored within the confined space.

1.5.8 Entry (to a confined space)

When a person's head or upper body is within the boundary of the confined space.

NOTE: Inserting an arm for the purpose of atmospheric testing is not considered as entry to a confined space.

1.5.9 Explosive limits

1.5.9.1 Lower explosive limit (LEL)

The concentration of a flammable contaminant in air below which the propagation of a flame does not occur on contact with an ignition source.

1.5.9.2 Upper explosive limit (UEL)

The concentration of a flammable contaminant in air above which the propagation of a flame does not occur on contact with an ignition source.

NOTE: The terms 'explosive limit' and 'flammable limit' are equivalent. AS/NZS 60079.20 and AS/NZS 61779.1 use the term 'flammable limit' whilst other standards use the more widely accepted term 'explosive limit'.

1.5.10 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 or 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 concentrations of airborne contaminants:

- (a) *Time-weighted average (TWA)* The average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day working week.
- (b) *Short-term exposure limit (STEL)* A 15-minute TWA exposure that should not be exceeded at any time during a working day, even if the eight-hour TWA average is within the TWA exposure standard.
- (c) *Peak* A maximum or peak airborne concentration of a particular substance determined over the shortest analytically practicable period of time, not exceeding 15 minutes.

NOTES:

- 1 Exposure at the STEL should not be longer than 15 minutes and should not be repeated more than four times a day. There should be at least 60 minutes between successive exposures at the STEL.
- 2 For further information refer to the Safe Work Australia *Hazardous Substances Information System* (HSIS).

1.5.11 Flammable airborne contaminant

Any dust, fume, mist, vapour or gas present in the air at concentrations that can propagate a flame on contact with an ignition source.

1.5.12 Flammable range

The range of flammable airborne containment (percentage by volume) in air at which an explosion can occur upon ignition. Expressed as 'lower explosive limit' (LEL) and 'upper explosive limit' (UEL) (see Clause 1.5.9).

1.5.13 Hot work

Welding, thermal or oxygen cutting, heating, including fire-producing or spark-producing operations that may increase the risk of fire or explosion.

1.5.14 Impairment

The condition of being unable to safely conduct a task as a consequence of physical or mental unfitness.

1.5.15 Regulatory authority

A Minister of the Crown, government department, commission or other authority having power to issue regulations, orders or other instructions having the force of law in respect of any subject covered by this Standard.

1.5.16 Safe oxygen range

A concentration of oxygen in the atmosphere having a minimum of 19.5% by volume and a maximum of 23.5% by volume, under normal atmospheric conditions.

NOTE: At pressures significantly higher or lower than normal atmospheric pressure, expert advice should be sought.

1.5.17 Self-contained breathing apparatus (SCBA)

A portable respirator that supplies oxygen, air or other respirable gas from a source carried by the user.

1.5.18 Shall

Indicates that a statement is mandatory.

1.5.19 Should

Indicates a recommendation.

1.5.20 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, if practical, observing those inside. In addition, where necessary, the competent person may operate and monitor equipment for the safety of personnel in the confined space and initiate emergency response.

1.5.21 Supplied-air respirator

A device that supplies air to the wearer from a source other than the ambient atmosphere.

1.5.22 Task-related hazard

In respect to a confined space, exposure to a hazard because of the task being conducted on or in the confined space.

1.5.23 Written authority

A document that gives permission for entry into a confined space and the conduct of tasks associated with the confined space.

NOTE: The written authority is sometimes known as an 'entry permit', 'access authority' or 'permit to work'.

SECTION 2 PLANNING

2.1 PLANNING TO MANAGE AND CONTROL CONFINED SPACES

The management and control of confined spaces rely on the development and implementation of management and control systems that clearly cover all aspects of confined spaces.

A confined space management and control system should—

- (a) identify legal and other requirements;
- (b) assign accountabilities and responsibilities for all aspects dealing with confined spaces;
- (c) plan for the identification of confined spaces and the control of associated risks;
- (d) encompass the design, manufacture, supply and modification of a confined space;
- (e) outline consultation processes with all relevant persons;
- (f) identify required training and competency standards;
- (g) establish a system for the management of risks associated with a confined space; and
- (h) identify documentation requirements.

In addition to the initial planning phase, procedures should be established to guarantee that planning is ongoing and take into consideration any changes, additions or modifications to the confined spaces, plant operations or plant configurations.

2.2 LEGAL AND OTHER REQUIREMENTS

Legal and other requirements governing the activities associated with confined spaces should be identified.

This information should be kept current and communicated to all persons involved with confined spaces.

NOTE: These may include—

- (a) related Acts and Regulations;
- (b) industry or organizational policies, procedures and standards;
- (c) other criteria that may not always be legally binding but have evidentiary status such as approved Codes of Practice;
- (d) general occupational health and safety (OHS) laws; and
- (e) authorizations, licenses and permits.

2.3 ACCOUNTABILITIES AND RESPONSIBILITIES

The accountabilities and responsibilities of persons whose tasks are associated with confined spaces should be identified and documented. These should cover—

- (a) capacity to assign, control, delegate, and review confined space procedures, etc;
- (b) identification and risk assessment of a confined space;
- (c) the issue and receipt of access authorities;
- (d) standby and emergency response;
- (e) atmospheric testing or monitoring; and
- (f) training and competency assessment.

2.4 DESIGN, MANUFACTURE, SUPPLY AND MODIFICATION CONSIDERATIONS

2.4.1 Minimizing the risks associated with confined space

The confined space shall be designed and manufactured to minimize—

- (a) the need to enter the confined space; and
- (b) the risks associated with conducting tasks in a confined space.

2.4.2 Entry to and exit from a confined space

Openings for entry to and exit from a confined space shall be of adequate size to permit rescue of all persons who may enter the confined space.

2.4.3 Modification to a confined space

Any modification to a confined space shall not detrimentally affect the safe means of entry to, exit from, or the conduct of tasks in the confined space.

2.4.4 Safe design of a confined space

In the design and manufacture of plant, structures or processes (which includes a confined space, either intentionally or otherwise), the need to enter the confined space should be eliminated or, if that is not achievable, minimized.

The following features should, where relevant and practicable, be incorporated at the design and manufacturing stages:

- (a) Provision of outlets and facilities for cleaning, in order to eliminate the need for entry.
- (b) Design of structure and mechanical parts to provide for safe and easy maintenance, in order to reduce the need for persons to enter.
- (c) Design that can structurally open up the enclosed or partially enclosed space for maintenance and safely revert back to its original design intent and functionality when required.
- (d) Use of cladding or lining materials that are durable, require minimal cleaning and do not react with materials and substances contained in the confined space.
- (e) Provision for the security of the confined space against unauthorized entry.

NOTE: Further guidance on general design considerations is given in Appendix C.

Where it is not possible to eliminate the need to enter the confined space, any risk associated with the means of entry to and exit from the space should be minimized. The safety of entry to and exit from a confined space is increased when openings are large in comparison to the persons and their equipment that have to pass through them.

Other features that should, where relevant, be incorporated at the design and manufacturing stages include the following:

- (i) Entry and exit openings to the confined space and within the confined space (e.g. openings through divisions, partitions or obstructions) should be to be of adequate size to allow the passage of persons wearing the necessary protective clothing and equipment, and to permit emergency response related to persons who may be in the confined space.
- (ii) A means of entry to and exit from the confined space should be designed and manufactured to provide a safe means of entry and exit, e.g. the provision of fixed ladders, platforms and walkways.

NOTE: Requirements for fixed platforms, walkways, stairways and ladders are set out in AS 1657.

- (iii) Openings for entry to and exit from a confined space should be designed and manufactured to be unobstructed by fittings or equipment that could impede emergency response. The means of entry to and exit from a confined space should be free from any obstructions whilst any persons are in the confined space.

NOTE: When the airborne contaminants or the nature of the tasks to be conducted in a confined space may require services such as power lines, hoses and ventilation ducts to pass through an entry or exit opening, a second opening may be required.

- (iv) The number and interval spacing of entry and exit openings should be adequate for entry to and exit from the confined space. The interval spacing of entry and exit openings on sewers or large gas mains may affect both the degree of natural ventilation and the ease with which emergency response can be afforded to persons within the mains: entry and exit dimensions should be sufficient where the critical entry dimensions extend over a significant length or height, as in the case of sewers, pipes, culverts, small tunnels and shafts (e.g. if there is a long distance between the entry or exit openings or if a shaft contains a ladder or step irons).

2.4.5 Manufacture of a structure or plant

During the manufacture and subsequent installation of a structure or plant, consideration should be given to planning for the identification and assessment of atmospheric and engulfment hazards that might be created by the progressive manufacturing and installation phases. At some point in the manufacture or commissioning of a structure or plant, its physical characteristics or usage may make it unsafe for human occupancy as there is likely to be a risk from atmospheric or engulfment hazards. Where the progressive assessment indicates the existence of a confined space, the requirements of this Standard apply.

2.4.6 Reclassification of a confined space

For a confined space to be reclassified as a non-confined space, it needs to have undergone sufficient changes in structure or usage to eliminate (without the need for risk control measures) all possible sources of inherent hazards that define a confined space. Any changes to a confined space would have to be such that a subsequent risk assessment would determine that it no longer meets the criteria for a confined space.

2.5 CONSULTATION

2.5.1 Stakeholder consultation

In implementing the requirements of this Standard, consultation shall take place between the stakeholders, or their representatives, in accordance with the relevant provisions of the occupational health and safety legislation in each jurisdiction.

2.5.2 Consultation mechanisms

Consultation should take place when determining the implementation of risk management systems for the conduct of tasks on or in confined spaces.

NOTE: Consultation with persons whose tasks are associated with confined spaces may include—

- (a) persons at the workplace and their representatives;
- (b) line managers;
- (c) OHS committees;
- (d) contractors and subcontractors;
- (e) designers, manufacturers, suppliers, modifiers, and users;
- (f) clients; and
- (g) independent experts.

2.6 TRAINING AND COMPETENCY

2.6.1 Training and competency assessment

The requirements for training and assessment of competency are as follows:

- (a) All persons with tasks associated with a confined space shall be trained and assessed as competent to conduct those tasks.
- (b) Persons shall be reassessed at appropriate intervals to maintain their competency to conduct tasks associated with confined spaces.

2.6.2 Records of training and competency

The training that is provided to persons and the achieved competencies shall be recorded.

NOTE: Additional guidance for the provision of training and competency assessment is given in Appendix D.

2.7 RISK MANAGEMENT

A methodology for the management of risks associated with the confined space should be established and regularly reviewed. This methodology should cover hazard identification, risk assessment and control of risks based on the hazards of the confined space, operational experience, products and services and tasks associated with the confined space.

2.8 CONFINED SPACE EMERGENCIES

2.8.1 Confined space emergency response planning

Appropriate emergency response and first aid procedures and provisions shall be identified, planned, established and rehearsed.

2.8.2 Confined space emergency response

Those persons involved in an emergency response shall be made aware of the conditions and the number of persons in the confined space prior to any entry.

2.8.3 Confined space emergency procedures

In a confined space emergency, the spontaneous reaction to immediately enter and attempt to rescue a person from a confined space could lead to the death or serious injury of those attempting the rescue. All persons who might be involved in any way with emergency response associated with a confined space should be made aware that emergency response procedures are to be followed at all times.

2.9 DOCUMENTATION

2.9.1 General

Documentation should be established and maintained in a suitable medium, e.g. in print or electronic form, to at least—

- (a) identify external (e.g. legal) and internal organizational requirements;
- (b) assign key roles and responsibilities;
- (c) identify the location of confined spaces in the workplace;
- (d) outline the system for hazard/risk assessments and risk control;
- (e) identify training and competency requirements;
- (f) set out confined space entry requirements (e.g. access authorities, entry permits and permits to work);

- (g) detail safe systems of work;
- (h) list inspection, calibration and maintenance activities on confined space safety equipment;
- (i) identify emergency response procedures; and
- (j) provide direction to related documentation.

2.9.2 Document control

Because confined space documents communicate standards and direct action, they should be current, comprehensive and issued by an authoritative source.

Documents should be—

- (a) readily locatable;
- (b) periodically reviewed, revised as necessary and approved by competent and responsible persons prior to issue;
- (c) current and available at all locations where operations are essential for the effective management of confined spaces;
- (d) when obsolete, promptly removed from all points of issue and points of use or otherwise assured against unintended use; and
- (e) archived where necessary and data retained for legal or knowledge preservation purposes or both.

2.9.3 Record keeping

The following documentation should be maintained, in accordance with organizational needs or in accordance with legislative requirements:

- (a) The location of confined spaces.
- (b) Conduct of hazard/risk assessments and assigned risk control measures.
- (c) Procedures used for conducting tasks in or on the confined space.
- (d) Training and competency.
- (e) Confined spaces entry authorizations (e.g. written authorities, entry permits and permits to work).
- (f) Atmospheric testing and monitoring.
- (g) Inspection, calibration and maintenance of confined space safety equipment.
- (h) Inspections and audits of confined spaces.
- (i) Reports related to any incident/accidents associated with the confined space.

SECTION 3 IMPLEMENTATION

3.1 CONFINED SPACE HAZARDS

3.1.1 Confined space hazard identification

For any confined space, the hazards associated with conducting tasks in or on the confined space shall be identified.

3.1.2 Atmospheric hazards and engulfment hazards of confined spaces

Confined spaces can present a risk from atmospheric hazards or engulfment. These may include the following:

- (a) Oxygen concentration in the atmosphere below 19.5% in the confined space, which may be caused by—
 - (i) slow oxidation reactions of either organic or inorganic substances, e.g. rusting;
 - (ii) rapid oxidization, e.g. a fire;
 - (iii) displacement of oxygen in the atmosphere by other gases; or
 - (iv) absorption by stored substances.
- (b) Oxygen enriched atmospheres, with oxygen concentration greater than 23.5% by volume. Atmospheres with oxygen enrichment have an increased risk of fire or explosion, particularly when flammable contaminants are present. Causes of oxygen enriched atmospheres in confined spaces include—
 - (i) inadvertent purging with oxygen; or
 - (ii) oxygen injection systems (used in sewerage systems).
- (c) The presence of contaminants in the atmosphere or on surfaces. The sources of contaminants encountered may include—
 - (i) the manufacturing process;
 - (ii) the substance stored or its by-products (e.g. petroleum products, or disturbing decomposed organic material that may liberate toxic substances such as hydrogen sulphide); or
 - (iii) hazardous services connected to the confined space.

NOTE: Contaminants may be in the form of gases, vapours, fumes, solids, liquids, sludge or particulates.
- (d) Free-flowing solids stored in the confined space, e.g. grain, sugar, flour, sand, coal or fertilizer.
- (e) An increase in the level of a liquid in the confined space.

3.1.3 Task-related hazards and other occupational hazards

The tasks a person is required to conduct may expose them to risks from the hazards associated with the occupational environment and the task(s) being conducted. These task-related hazards may include the following:

- (a) A reduction in the oxygen concentration in the atmosphere to below 19.5% by volume in the confined space. This may be caused by fire or respiration.

- (b) Oxygen enriched atmospheres with oxygen concentration greater than 23.5% by volume, which may be caused by—
 - (i) a leaking oxygen hose or fitting when using oxy-acetylene equipment; or
 - (ii) the use of chemicals that release oxygen, e.g. hydrogen peroxide.
- (c) Airborne contaminants, e.g. dust, fibres, and lead or mercury fumes.
- (d) Inability to maintain continuous communication and/or observation between those in the confined space and the stand-by person(s), or other systems of work methods and controls provided for an equal or better safety outcome.
- (e) Noise, e.g. that caused by hammering or the use of equipment within the confined space.
- (f) Temperature (either high or low) resulting from the occupational environment or the weather conditions, or where appropriate ventilation is not provided or appropriate clothing is not worn.
- (g) Radiation within the confined space, e.g. from X-rays, radiation gauges, isotopes, lasers and welding equipment.
- (h) Manual handling.
- (i) Unsafe entry and exit or unsafe surfaces.
- (j) Inadequate lighting.
- (k) Restricted entry or exit.
- (l) Openings obstructed by fittings or equipment that could impede rescue.
- (m) Entrapment from the operation of moving equipment, e.g. being trapped by augers, or crushed by rotating or moving parts such as conveyor belts.
- (n) The tasks conducted in the confined space, e.g. painting with coatings containing toxic or flammable contaminants, welding or brazing with metals capable of producing toxic fumes.
- (o) Exposed live electrical conductors.

Particular attention should be given to the task-related hazards created by a work team(s) in, on or near the confined space that may affect other work team(s) within the confined space.

3.2 IDENTIFICATION OF A CONFINED SPACE

3.2.1 Identification principles

Guidance for the identification of the hazards that define a confined space is given in Figure 1.

Table 1 provides an example of a process for identifying hazards that may be present in a confined space. By following the steps A to F and answering yes or no to the question posed by each step, the physical characteristics and hazards can be readily identified. For an enclosed or partially enclosed space to be considered as a potential confined space, see Note 1 to Table 1.

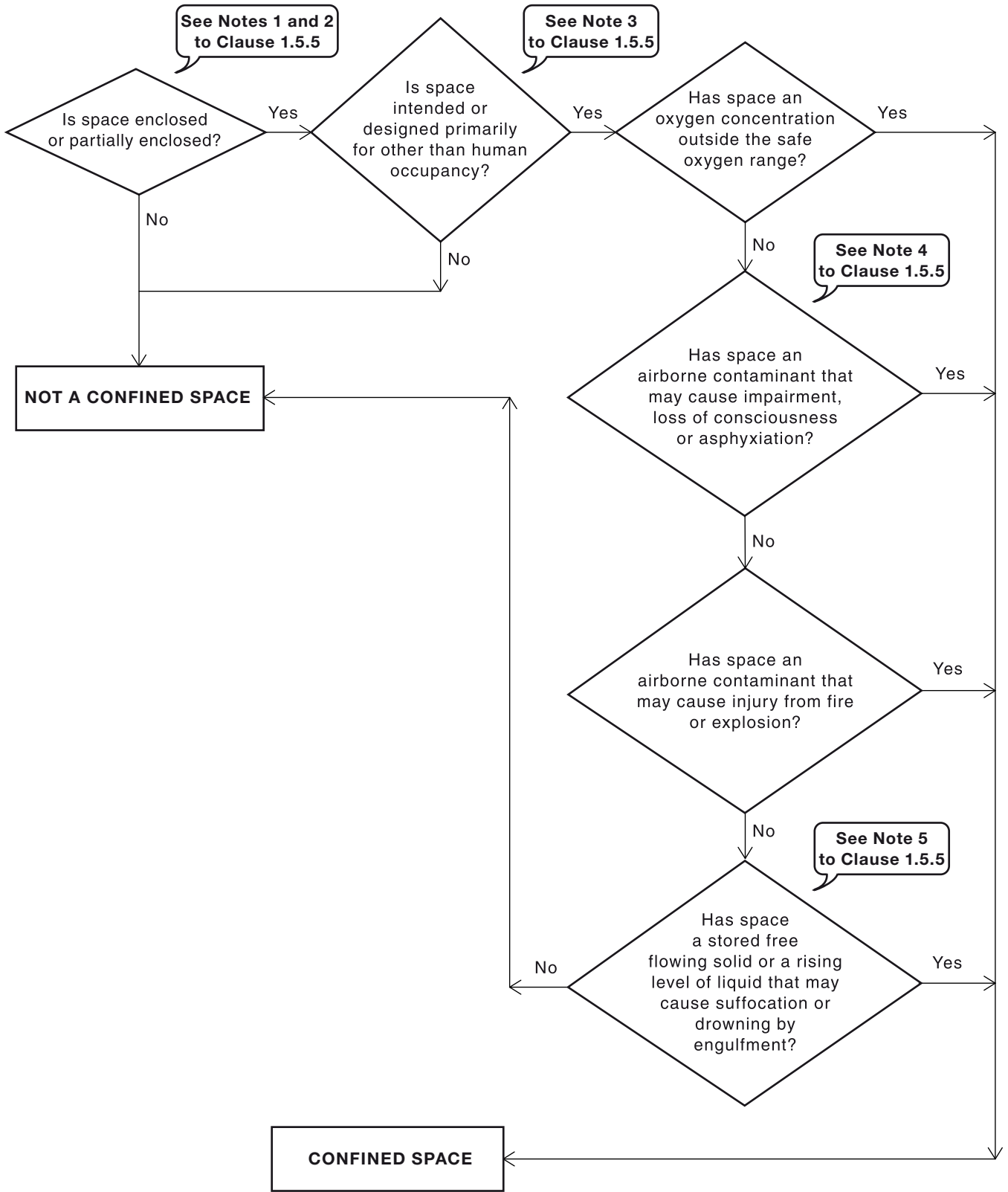


FIGURE 1 CONFINED SPACE IDENTIFICATION AND RISK CONTROL

TABLE 1
SAMPLE CONFINED SPACE HAZARD IDENTIFICATION MATRIX

Description of space	Physical characteristic		Identified hazards				Is the enclosed or partially enclosed space a potential confined space?
	Step A	Step B	Step C	Step D	Step E	Step F	
	Is space enclosed or partially enclosed?	Is space intended or designed primarily for other than human occupancy?	Could the atmosphere have oxygen concentration outside the safe oxygen range?	Could the atmosphere have a concentration of airborne contaminant that may cause impairment, loss of consciousness or asphyxiation?	Could the atmosphere have a concentration of flammable airborne contaminant that may cause injury from fire or explosion?	Could the atmosphere have a stored free-flowing solid or a rising level of liquid that may cause suffocation or drowning?	
Requires A and B?		Required to have either C, D, E or F?					
Sewage pit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Workshop welding bay	Yes	No	Yes	No	No	No	No
Boiler	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NOTES:

- 1 For an enclosed or partially enclosed space to be considered as a potential confined space, the following conditions apply: Confined Space = A + B + (C or D or E or F).
- 2 The hazards identified in Steps C to F should be confirmed by risk assessment.

3.2.2 Security and signposting

Confined spaces should at all times be secured against unauthorized entry and, where practicable, permanently signposted (see Figure 2). Signs should comply with AS 1319.

When entry and exit to a confined space is required, signs and barriers shall comply with Clause 3.4.29(f).



FIGURE 2 TYPICAL CONFINED SPACE SIGN

3.3 RISK ASSESSMENT

3.3.1 Conducting a risk assessment

A risk assessment shall be conducted by a competent person or persons before conducting any tasks associated with the confined space. The assessment shall be documented and take into account at least the following:

- (a) **The hazards of the confined space.**
- (b) **The tasks required to be conducted, including the need to enter the confined space.**
- (c) **The range of methods by which the tasks can be conducted.**
- (d) **The hazards involved and associated risks involved with the actual method selected and equipment proposed to be used.**
- (e) **Emergency response procedures.**
- (f) **The competence of the persons to conduct the tasks.**

3.3.2 Risk factors

Factors to consider when undertaking a risk assessment of a confined space include the following:

- (a) Atmospheric assessment, including testing or monitoring to be undertaken and the parameters to be assessed before a written authority is issued.
- (b) Engulfment of a person in any flowing solids in the confined space or engulfment from a rising level of liquid in the confined space.
- (c) All proposed operations and tasks, particularly those that may cause a change to the conditions in the confined space.
- (d) The number of persons occupying the 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) Any risk control measures needed to bring the confined space to atmospheric pressure.
- (h) The number of persons required outside the space—
 - (i) to maintain equipment essential for the task being undertaken within the confined space;
 - (ii) to provide adequate communication with and observation of the persons within the confined space; and
 - (iii) to properly initiate emergency response procedures.
- (i) Risks associated with other hazards.
- (j) Arrangements for emergency response, e.g. first aid and resuscitation.
- (k) The physiological and psychological demands of the task and the competency of those persons involved in the tasks or emergency response duties.
- (l) Adequate instruction of those persons in any required procedure, 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.
- (m) The availability and adequacy of appropriate personal protective equipment, protective clothing and emergency equipment for all persons likely to enter the confined space.
- (n) The need for additional risk control measures, including—
 - (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 air from operations or sources outside the confined space, e.g. from the exhaust of an internal combustion engine;
 - (iv) prohibition of movement of equipment such as forklifts in adjacent areas; and
 - (v) prohibition of spark generating equipment, clothing and footwear;
- (o) Whether purging or cleaning in the confined space is necessary.
- (p) Whether hot work is necessary.
- (q) Conditions that could impede entry and exit or the conduct of the tasks in the confined space, e.g. plant layout, dimensions, manual handling and ergonomic aspects of the task activity.

NOTE: A sample risk assessment form is given in Appendix E.

3.3.3 Risk assessment process

A risk assessment process should be determined and implemented. Risk assessments should be conducted by a competent person or persons.

It is often found that a team will produce a better outcome than individual efforts. Such a team should possess a wide ranging knowledge, which should include—

- (a) knowledge of the particular confined space under assessment;
- (b) any work methods that will be used during the operations to be conducted in or on the confined space;

- (c) confined space safety practices; and
- (d) risk assessment processes.

NOTE: Guidance on risk assessment may be found in AS/NZS 3931 and AS/NZS 4360.

3.3.4 Generic risk assessment

Where multiple similar confined spaces in which similar tasks are conducted are present and the risk factors are identical, a generic risk assessment may be appropriate.

3.3.5 Review of risk assessment

The risk assessment shall be reviewed and revised whenever there is evidence to indicate that there is a change in the risk.

3.3.6 Change in risk

Factors that may change the risks in a confined space include, but are not limited to—

- (a) installation or modification of plant;
- (b) a change in equipment operating conditions;
- (c) a change in the atmosphere or occupational environment;
- (d) a change in working arrangements or procedures; or
- (e) incidents that affect, or could affect, the safety of persons.

3.4 RISK CONTROL MEASURES

3.4.1 Risk control measures

If a risk assessment identifies a risk to health or safety arising from the tasks to be conducted in a confined space, the risk shall be eliminated or, if this is not possible, minimized by the implementation of appropriate risk control measures. The risk control measures shall be documented.

3.4.2 Hierarchy of risk control measures

A hierarchy of risk control measures to eliminate or, if this is not possible, minimize the risk should be followed in the priority order listed. The hierarchy comprises—

- (a) elimination;
- (b) substitution;
- (c) isolation;
- (d) engineering controls;
- (e) administrative controls; and
- (f) use of personal protective equipment.

Personal protective equipment should only be used either as a last resort when all of the other risk control measures (individually or in combination) have failed to adequately control the risk, or in an emergency response.

3.4.3 Combining risk control measures

All attempts should be made to apply each element of the hierarchy of risk control in the order given in Clause 3.4.2, moving to the next lower element when application is not possible. The process of progressively applying the elements of the hierarchy of risk control should continue until the risks have been eliminated or minimized. It may be necessary to use a combination of risk control measures to eliminate or minimize the risk.

NOTE: Some risk control measures are mandatory for confined spaces.

3.4.4 Review of risk control measures

Risk control measures should be carefully reviewed and improved, extended or replaced as necessary to provide adequate risk control. See also Clause 3.3.5.

3.4.5 Isolation requirements

Prior to any person entering a confined space, all potentially hazardous services, (including all process services) normally connected to that space shall, where it is possible to do so, be isolated in order to prevent—

- (a) the introduction of any materials, contaminants, agents or conditions harmful to persons occupying the confined space; and**
- (b) the activation or energizing in any way of equipment or services that could pose a risk to the health or safety of persons within the confined space.**

3.4.6 Isolation factors

It may be necessary to withdraw a confined space from service before it is prepared for entry. Procedures should be in place to advise all persons who may be involved with the repair, maintenance or operation of the confined space of the withdrawal of the confined space.

Positive steps should be taken to achieve the following:

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

NOTES:

- 1 Attention is drawn to hazards that may arise from the operation of some protective services in an occupied confined space (e.g. fixed fire extinguishing systems, see AS 4214).
 - 2 Additional recommendations for the conduct of hot work in confined spaces are given in Appendix F.
- (b) De-energization and lockout, or if lockout is not feasible then tag-out, or both lockout and tag-out, of machinery, mixers, agitators or other equipment containing moving parts in the confined space. This may require additional isolation, blocking or de-energizing of the machinery itself to guard against the release of stored energy (e.g. springs).
 - (c) Isolation of all other energy sources that may be external to, but still capable of, adversely affecting the confined space (e.g. pumps, heating or refrigerating methods).

NOTE: Where it is not possible to isolate all potentially hazardous services, appropriate risk control measures should be in place.

3.4.7 Methods of isolation from hazardous services

A confined space should be isolated from hazardous services before entry is permitted. Methods of isolation are as follows:

- (a) Removal of a valve, spool piece or an expansion joint in piping leading to, and as close as practicable to, the confined space. Blank or cap the open end of the piping leading to the confined space. The blank or cap should be identified to indicate its purpose.

NOTE: 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, that can build 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) are 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. Any drain valve between the two closed valves should also be locked open or tagged open to atmosphere as part of this method.
- (d) Alternative methods providing at least the same level of security as one of the methods listed in Items (a) to (c).

3.4.8 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 that might pose a risk to persons are present, the possibility of movement should be prevented by using one of the methods described below or by an alternative method 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.

NOTE: For additional guidance see AS 4024.1603.

Procedures for entering the confined space should be as follows:

- (a) The person entering the confined space or a competent person authorized in writing 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. This is 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 an 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. 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) cannot be used, 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 authorized in writing.
- (e) Where the locking or tagging is undertaken by a competent person authorized in writing, all persons entering the confined space should verify, or have it verified to them, that isolation is effective prior to their entry.

3.4.9 Removal of means of isolation

The locks, tags, blanks or other protective systems should only be removed after the person in receipt of the written authority has advised in writing that all tasks have ceased and all persons have vacated the confined space.

3.4.10 Establishing atmospheric pressure prior to entry

Many confined spaces are designed for a particular function and that may, or may not be at atmospheric pressure, e.g. a pressure vessel. Before entry is permitted to a confined space, control measures should be taken to establish and maintain atmospheric pressure within the space.

3.4.11 Purging a confined space

Where necessary, the confined space shall be cleared of contaminants by use of a suitable purging agent. The purging agent or any gas used for ventilation purposes shall not be pure oxygen or gas mixtures with oxygen concentration greater than 21%.

3.4.12 Purging operations

Care should be taken in purging a confined space to preclude rupture or collapse of the enclosure due to pressure differentials. Purging operations should be conducted such that the structural integrity of the confined space is not compromised. Attention should be given to the design pressure, design temperature, critical exposure temperature and vacuum rating.

Where required by risk assessment, barriers and signs should be erected to indicate exclusion/prohibition areas surrounding purging vents and openings.

3.4.13 Cleaning of a confined space

Where it is practicable, a confined space should be cleaned from the outside, therefore eliminating the need for entry. All substances that are likely to present a hazard to persons who enter the confined space should be removed prior to any entry to the confined space.

Where entry to a confined space is necessary for the purposes of cleaning, a written authority is required.

NOTE: Additional recommendations for the cleaning of confined spaces are given in Appendix G.

3.4.14 Location of contaminants

Potentially hazardous concentrations 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 they are disturbed or heat is applied. Such material may also lodge in joints of vessels or in bends of connecting pipes or other places where removal is difficult.

All regimes of inspection for confined spaces should include measures to detect the occurrence of these latent contamination conditions. When such conditions are detected, appropriate risk control measures should be taken to eliminate the hazard or reduce the level of risk in the confined space.

3.4.15 Flammable contaminants

When flammable contaminants are to be purged, purging and ventilation equipment designed for use in hazardous locations (see AS/NZS 60079.10.1, AS/NZS 60079.11 and AS/NZS 61241.10) should be used and risk control measures taken to eliminate all sources of ignition. For example, fans used to exhaust flammable contaminants should be intrinsically safe.

NOTE: Some Australian Standards specify a lower percentage of the LEL than those required by this Standard, e.g. AS 1940.

3.4.16 Static electricity

Where necessary, reference should be made to AS/NZS 1020 to guard against static electricity discharge.

3.4.17 Ventilation

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

3.4.18 Combustion engines

Combustion engines, e.g. those used to drive generators and pumps, should not be used inside a confined space unless risk control measures are implemented to provide for the safety of the atmosphere. Risk control measures should include the complete removal of exhaust gases and continuous atmospheric monitoring. The risk arising from the use of combustion engines can be eliminated by using electrically or pneumatically powered equipment.

3.4.19 Exhaust location

Any airborne contaminants removed from the confined space should only be exhausted to the atmosphere at a location where they do not represent a risk. Combustion engines providing power for compressed air or any other use associated with the tasks being conducted in the confined space should be located so that their exhaust emissions cannot enter the confined space or contaminate air being supplied to the confined space.

3.4.20 Control of mechanical ventilation equipment

Where the maintenance of the atmosphere in a confined space is dependent on mechanical ventilation equipment, e.g. fans, the equipment should—

- (a) be continuously monitored while the confined space is occupied; and
- (b) have its controls (including any remote power supply) clearly identified and tagged to guard against unauthorized operation.

3.4.21 Operations causing the generation of contaminants

During operations likely to generate contaminants, ventilation equipment may not be adequate or sufficiently reliable to maintain a safe breathing atmosphere. In such circumstances additional risk control measures may be required.

NOTE: Additional recommendations for the conduct of hot work in confined spaces are given in Appendix F.

3.4.22 Atmospheric testing or monitoring

Atmospheric testing or monitoring shall be conducted in a manner consistent with the hazards identified in the risk assessment of the confined space.

No person shall enter a confined space to conduct atmospheric testing or monitoring without a written authority.

3.4.23 Risk control measures for atmospheric testing within a confined space

Where a written authority is issued for entry to conduct atmospheric testing within the confined space, the written authority should include any risk control measures necessary for safe entry and atmospheric testing, e.g. supplied-air respiratory protective devices. (See Clauses 3.4.33 and 3.4.42.) The results should be recorded on the written authority.

3.4.24 Atmospheric tests required

Atmospheric testing should include testing by scientific means for—

- (a) oxygen concentration;
- (b) concentration of flammable airborne contaminants; and
- (c) concentration of airborne contaminants.

3.4.25 Testing of remote regions of a confined space for flammable airborne contaminants

It is not always possible to guarantee that the atmosphere of all regions within the confined space are below 5% of a flammable airborne contaminant's LEL, e.g. prior to testing the atmosphere of a more remote region of the confined space that cannot be reached by probes. In such cases, once the atmosphere adjacent to the entry point has been proven safe for entry (i.e. below 5% LEL), testing of the more remote regions within the confined space may be conducted, provided continuous monitoring with a suitably calibrated explosive (flammable) atmospheric substance detector is used in the confined space at all times while persons are present. (See Clauses 3.4.32(a), 3.4.32(c) and 3.4.42.)

Additional safety measures should be considered because of the reduction in the safety margin caused by the increase from 5% LEL to 10% LEL.

3.4.26 Retest or monitoring after entry

Where the risk assessment or the evaluation of the atmosphere identifies a need for retest or monitoring, or because of the potential for later release of airborne contaminants or a variation in oxygen concentration, arrangements should be made to monitor or retest the atmosphere within the confined space, as determined by risk assessment.

3.4.27 Explosive (flammable) atmospheric substance detectors

A continuous-monitoring explosive (flammable) atmospheric substance detector should be fitted with latching, visible and audible alarms which activate at a concentration of airborne contaminant not greater than 10% of the LEL.

NOTE: The LEL and UEL for flammable substances vary depending on the particular substance. AS/NZS 60079.20 gives data on upper and lower flammability limits for a number of flammable substances.

Detectors used to measure LEL should be calibrated for the flammable substance under investigation. Where a mixture of flammable substances occur, the LEL of the mixture may not be known precisely and care is required to provide for the substance with the lowest LEL.

Manufacturer's information should be consulted to determine the sensitivity of the monitor to different flammable substances any other factors that may impact on the ability of a particular monitor to measure the flammable substance in question.

Where there is no exposure standard for a substance, expert guidance should be obtained.

3.4.28 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. Where there is no exposure standard for a substance, expert guidance should be obtained.

3.4.29 Requirements for confined space entry

No person shall enter a confined space unless—

- (a) review of the risk assessment has been completed in accordance with Clauses 3.3.1 and 3.3.5;**
- (b) written authority is provided to, or completed by, the person responsible for direct control of the tasks in the confined space;**
- (c) the written authority includes any risk control measures or precautions necessary, including the number of stand-by persons required, for the safe entry and execution of the tasks;**

- (d) they are advised of, understand and comply with the requirements of the written authority;
- (e) a record of their presence in the confined space is maintained;
- (f) signs and protective barriers are erected to prevent entry of persons not involved in the tasks; and
- (g) appropriate and sufficient arrangements have been made for the initiation of emergency response and, where necessary, rescue of persons from the confined space.

3.4.30 Confined Space entry monitoring

Risk control measures shall require—

- (a) provision of a standby person or persons; or
- (b) systems of work methods and controls that provide an equal or better safety outcome to that provided by a standby person (see Clause 1.5.20).

3.4.31 Safe atmosphere

Before a person enters a confined space, and where it is technically feasible to do so, the atmosphere of the confined space shall have—

- (a) a safe oxygen range;
- (b) airborne contaminants that may cause impairment, loss of consciousness or asphyxiation reduced to below the relevant exposure standards; and
- (c) a concentration of flammable airborne contaminant below 5% LEL.

3.4.32 Flammable airborne contaminants in the atmosphere

Where flammable airborne contaminants are present in the atmosphere of a confined space, the following requirements shall apply:

- (a) Except in case of emergency response, entry shall not be permitted where the concentration of flammable airborne contaminants in the atmosphere is 5% LEL or greater, or where the oxygen concentration of the atmosphere exceeds 23.5%.
- (b) Where persons have entered or are conducting tasks in a confined space and the concentration of flammable airborne contaminant in the atmosphere of the confined space has been found to be greater than 5% LEL and less than 10% LEL, the persons shall be removed unless continuous monitoring with a suitably calibrated explosive (flammable) atmospheric substance detector is used in the confined space at all times while persons are present.
- (c) Where the concentration of flammable airborne contaminant in the atmosphere of a confined space has been found to be 10% LEL or greater, no persons shall remain in the confined space.

3.4.33 Use of respiratory protective devices

Where the hierarchy of risk control measures cannot provide a concentration of oxygen in the atmosphere greater than 19.5% or the airborne contaminants that may cause impairment, loss of consciousness or asphyxiation cannot be reduced to below the relevant exposure standards, no persons shall enter the confined space unless they are equipped with supplied-air respiratory protection and where appropriate, personal protective equipment.

3.4.34 Provision of equipment

Equipment shall be provided as follows:

- (a) Suitable equipment shall be provided including, where necessary, equipment for—
 - (i) personal protection;
 - (ii) emergencies including rescue;
 - (iii) first aid;
 - (iv) communication; and
 - (v) fire suppression.
- (b) The equipment shall be appropriate to the tasks to be conducted in the confined space, and maintained in a proper working condition.

3.4.35 Cancellation of written authority

Prior to a written authority being cancelled, all tasks in the confined space shall cease and all persons shall be removed from the confined space.

3.4.36 Completion of written authority

The written authority should be completed prior to its issue.

NOTES:

- 1 A sample written authority is given in Appendix H.
- 2 The content of the written authority need not be limited to that given in Appendix H.

The information and risk control measures appropriate to the risk assessment and listed below should be considered as a basis for a written authority.

- (a) Location and description of the tasks to be done.
- (b) Hazards that may be encountered.
- (c) Isolation checklist.
- (d) Atmospheric test results as appropriate.
NOTE: Additional recommendations for atmospheric testing and monitoring are given in Appendix I.
- (e) Need for monitoring ventilation and the atmosphere.
- (f) Working procedures and conditions, including—
 - (i) reference to work procedures;
 - (ii) awareness that conditions (physical or chemical) may change and may need continuing review;
 - (iii) the possibility of heat stress from task-generated heat, ambient temperature or the effect of wearing protective clothing; and
 - (iv) the likely levels of noise within the confined space.
- (g) Need for effective continuous communication with persons in the confined space.
- (h) Clothing and equipment including—
 - (i) the types of equipment and clothing required for the task;
 - (ii) the need for respiratory protective devices;
 - (iii) the need for safety harness and line; and

- (iv) the need for emergency lighting, e.g. a torch.
- (i) Persons including—
 - (i) the number of persons to enter the confined space;
 - (ii) stand-by persons for communication and operation of essential equipment;
 - (iii) persons for rescue and first aid; and
 - (iv) adequacy of training and understanding of the hazards.
- (j) Other risk control measures 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) the need for systems of work methods and controls that provide for an equal or better safety outcome than that provided by a stand-by person.
- (k) Emergency response 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.

3.4.37 Issue of written authority

When a written authority is issued, the information and risk control measures listed on the written authority should be re-confirmed whenever it becomes evident that the duration of tasks will involve—

- (a) a change of the person to whom the written authority was issued; or
- (b) a break in continuity of the tasks that may have changed the conditions under which the written authority was issued.

3.4.38 Display of written authority

The written authority should be displayed in a prominent place, usually adjacent to the confined space entry, to facilitate signing and clearance.

3.4.39 Identification of persons entering a confined space

A record of each person required for stand-by purposes should be maintained.

3.4.40 Communication

Continuous communication and, where possible, observation should be provided between those in the confined space and the stand-by person(s). Where systems of work and controls are used that provide for an equal or better safety outcome than that provided by a stand-by person, continuous communication should also be provided.

NOTE: Communication can be achieved, dependent on the conditions existing in the confined space, in a number of ways, including voice, radio, hand signals, hard wired communications and other appropriate means. For example, where visual or oral communication is not possible and where radio signals cannot penetrate, then hard wired, full duplex communication systems should be used. Microwave, long wave or low frequency radio equipment could be an alternative when normal radios are unsuitable. In confined spaces where flammable conditions could exist, radios should be Intrinsically Safe (IS).

3.4.41 Alternating entry and stand-by persons

Where it is expected that the person entering the confined space and the stand-by person may change roles, either may be authorized to stand-by while the other person is inside the confined space.

3.4.42 Respiratory protective devices

Respiratory protective devices should comply with AS/NZS 1715 and AS/NZS 1716.

Suitable supplied-air respiratory protection devices complying with AS/NZS 1716 should be worn where—

- (a) control measures cannot ensure that a safe atmosphere can be established or may not be maintained in accordance with Clause 3.4.31; or
- (b) the nature of the work procedure within the confined space is likely to degrade or contaminate the atmosphere in the confined space, e.g. hot work, painting or removal of sludge.

The source of breathing air should be in accordance with AS/NZS 1715. Respiratory protective devices should be selected, fitted, used, stored, maintained and inspected in accordance with AS/NZS 1715.

NOTE: Appendix J provides additional information concerning personal protective equipment.

For routine tasks in a confined space where supplied-air respiratory protection is to be used in atmospheres as outlined in Clause 3.4.33, an air-hose (natural breathing type) or full face air-line with auxiliary protection (emergency breathing device, see AS/NZS 1715) are the preferred means of respiratory protection.

3.4.43 Safety harnesses lines and lifting equipment

Where safety harnesses and safety lines or rescue lines are to be used, they should comply with AS/NZS 1891 series.

3.4.44 Electrical equipment

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

Where an electrical apparatus is to be used in an explosive gas atmosphere, the apparatus should comply with the AS/NZS 60079 series, and in particular with AS/NZS 60079.11 and AS/NZS 60079.25.

Electrical equipment for the detection and measurement of flammable gases should comply with the appropriate requirements of the AS/NZS 61779 series of Standards.

3.4.45 Portable electrical equipment

Portable electrical equipment should either—

- (a) be connected, individually or collectively, to an earth-free, protected extra-low voltage supply (see AS/NZS 3000) from an isolating transformer(s) complying with AS/NZS 61558, with the transformer(s) located outside the confined space; or
- (b) be protected through a residual current device complying with AS/NZS 3190, located outside the confined space.

Where there is a potential for combustibles, portable electrical equipment should be intrinsically safe.

3.4.46 Supply cable

Portable electrical equipment should be fitted with a flexible supply cable not inferior to a heavy duty type complying with AS/NZS 3191. The cables should be located, suspended or guarded to minimize accidental damage.

3.4.47 Double-insulated tools

Where available, it is recommended that double-insulated electrical tools be used. Appropriate IP rated electrical equipment should be used where required by the risk assessment, taking into account the confined space environment. (See AS 60529.)

3.4.48 Ignition sources

Where a flammable airborne contaminant might exist, precautions should be taken to eliminate all sources of ignition. (Refer to AS/NZS 60079.10.1 and AS/NZS 61241.10.)

3.4.49 Gas cylinders and hoses

Except for cylinders for use with self-contained breathing apparatus, no cylinder of compressed or liquefied gas 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. 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. These hoses should be tested for leaks prior to installation.

3.4.50 Gas monitors

Gas monitors used for the purpose of atmospheric monitoring within a confined space should be maintained and used in accordance with the manufacturer's instructions and warnings.

NOTE: Refer to AS/NZS 60079.0 and AS/NZS 60079.11.

SECTION 4 REVIEW

4.1 REVIEW PROCESS

A review of all confined spaces activities should be conducted to provide for continuing suitability and effectiveness.

The scope of the review should be sufficiently broad to address the implications of all confined spaces activities, including an evaluation of the effectiveness of the confined spaces management system and the need for any changes in light of—

- (a) changing legislation or organizational requirements;
- (b) changes in the products, operations or activities of the organization;
- (c) changes to the structure of the organization;
- (d) advances in science and technology including epidemiology;
- (e) lessons learned from confined space incidents; and
- (f) feedback (particularly from persons at the workplace).

4.2 CONTINUOUS IMPROVEMENT

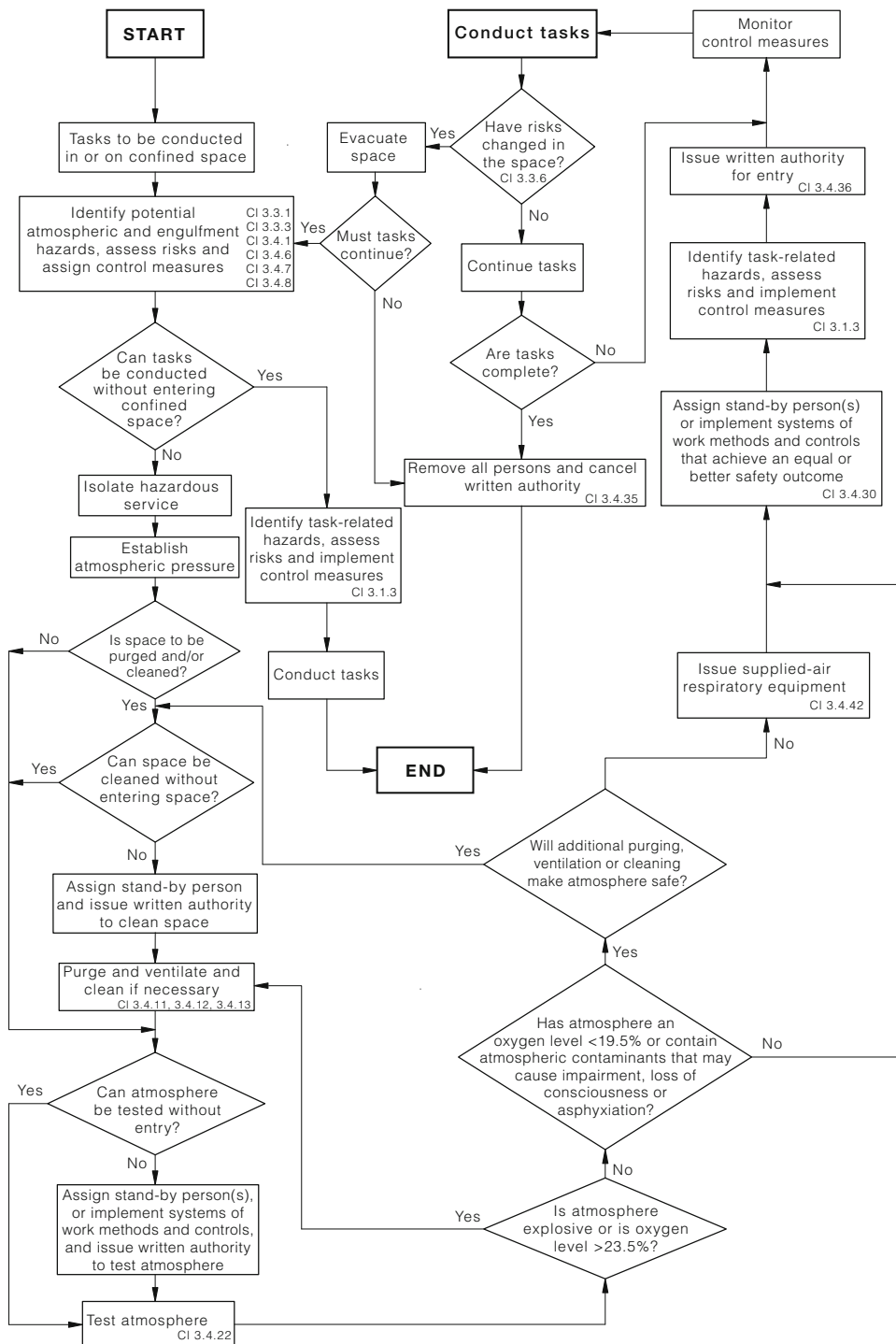
The concept of continuous improvement should be embodied in the organization's OHS management system. It is achieved by continually evaluating the performance of the system against policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continual improvement process should—

- (a) identify areas of opportunity for improvement of the management of confined space activities;
- (b) conduct inspections of all activities associated with confined space entry and tasks;
- (c) conduct system audits;
- (d) determine the root cause or causes of non-conformance or deficiencies;
- (e) develop and implement plans of corrective and preventive action to address the root causes;
- (f) verify the effectiveness of corrective and preventive action; and
- (g) document any changes in procedures resulting from process improvement.

APPENDIX A SUMMARY OF PROCEDURES FOR ENTRY AND CONDUCT OF TASKS IN A CONFINED SPACE

(Informative)



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APPENDIX B
LIST OF REFERENCED DOCUMENTS

(Normative)

AS	
1210	Pressure vessels
1228	Pressure equipment—Boilers
1319	Safety signs for the occupational 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
1940	The storage and handling of flammable and combustible liquids
4024	Safety of machinery
4024.1603	Part 1603: Design of controls, interlocks and guards—Prevention of unexpected start-up
4214	Gaseous fire extinguishing systems
5034	Installation and use of inert gases for beverage dispensing
60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS	
1020	The control of undesirable static electricity
1200	Pressure equipment
1270	Acoustics—Hearing protectors
1336	Recommended practices for occupational eye protection
1337	Eye protectors for industrial applications
1680	Interior and workplace lighting
1680.1	Part 1: General principles and recommendations
1715	Selection, use and maintenance of respiratory protective devices
1716	Respiratory protective devices
1800	Occupational protective helmets—Selection, care and use
1801	Occupational protective helmets
1891	Industrial fall-arrest systems and devices
1891.4	Part 4: Selection, use and maintenance
2210	Occupational protective footwear
2210.2	Part 2: Requirements and test methods
3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
3100	Approval and test specification—General requirements for electrical equipment
3190	Approval and test specification—Residual current devices (current-operated earth-leakage devices)
3191	Electric flexible cords

AS/NZS

- 3931 Risk analysis of technological systems—Application guide
- 4360 Risk management
- 60079 Explosive atmospheres
- 60079.0 Part 0: Equipment—General requirements
- 60079.10.1 Part 10.1: Classification of areas—Explosive gas atmospheres
(IEC 60079-10-1, Ed.1.0(2008) MOD)
- 60079.11 Part 11: Equipment protection by intrinsic safety ‘i’
- 60079.20 Part 20: Data for flammable gases and vapours, relating to the use of
electrical apparatus
- 60079.25 Part 25: Intrinsically safe systems
- 61241 Electrical apparatus for use in the presence of combustible dust
- 61241.10 Part 10: Classification of areas where combustible dusts are or may be present
- 61558 Safety of power transformers, power supply units and similar (series)
- 61779 Electrical apparatus for the detection and measurement of flammable gases
- 61779.1 Part 1: General requirements and test methods

ISO

- 15534 Ergonomic design for the safety of machinery
- 15534-1 Part 1: Principles for determining the dimensions required for openings for
whole-body access into machinery
- 15534-2 Part 2: Principles for determining the dimensions required for access
openings
- 15534-3 Part 3: Anthropometric data

INTERNATIONAL MARITIME ORGANIZATION

Resolution A272 (VIII)

Resolution A330

SAFE WORK AUSTRALIA

Hazardous Substances Information System (HSIS)

WTIA (Welding Technology Institute of Australia)

Technical Note 7 Health and Safety in Welding

APPENDIX C GENERAL DESIGN CONSIDERATIONS

(Informative)

C1 DESIGN AND INSTALLATION

Hazards involved in conducting tasks in a confined space should be minimized at the design stage and during initial installation of equipment. The design for a confined space should eliminate the need to enter the confined space for maintenance or other purposes.

Features aimed at enhancing the safety of persons conducting tasks in a confined space, which should be incorporated at the design and installation stages, are as follows:

- (a) Provision of adequate and convenient means of entry and exit for persons who may be required to wear personal protective equipment, including respiratory protective devices and clothing (see also Paragraph C2).

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 eliminate or reduce 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 conduct tasks in other than stooped, awkward 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) Provision levels of illumination, complying with AS/NZS 1680.1, that will be sufficient to permit safe entry, conduct of tasks and exit.
- (h) Provision of fixed ladders, platforms and walkways complying with AS 1657.
- (i) Provision of signs at each entry to the confined space warning against entry by persons other than those who are authorized to enter. These signs should be appropriate to the workplace and comply with AS 1319.
- (j) Provision of outlets and 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 into the confined space.

NOTE: Consideration should be given to the type, frequency and duration of the tasks likely to be carried out within the confined space.

C2 MEANS OF ENTRY AND EXIT

Except for boilers and pressure vessels for which specific requirements for openings exist, each confined space should be provided with at least one entrance of sufficient size to permit entry and exit.

NOTE: Guidance may be found in ISO 15534-1, ISO 15534-2 and ISO 15534-3.

Except for boilers and pressure vessels, there should be 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 (e.g. AS/NZS 1200, AS 1210, AS 1228) and regulations.
- 2 Guidance to the dimensions of entry openings to cargo tanks and water ballast spaces on ships is provided in Resolutions A272 (VIII) and A330 (IX) of the International Maritime Organization.

The means of entry to and exit from a confined space need to be kept free from any encumbrances. When the atmospheric hazards or the nature of the tasks to be conducted in a confined space may require such things as power lines, hoses and ventilation ducts to pass through an entry or exit opening, the provision of a second opening is recommended.

APPENDIX D

GUIDANCE FOR THE PROVISION OF TRAINING AND COMPETENCY ASSESSMENT

(Informative)

D1 CORE TRAINING ELEMENTS

Training is essential in providing persons with the competence to successfully implement and comply with legislative obligations and to manage confined spaces entry and tasks. The information in this Appendix provides guidance in the form of a common set of ‘core training elements’ that outline the knowledge and skills generally required for the safe entry and conduct of tasks in or on confined spaces. The core training elements do not seek to provide specific training content of a technical or prescriptive nature, which is up to the training provider. They are intended to provide a consistent approach to the development and delivery of training courses.

The core training elements in this Appendix have been developed in recognition of the requirements outlined in this Standard. The information should assist organizations and training providers to determine the extent of the competencies required by different target groups. Table D1 provides guidance on core training elements and corresponding performance criteria.

The training may be divided into two broad groups as follows:

- (a) *General awareness training* Many target groups may require an overview of confined spaces and may only need a general awareness course. Such a course awareness course should, at least, provide a general understanding of relevant legislation, confined space hazards and associated risks.
- (b) *Specific training* Target groups may require specific competencies based on the degree of risk and the type of tasks to be conducted in confined spaces. Specific training courses may be needed to cover confined space hazard identification, risk assessment and control, safety equipment, atmospheric testing and monitoring, stand-by duties, emergency response, etc.

D2 IDENTIFYING KEY COMPETENCY REQUIREMENTS

There are many methods for identifying the key competencies that a person may need to enable them to conduct their role associated with confined spaces. A person may need competencies within the following broad roles:

- (a) Design, manufacture, install or modify a confined space.
- (b) Participate in confined space risk management process.
- (c) Control confined space hazards.
- (d) Enter and conduct tasks in or on a confined space.
- (e) Participate in confined spaces stand-by role (initiate rescues procedures).
- (f) Participate in emergency response.

There may be specific roles that may not fall within the broad roles given above. These will need to be taken into account when determining the competency requirements for these specific roles.

In Table D1 the recommended core training elements and performance criteria have been matched to the broad roles given above.

TABLE D1
RECOMMENDED CORE TRAINING ELEMENTS
AND PERFORMANCE CRITERIA

Core training element	Performance criteria	Broad roles (Refer to Paragraph D2)
1. Demonstrate an understanding of legislation, standards & codes of practice relevant to confined spaces.	1.1 Identify legislation, standards and codes of practice relevant to designers, manufacturers, installers, modifiers and users of confined spaces.	a, b, c, d, e, f
	1.2 Describe the responsibilities and obligations relevant to designers, manufacturers, installers, modifiers and users of confined spaces.	a, b, c, d, e, f
2. Identify the criterion that defines confined spaces.	2.1 Describe the physical and inherent hazards of confined spaces.	a, b, c, d, e, f
	2.2 Identify the risks of exposure to the inherent hazards of confined spaces and the potential health and safety effects.	a, b, c, d, e, f
	2.3 Identify confined spaces in the workplace.	a, b
3. Assess risks associated with entering and conducting tasks in or on a confined space.	3.1 Demonstrate knowledge of the principles of risk management.	a, b, c, d, e, f
	3.2 Conduct a risk assessment of the inherent hazards of a confined space.	b, c, f
	3.3 Conduct a risk assessment of the task related hazards of a confined space.	b, c, f
	3.4 Document risk assessments conducted.	b, c, f
	3.5 Participate in the risk assessment process.	b, c, d, e, f
	3.6 Demonstrate knowledge of when risk assessments need to be reviewed and revised.	b, c, f
	3.7 Identify sources of information on confined spaces hazards, associated risks and risk control measures.	a, b, c, f
4. Identify and implement risk control measures.	4.1 Identify risk control measures in accordance with the hierarchy of risk control.	a, b, c, d, e, f
	4.2 Describe methods for the isolation of potentially hazardous services connected to confined spaces.	a, b, c, f
	4.3 Describe methods of cleaning, purging and ventilating confined spaces.	b, c, f
	4.4 Demonstrate an understanding of atmospheric testing and/or monitoring equipment and techniques.	b, c, d, f
	4.5 Describe how monitoring results are documented, interpreted and communicated.	b, c, f
	4.6 Demonstrate knowledge of confined space authorised entry requirements.	b, c, d, e, f
	4.7 Demonstrate knowledge of practices and procedures for conducting tasks in or on the confined space.	b, c, d, f
	4.8 Demonstrate knowledge of the risk control measures applicable to the entry and the conduct of tasks in or on the confined space.	b, c, d, e, f
	4.9 Evaluate the effectiveness of risk control measures.	b, c, f

(continued)

TABLE D1 (continued)

Core training element	Performance criteria	Broad roles (Refer to Paragraph D2)
	4.10 Demonstrate knowledge of the correct selection, use and maintenance of personal protective equipment to be used in the confined space.	b, c, d, e, f
	4.11 Describe the communication system between persons inside and outside the confined space.	b, c, d, e, f
5. Apply emergency response procedures.	5.1 Demonstrate an understanding of emergency response procedures.	c, d, e, f
	5.2 Demonstrate knowledge of stand-by duties and responsibilities.	c, d, e, f
	5.3 Demonstrate knowledge of emergency response duties and responsibilities.	c, d, e, f
	5.4 Demonstrate knowledge of the correct selection, use and maintenance of personal protective equipment to be used in emergency response.	c, d, e, f

D3 COMPETENCY ASSESSMENT

Before a person conducts any tasks associated with a confined space they should be assessed to confirm their competency to conduct such tasks. Persons should be reassessed, at appropriate intervals, to confirm ongoing competency relevant to their tasks associated with confined spaces. A person should be retrained whenever they cannot demonstrate ongoing competency. The duration of retraining should be sufficient for the person to demonstrate required competencies.

D4 TRAINING COURSE DURATION

The duration of training courses should reflect the competency needs of the various target groups. Prior knowledge and learning should be considered and, where applicable, may reduce training duration. For example, target groups who enter confined spaces and conduct tasks, conduct atmospheric testing or monitoring, participate in stand-by duties or the like, will require specific competencies based on the degree of risk and the nature and complexity of tasks to be conducted. In these instances the duration of the training courses should be commensurate with attaining the relevant competency.

D5 TRAINERS AND ASSESSORS

Trainers and assessors should be knowledgeable in all relevant aspects of confined spaces and conversant with relevant legislation, codes of practice and standards.

APPENDIX E
 SAMPLE RISK ASSESSMENT FORM
 (Informative)

This Appendix sets out a sample risk assessment form (see Figure E1), a table for qualitative measurement of the likelihood of an occurrence (see Table E1), a table for the qualitative measurement of the consequence or impact of an occurrence (see Table E2) and a table setting out a simple method for ranking risks (see Table E3).

SAMPLE RISK ASSESSMENT							
Description of Plant: Sewage pit							
Description of Task: Replace sewage pump							
Risk assessment conducted by: John Citizen					Date: 04/8/2005	Time: 2.15 pm	
Atmospheric Hazard or Engulfment	Task Related Hazard	Associated Risk	Level of risk (see Table E3)				Risk Control Measures
			H	S	M	L	
	Safe entry and exit	Falling from height		X			<ul style="list-style-type: none"> • Erect barriers • Provide safety harnesses and lifting devices • Assess competency of persons in use of PPE
Hydrogen sulphide gas		Poisoning	X				<ul style="list-style-type: none"> • Ventilate space • Monitor atmosphere • Assess competency of persons in use of monitoring equipment • Assess competency of persons to wear respiratory protective devices • Assign standby person • Select communications equipment
	Inadequate lighting	Physical Injury			X		<ul style="list-style-type: none"> • Provide appropriate safe lighting
	Noise	Hearing impairment				X	<ul style="list-style-type: none"> • Provide hearing protection and train persons in its use.
	Physiological and psychological	Stress and/or physical exhaustion		X			<ul style="list-style-type: none"> • Assess and monitor persons
	Welding	Fumes		X			<ul style="list-style-type: none"> • Provide fume extraction equipment • Provide fire extinguishers • Hot work permit

FIGURE E1 SAMPLE RISK ASSESSMENT FORM

TABLE E1
QUALITATIVE MEASUREMENT OF LIKELIHOOD
OF AN OCCURRENCE

Level	Descriptor	Description
A	Almost certain	The event is expected to occur in most circumstances
B	Likely	The event will probably occur in most circumstances
C	Moderate	The event should occur at some time
D	Unlikely	The event could occur at some time
E	Rare	The event may occur only in exceptional circumstances

TABLE E2
QUALITATIVE MEASUREMENT OF CONSEQUENCE OR IMPACT
OF AN OCCURRENCE

Level	Descriptor	Description
1	Insignificant	No injuries
2	Minor	First aid treatment, on-site release immediately contained
3	Moderate	Medical treatment required, on-site release contained with outside assistance
4	Major	Extensive injuries, off-site release with no detrimental effects
5	Catastrophic	Death, toxic release off-site with detrimental effects

TABLE E3
QUALITATIVE RISK ANALYSIS MATRIX—LEVEL OF RISK

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
	1	2	3	4	5
A (Almost certain)	S	S	H	H	H
B (Likely)	M	S	S	H	H
C (Moderate)	L	M	S	H	H
D (Unlikely)	L	L	M	S	H
E (Rare)	L	L	M	S	S

LEGEND:

H = high risk; detailed research and management planning required at senior levels

S = significant risk; senior management attention needed

M = moderate risk; management responsibility should be specified

L = low risk; manage by routine procedures

APPENDIX F

ADDITIONAL RECOMMENDATIONS FOR THE CONDUCT OF HOT WORK IN
CONFINED SPACES

(Informative)

F1 GENERAL

Information should be provided on the possibility of hot work reducing the oxygen concentration of the atmosphere and that hot work itself may release airborne contaminants. The recommendations in this Appendix are in addition to the requirements for conducting tasks in a confined space.

NOTES:

- 1 Hot work is defined in Clause 1.5.13 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 this Standard, the relevant provisions of AS 1674.1, and 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.

F2 PERMITS

Hot work in or on the exterior surfaces of a confined space should not be commenced until a hot work permit has been issued. The hot work permit may be an integral part of the written authority to enter the confined space.

The hot work permit should certify that appropriate risk control measures have been carried out and should list the frequency of any tests necessary to maintain safe conditions. Aspects to be taken into account when considering the issue of a hot work permit include the following:

- (a) Where a confined space or an adjacent space has contained a flammable contaminant, in addition to the requirements of Paragraph F3, the hot work permit should be issued only after inspection and testing have established that the following factors have been considered:
 - (i) The concentration of flammable contaminants in the atmosphere.
 - (ii) The removal of any liquid and solid residues where necessary to prevent the release of flammable contaminants that will raise the concentration of flammable airborne contaminants.
 - (iii) The concentration of flammable contaminants within any piping within the confined space or connected to it.
- (b) In a confined space having last contained dry material that, when dispersed in air, creates a flammable or explosive atmosphere, the hot work permit should be issued only after inspection has established that loose dust has been removed from the confined space and all appropriate surfaces have been cleaned or the material has been rendered safe (e.g. by wetting grain dust).
- (c) Where fixed fire-extinguishing equipment employing an extinguishing agent that 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 to become hazardous to persons. In such cases, alternative fire protection should be provided during occupancy in the confined space by adequate numbers of the appropriate size and type of portable fire extinguishers.

F3 FIRE PREVENTION

The following fire preventative measures should be taken:

- (a) All combustible substances, including any dry residues, in the vicinity of the hot work should be removed to a safe place. If they cannot be moved, they should be covered by a non-combustible blanket, flame-resistant tarpaulin, or other means to prevent ignition from heat, sparks and slag.
- (b) Consideration should be given to the assignment of a fire watch while the hot work is being conducted and for a period of not less than 30 minutes after completion of the hot work. In many cases, the fire watch may be conducted by the stand-by person(s).
- (c) When welding or cutting is to be conducted 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 conducted.

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.
- (e) 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.
- (f) When arc welding is suspended for a substantial period, e.g. 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.
- (g) When gas welding or cutting is suspended for a substantial period, e.g. during lunch periods or overnight, the torch and cylinder valves should be closed. The torch and hose should be removed from and depressurized outside the confined space.
- (h) No compressed gas cylinders or associated manifolds, other than those used for self-contained breathing apparatus, should be located inside the confined space.
- (i) Flammable metal anti-corrosion anodes should be removed from the immediate area.

F4 CONTROL OF FUMES

Fumes should be controlled as follows:

- (a) In a confined space, all surfaces covered with coatings that would decompose or volatilize under hot work into toxic, flammable, 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 un-stripped 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: Coatings that may pose a hazard include zinc, cadmium, lead paints, certain other paints and plastics.

- (b) Means should be provided to exhaust airborne contaminants from the confined space. The exhaust suction point should be located as close as possible to the source of contamination within the confined space (e.g. close to the metal being welded). Such exhaust should be directed to a location where it presents no hazard and will not accidentally be re-circulated into the confined space.

APPENDIX G

ADDITIONAL RECOMMENDATIONS FOR THE CLEANING OF CONFINED SPACES

(Informative)

G1 GENERAL

This Appendix lists recommendations for conducted cleaning tasks in a confined space that are additional to the requirements for carrying out tasks in a confined space.

Procedures and processes to clean the inside of a confined space should be reviewed and authorized 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 those given in this standard.

The following general practices should be observed:

- (a) Initial cleaning should be conducted from outside the confined space. This initial cleaning, including drainage and scale removal, should continue until the risk from the atmospheric hazards has been eliminated or reduced as far as possible.
- (b) Each person entering the confined space should be provided with appropriate protective clothing, appropriate 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.
- (d) Safety precautions detailed in material safety data sheets (MSDS) and plant safety information should be incorporated as a minimum level of safety.

G2 HYDROJETTING

G2.1 General

The following general precautions should be observed when hydrojetting is conducted in a confined space:

- (a) Hydrojetting should always be conducted by trained persons.
- (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 hydrojetting is in progress.
- (d) Where there is a possibility of a flammable airborne contaminant, the nozzle of the hydrojetting equipment should be earthed to decrease the generation of static electricity (see also AS/NZS 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 ships, tanks and 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.

G2.2 Equipment

All high-pressure cleaning equipment should be fitted with actuating devices that require positive effort by the operator's 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 to avoid constant pulsation damage, especially from corners when laying out hydrojet hoses on the ground.

G3 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 airborne contaminant 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/NZS 1020).
- (b) Where there is a possibility of a flammable airborne contaminant in the confined space, steam temperatures should be significantly lower than the auto-ignition temperature of the previously stored products.
- (c) The confined space should be allowed to return to an acceptable thermal environment prior to entry.

G4 ABRASIVE BLASTING

Cleaning by abrasive blasting should only be conducted where suitable supplied-air respiratory protective devices are used and legislation for the particular jurisdiction is followed.

Provision should be made to contain all grit and dust so that it does not create an airborne dust problem.

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 respirable-air line to the respirator.
- (c) Escape equipment.
- (d) Actuating devices that require positive effort by the operator to keep the blasting apparatus supply valve open.

G5 CHEMICAL CLEANING

In addition to creating toxicity hazards, chemicals used in cleaning operations may also be capable of producing a flammable airborne contaminant. The safety of the atmosphere should be re-evaluated after cleaning and prior to the commencement of any further tasks.

APPENDIX I

ADDITIONAL RECOMMENDATIONS FOR ATMOSPHERIC TESTING AND MONITORING

(Informative)

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

I1 GENERAL

Testing of the atmosphere when required, and a survey of other hazards should be conducted from outside the confined space and from as many nozzles and openings as are available before any entry occurs. The results should be recorded on the written authority. Tests should be conducted in the order listed and should include those for oxygen concentration, flammability, airborne contaminants (e.g. carbon dioxide, carbon monoxide and dusts) and thermal extremes.

Atmospheric testing of more remote regions within the confined space, away from the entry or exit, may be conducted once the area adjacent to the point of entry to the confined space has been made safe for entry.

Normal entry should only be considered when the test results show the confined space is safe.

The normal means of evaluating the atmosphere is to test it for specific substances with a suitable portable analyzer. There are many different kinds of analyzers available but the results are only as good as the competency of the operator and the state of analyzer maintenance and calibration. For example, a gas detector should be used in accordance with manufacturer's recommendations and relevant standards. This is to enable an accurate reading to be 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 analysers with audible alarms should be inserted using appropriate non-sparking equipment.

I2 ATMOSPHERIC TESTING AND MONITORING EQUIPMENT

Flammable gas detectors should comply with AS/NZS 61779.1. The competent person is to have a thorough knowledge of the 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 that may damage the sensor and give misleading results caused by 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 gas or vapours (e.g. false zeros).
- (i) Oxygen deficiency causing a low percentage of the LEL flammable gas reading.
- (j) Oxygen enrichment where the instrument may act as an ignition source causing an explosion.
- (k) Differences in atmospheric pressure that may cause erroneous readings in some sensors.

Equipment for testing and 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 should be selected for their functional ability to measure hazardous concentrations. Instruments should be calibrated in accordance with the manufacturer's standards or manuals.

After atmospheric purging or ventilation has been completed, forced draft devices, such as inductors or fans, should be turned off for a sufficient time to allow a normal atmospheric condition to exist for the atmospheric 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 so that it is not disconnected while the inspection or other task is in progress. The stand-by person is responsible for monitoring the proper operation of the forced draft ventilation device.

Atmospheric testing of the confined space, consistent with the risk assessment should be conducted before the written authority is issued. The risk assessment, may require atmospheric testing including, but not limited to—

- (i) oxygen concentration;
- (ii) flammable airborne contaminants;
- (iii) airborne contaminants; and
- (iv) chemical deposits on surfaces.

A satisfactory result should be obtained before proceeding.

13 RETESTING AND MONITORING

Retesting and monitoring of the atmosphere may be necessary, e.g. 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.

Arrangements should be made for repeat tests for oxygen and airborne contaminants at intervals that take account of the likelihood of a change in conditions. No set time can be applied for all circumstances, but the time between tests should be not more than 24 hours. There should not be a significant delay between tests and the first entry to the confined space.

The frequency of retesting should be determined by a competent person 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.

14 INTERPRETATION OF MEASUREMENT RESULTS

Measurements of all relevant airborne contaminants and the interpretation of results should be conducted by a competent person. The results should be compared with the relevant exposure standard, and with the LEL if the contaminant is flammable or combustible. Clause 3.4.32(a) requires that no entry into a confined space is permitted if the concentration of the flammable contaminant in the atmosphere exceeds 5% LEL. A measurement less than 5% 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 airborne contaminant of less than 10% LEL before evacuation of the confined space is necessary (see Clause 3.4.32(b)). Requirements on explosive limits for many gas mixtures are provided in AS/NZS 60079.20. Where a substance is not listed, then an information search is to be undertaken to identify the LEL.

Care should be taken that the concentration of airborne contaminants does not exceed occupational exposure standards. Where no exposure standard exists, a competent person should develop a standard based on the available scientific data.

This Standard requires that the results be compared with the relevant exposure standards and that exposure does not exceed the exposure standard. The interpretation and intended use of exposure standards is described in HSIS.

15 COMBUSTIBLE DUST DETECTORS

Persons who will be using instruments to detect the presence of airborne dust concentrations should be made aware of the difficulties involved in establishing flammability limits for combustible dusts.

The explosivity of dusts generally increases as the particle size decreases, since smaller dust particles can be more easily thrown into suspension. Small dust particles disperse more uniformly and remain in suspension longer than large dust particles.

Additionally, a given mass of smaller particles has a greater specific surface and can absorb more oxygen per unit mass and can oxidize more rapidly than a similar mass of large particles. A greater electrical charge can develop on finer particles because of increased capacitance. The level of uncertainty associated with flammability limits of combustible dusts also stems from the transient nature of dust clouds, particularly with respect to local concentrations in a cloud as a function of time and space.

Calibration of continuous dust monitoring equipment should be conducted with the same type of dust as that to be measured. The preparation of dynamic dust-in-air mixtures of known concentration for calibrating continuous dust measuring equipment requires considerable laboratory instrumentation and good quality control.

APPENDIX J

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

(Informative)

J1 GENERAL

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

The competent person should decide 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, should be considered as a minimum:

- (a) The risk assessment as required under Clause 3.3.1.
- (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 persons when wearing personal protective equipment.

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

J2 EYE AND FACE PROTECTION

Plano-goggles or visors should be provided for persons who wear corrective spectacles. 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.

Requirements for eye protection are given in AS/NZS 1337. Guidance on eye protection is given in AS/NZS 1336.

J3 HEAD PROTECTION

Requirements for industrial safety helmets are given in AS/NZS 1801. Guidance on selection care and use is given in AS/NZS 1800.

J4 FOOT PROTECTION

Requirements for safety footwear are given in AS/NZS 2210.2.

J5 BODY PROTECTION

All persons who enter a confined space should wear full-coverage 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. If the hazards are heat or cold, protection from over-exposure should be worn. The weight and restriction of body protection can, however, become hazards themselves.

J6 HEARING PROTECTION

Hearing protection is required when the risk assessment indicates it is necessary. 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. Requirements for hearing protectors are given in AS/NZS 1270.

J7 RESPIRATORY PROTECTIVE DEVICES

The competent person should determine the appropriate respiratory protective device based upon conditions and test results of the atmosphere within the confined space, and the tasks to be conducted. The respiratory protective device should also fit properly and be safe to use. Care needs to be taken in the selection of equipment and in its use. Requirements for respiratory protection devices are given in AS/NZS 1716.

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.

J8 HAND PROTECTION

Where hands are exposed to rough surfaces or sharp edges, the appropriate degree of protection ranging from canvas to metal mesh gloves, should be provided depending on the material handled. Gloves made of a suitable resistant material are to be worn to protect against corrosive, toxic or irritating materials. Heat protective gloves are required when persons handle objects with temperatures greater than 60°C.

J9 SAFETY HARNESS, SAFETY LINE RESCUE LINE

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

Guidance on selecting the appropriate type of safety harness or safety line or rescue line may be found in AS/NZS 1891.4 and should take account of the possible hazards/rescue arrangements. Guidance on storage, maintenance and inspection of the equipment may be found in AS/NZS 1891.4.

J10 MAINTENANCE OF EQUIPMENT

J10.1 General

A procedure should be established to ensure that regular maintenance is conducted so that the efficiency of the risk control measures is not reduced. Maintenance includes visual checks, inspections, testing of equipment, preventive maintenance and remedial tasks. Any measures used to secure the confined space should be effectively maintained so that entry into the confined space is prevented or adequately controlled. Personal protective equipment should be cleaned, stored and maintained, in accordance with manufacturers' recommendations and its use effectively supervised.

J10.2 Personal protective equipment

Maintenance is an integral part of any personal protective equipment program so 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, great care should be taken so that such equipment will offer the appropriate level of protection, and not be 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 person 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) Reporting of damaged, defective or lost equipment to a competent person responsible for repair or replacement.
- (g) Ensuring that supplies of disposable protective equipment are always 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 appropriate training, cleaning equipment and storage facilities are provided. However, the cleaning and maintenance of more complex equipment, such as non-disposable respiratory protective devices requires specialized knowledge and equipment. It is usually necessary to set up a centralized cleaning and servicing section for this type of equipment.

All 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. This includes respiratory protective devices, safety harnesses, safety lines and rescue lines and reviving equipment.

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.

Guidance on the use and maintenance of respiratory protective equipment is given in AS/NZS 1715. 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.

J11 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.

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