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Resources Safety

Storage and handling of dangerous goods

Code of practice

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Foreword

The Act

The *Dangerous Goods Safety Act 2004* (the Act) provides risk management dangerous goods legislation for the first time in Western Australia. A key focus of the Act is the duty to minimise risk from dangerous goods.

The duty to minimise risk not only applies to employers and employees but to all persons, including members of the public. This duty is placed on everyone involved with dangerous goods and goes beyond the workplace duties of the *Occupational Safety and Health Act 1984* and the *Mines Safety and Inspection Act 1994*. Public safety is one of the most important features of the Act.

Regulations

The Act is supported by the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (the Storage and Handling Regulations) and the Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 (the MHF Regulations). It is essential to understand and comply with the Storage and Handling Regulations and, where applicable, MHF Regulations, and adopt a risk management approach using all relevant codes and standards.

Both sets of regulations are enforceable, and non-compliance may result in licence suspension, prosecution, or directions to cease operations and undertake remedial action.

Standards

Although reference is made in this code of practice to specific versions of Australian and other standards, it is good practice to consult the latest versions where applicable.

Acknowledgement

Parts of this code of practice are based, with permission, on WorkCover NSW Publication No. 1354, *Storage and Handling of Dangerous Goods: Code of Practice*, published in 2005.

Contents

1 Introduction

1.1 Scope

Dangerous goods may be explosive, flammable, combustible, spontaneously combustible, oxidising, water-reactive, toxic or corrosive. They can be deadly and seriously damage property and the environment so it is important that they are stored and handled safely.

This code of practice describes measures that can be used to reduce the risks associated with the storage and handling of dangerous goods, and achieve the performance-based safety outcomes of the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (the Storage and Handling Regulations).

It may be possible to use measures other than those described here that provide the same or a lower level of risk — the code is not intended to prevent innovative safety practices and equipment that give at least equivalent safety performance.

A glossary of terms used in this code of practice is given in Appendix 1.

1.2 Application

The code of practice provides practical guidance on how to comply with the Storage and Handling Regulations for persons who manufacture, import, supply, store or handle dangerous goods, or work in an industry that conducts such activities. It covers the general requirements that apply to all dangerous goods (e.g. risk management of dangerous goods storage and handling systems), and includes guidance on secondary containment and transit stores.

The code of practice only applies to dangerous goods sites that store or handle dangerous goods above the placard quantity specified in Schedule 1 of the Storage and Handling Regulations. It also applies to operators of major hazard facilities (MHFs), who have additional duties under the Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 (the MHF Regulations).

The code of practice cannot cover every possibility. Those who have duties under the *Dangerous Goods Safety Act 2004* or associated regulations should remain alert to developments and hazards that may not be fully addressed by this code of practice or other guidance material. When in doubt, experts should be consulted to determine what further measures may be necessary or desirable, considering good working practices and local circumstances.

1.3 Approach

An analysis of the hazards and risks with the particular type of dangerous goods at the site will indicate which sections of this code of practice are relevant. The Class assigned to the goods is a key indicator of the hazard. Chapter 3 provides essential advice on identifying dangerous goods.

The total quantity of dangerous goods stored or handled is a key indicator of risk. For example, some aspects of this code of practice may not be relevant to the site if there are only small quantities in packages. A systematic application of risk management should indicate relevant control measures, using this code as a guide.

Guidance on identifying and controlling hazards is provided in Chapter 4. Details of risk assessment are provided in Chapter 5. Chapter 6 explains the hierarchy of risk control. Chapters 7 to 9 provide information on specific control measures and references to relevant Australian Standards.

1.4 What goods are covered?

This code of practice covers the storage and handling of the following dangerous goods (Table 1.1):

- dangerous goods of Classes 2, 3, 4, 5, 8, 9 and Division 6.1;
- C1 combustible liquids;
- goods too dangerous to be transported (GDT); and
- sulfur in all forms.

Table 1.1 Goods covered by this code of practice

Type of goods	Description	Class label	Reference for classification
Class 2	Gases		ADG Code
Division 2.1	Flammable gases		
Division 2.2	Non-flammable, non-toxic gases		
Division 2.3	Toxic gases		

Type of goods	Description	Class label	Reference for classification
Class 3	Flammable liquids		ADG Code
Class 4	Flammable solids and other reactive substances		
Division 4.1	Flammable solids, including all forms of sulfur		
Division 4.2	Substances liable to spontaneous combustion		
Division 4.3	Substances that in contact with water emit flammable gases		
Class 5	Oxidising substances, organic peroxides		
Division 5.1	Oxidising substances		
Division 5.2	Organic peroxides		

Type of goods	Description	Class label	Reference for classification
Division 6.1	Toxic substances		ADG Code
Class 8	Corrosive substances		
Class 9	Miscellaneous dangerous goods and articles		
Goods too dangerous to be transported (GDT)	Goods as listed in the Australian Dangerous Goods Code		
C1 combustible liquids	A C1 combustible liquid has a flashpoint between 60°C and 150°C		ADG Code and Australian Standard AS 1940:2004 *The storage and handling of flammable and combustible liquids*

Note: The ADG Code is the 'Australian Code for the Transport of Dangerous Goods by Road and Rail', published by the Australian Government from time to time.

Figure 1.1 Classification of dangerous goods sites

1.5 What sites are covered?

The requirements of the regulations become more stringent as the quantity of dangerous goods stored and handled at a site increases (see Figure 1.1).

The operator of the site must know the site classification to know what duties apply. To determine this, the quantity of all dangerous goods stored or handled at a site is compared with the prescribed quantities given in Schedule 1 of the Storage and Handling Regulations. Operators who store or handle dangerous goods in excess of the manifest quantity must have the site licensed with Resources Safety.

Additional requirements apply to declared MHFs in relation to holistic risk management at these facilities. A dangerous goods site may be declared an MHF if the amount of dangerous goods stored or handled exceeds the Critical Quantity in Schedule 1 of the MHF Regulations.

Note: Schedules and licensing requirements are summarised in information sheets available from the Dangerous Goods FAQs section of the Resources Safety website.

1.6 What sites and goods are not covered?

The regulations cover dangerous goods in all environments except:

- while being transported in accordance with the Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007;
- while being handled in a port area as those activities are regulated under the Dangerous Goods Safety (Goods in Ports) Regulations 2007;
- while being transported in a port area or on a vessel;
- dangerous goods that form part of batteries used in plant;
- dangerous goods that form part of the refrigeration system of refrigerated freight containers;

- when in a fuel container that is fitted to a vehicle, vessel or aircraft, mobile plant, appliance or other device, where the dangerous goods are intended for use in its operation;
- dangerous goods that are in portable fire fighting equipment, portable safety equipment or portable medical equipment, where that equipment is held for use at the premises;
- asbestos;
- combustible liquids other than C1 combustible liquids;
- when in a storage or handling system or dangerous goods pipeline, that has been made safe or thoroughly cleaned and free of dangerous goods;
- dangerous goods that are the property of any of the Australian Defence Force and that are on any land or in any building owned or held under lease by the Commonwealth.
- compressed gas in pneumatic tyres;
- Division 2.2 dangerous goods in balloons or dirigibles;
- when the dangerous goods comprise potable liquids in consumer packages at retail premises;
- when the dangerous goods comprise naturally occurring gas in an underground mine; or
- C1 combustible liquid filled electrical cables.

The regulations also do not apply to the storage and handling of the following quantities of dangerous goods at sites that are not workplaces as defined in section 3(1) of the *Occupational Safety and Health Act 1984*:

- Division 2.1 or 2.2 or compressed oxygen if
  - each is in one or more containers in a total capacity of not more than 50 L,
  - total quantity of compressed gas and oxygen is not more than 100 L, and
  - the dangerous goods as a whole form part of a welding set or are used or intended to be used with a portable flame torch;
- Division 2.2 in portable gas cylinders that are used or intended to be used for medical purposes in a total quantity of not more than 100 L;
- Class 3 in a total quantity of not more than 250 L;
- pool and spa sanitising agents (comprising calcium hypochlorite, sodium dichloroisocyanurate, sodium trichloroisocyanurate, potassium dichloroisocyanurate, trichloroisocyanuric acid or any other oxidising substances, in solid form, used for sanitising water) in a total quantity of not more than 100 kg;
- hypochlorite solutions designated by UN 1791 in a total quantity of not more than 100 L;
- Class 9 dangerous goods in a total quantity of not more than 100 kg or L;
- dangerous goods of Packing Group I in a total quantity of not more than 5 kg or L;
- C1 combustible liquids in a total quantity of not more than 1000 L; and
- any dangerous goods in a total quantity of not more than 100 kg or L excluding those specified above and Division 2.3.

Specific regulations apply to rural or small quantity dangerous goods locations have.

1.7 Difference between dangerous goods and hazardous substances

Dangerous goods should not be confused with hazardous substances — they are classified according to different criteria.

Dangerous goods are classified on the basis of *immediate physical or chemical effects*, such as fire, explosion, corrosion and poisoning affecting property, the environment or people.

Hazardous substances are classified only on the basis of *health effects* — whether immediate or long-term (e.g. corrosives, poisons).

Dangerous goods and hazardous substances are regulated under separate legislation focusing on controlling the different risks described above. However, many hazardous substances are also classified as dangerous goods. Where a hazardous substance is also a dangerous good, both legislations apply.

2 Risk management fundamentals

2.1 Risk management approach

This chapter focuses on planning and applying risk management principles to the storage and handling of dangerous goods.

Risk management is a way of organising efforts to determine safe systems of handling and storage. Following the procedure below will help identify safety issues unique to a site. Operators must consult with employees about these steps.

Steps in risk management

Risk is a combination of the likelihood and severity of any harm the hazards may generate. Risk management involves the following steps:

1. **Identify the hazards** — Examine all activities, work processes, plant, substances, work environment, layout and condition of the site, and any other factors affecting safety. Specifically include dangerous goods classification of container contents; any dust or gas hazards that may arise from the nature of the substances and articles in use, handled or stored. This is explained in Chapter 3, with further technical details in Chapter 4.

2. **Assess the risks** — Identify the factors contributing to the risk. With dangerous goods, the quantity stored and in use is one indicator of the level of risk. The greater the quantity the greater the risk. Prioritise the risks, tackling the most serious ones first. Evaluate the effectiveness of existing control measures. Risk assessment is explained in Chapter 5.

3. **Eliminate or reduce the risk(s)** — Apply the 'hierarchy of control' measures (see Chapter 6 and Section 2.4). Control measures are outlined in Chapter 7 and detailed in Chapters 8 and 9. Identify any record keeping necessary to ensure controls are maintained.

4. **Monitor and review the control measures** — Ensure that safety is maintained and the risk control measures are working. Respond to changes in work practices, activities and other conditions. Supervision is essential to ensure workers and the public follow correct practices.

This code of practice provides guidance for the first three steps.

2.2 Operator's obligation to consult with employees about risk management

An operator of a dangerous goods site must give every person engaged to work on the site reasonable opportunity to comment on the risk assessment, emergency plan or safety management system for the site.

Operators should consult with employees about implementing this code of practice. It may help if issues on hazardous substances (such as exposure of workers to atmospheric contaminants) are discussed at the same time. For example, when discussing the physical risk of the flammability of the vapour produced by a substance, it is also appropriate to discuss inhalation and toxicity risks.

When to consult

Whenever operators undertake a risk assessment or determine control measures, they must consult with employees as part of this process and take their views into account. For example, consultation should take place when:

- evaluating safety issues as part of the process of purchasing new types of dangerous goods or plant to be used with dangerous goods — this includes safety features of the plant used with dangerous goods, its location and compatibility with other plant or equipment in the workplace;
- developing safe work procedures for related tasks, such as decanting, loading, unloading and using bulk handling equipment;
- developing inspection and maintenance procedures;
- developing emergency procedures to address risks such as fire and explosions;
- investigating the causes of injuries, accidents or other incidents (such as 'near misses') that may arise; and
- considering modifications to the containers of dangerous goods or associated plant.

Topics for discussion

When undertaking consultation, operators should share all relevant safety information with employees. This must include information provided by the manufacturer or supplier of goods and plant, health and safety issues that may arise from the use of goods or plant, and how these issues will be addressed. Employees should be given sufficient time to consider this information and discuss any questions they may have with the operator.

Topics to discuss during consultation may include:

- risk assessment and risk control measures for dangerous goods;
- selection of suitable personal protective equipment (PPE), when chosen as a control measure;
- the best ways to communicate health and safety information, including providing information to contractors or other workers at the site;
- effective provision of signage;
- establishing administrative procedures such as hazard and accident reporting;
- accessing emergency response procedures for the site; and
- coordination with contractors and other workers at the site, such as vehicle drivers loading or unloading.

2.3 Identifying dangerous goods and providing information

The following information should be made available to relevant persons during consultation:

- labels on containers and material safety data sheets (MSDSs) (see Chapter 3);
- dangerous goods classification of the substance;

- any written risk assessment reports;
- any relevant manufacturer's information relating to the use of plant;
- emergency plan; and
- manifest for the site.

2.4 Preventing accidents and injuries — hierarchy of control

After identifying the hazards and assessing the risks, the key step is to determine the safeguards or work systems that are needed to minimise risks. Operators must involve employees when making these decisions.

The hierarchy of control (Chapter 6) should be followed when choosing control measures recommended in this code of practice. Many of the measures will be those described in relevant Australian Standards. Sites where the controls were adopted from the relevant Australian Standards prescribed in the old (repealed) dangerous goods regulations will largely conform to this code of practice.

The hierarchy of control measures is listed below in order of effectiveness. Work through the sequence, starting with 1 representing the highest level. Determine the control from the highest level reasonably practicable, and develop each control measure for each risk identified. The term 'reasonably practicable' is explained in Section 6.3. In some situations a combination of control measures may be needed.

The hierarchy of control principles are outlined below and detailed in Chapter 6.

1. *Elimination of the risk* (e.g. use a non-harmful substance instead of dangerous goods).
2. *Substitution of the system of work, substance or plant for something less hazardous* (e.g. change the type or reduce quantities of goods kept on site).
3. *Isolation of the hazard* (e.g. introduce a restricted work area, enclose the system, separate goods from other hazards or segregate incompatible substances).
4. *Introduction of engineering controls* (e.g. install forced ventilation to remove fumes).
5. *Use of administrative controls* (e.g. modify the system of work, such as changing the times at which certain tasks are done, hazard warning signs, specific training and work instructions).
6. *Use of personal protective equipment* (PPE) (e.g. eye, respiratory and hand protection for workers).

2.5 Design of new sites or plant

All sites, structures and plant should be designed and manufactured for use with the specific dangerous goods that will be handled or stored. All safety aspects of the design, commissioning, operation, testing, maintenance, repair and decommissioning should be anticipated and planned at the design stage. This enables control mechanisms to be incorporated into the design. The costs of control measures may be lower if incorporated into a safe design, rather than adapting inappropriately designed plant or sites.

The design process should follow the principles of the hierarchy of control (Chapter 6), and specific control measures (Chapters 7 to 9). The designer of plant must identify,

assess and control any hazards or risks. Any dangerous good necessary for the use of the plant should be specified, and warnings provided in relation to unsuitable goods.

If a structure or plant to be used for dangerous goods was not originally designed and built for that purpose, a specific risk assessment should be carried out to ensure its suitability.

Take account of any external factors in the layout of the site, such as whether or not the location and type of fire protection meets with operational requirements of the Fire and Emergency Services Authority of Western Australia (FESA). If intending to store substantial quantities of dangerous goods, engaging the advice of FESA will assist in designing a suitable fire protection system. Australian Standards relevant to the goods to be stored also advise on safety precautions and fire protection (Chapter 12).

Further advice on design of sites and storage is provided in Chapter 7.

2.6 Installation, maintenance and inspections

The operator of a dangerous goods site must ensure that storage or handling systems at the site have been designed, built, maintained, and isolated by means of distance or barriers so that, so far as is reasonably possible, they can be operated with minimal risk to people, property or the environment.

Installation, maintenance and inspections should be done by a competent and experienced person – someone who has the appropriate practical experience and theoretical knowledge to carry out the task safely and effectively. The person should have an understanding of the statutory requirements and an appreciation of the hazards involved, and be able to recognise the need for specialised advice or assistance when necessary.

Keeping risks low

Regular checks, inspection, maintenance and cleaning programs are essential for maintaining control measures and keeping risks low.

Examine containers and associated plant in accordance with the manufacturer's instructions or operator's manual to ensure they are in a safe operating condition, prior to use and on a regular basis. Where use of a container or plant is seasonal or periodic, an inspection should take place at the beginning of each season or work period.

Intervals for comprehensive inspection will be determined by the type of product stored and any external environmental factors.

Arrange for a comprehensive and detailed examination of storage containers and associated plant by a competent person at intervals recommended by the manufacturer, or more frequently in harsh environments such as near seawater or where factors such as the nature of the stored material could cause corrosion.

Key areas for inspection and maintenance

The following items should be included in a regular inspection and maintenance program, where relevant:

- filling devices, valves and control mechanisms used for transfer;
- any safety devices fitted to plant;
- air or dust filters, and dust control system for operation, cleanliness and integrity;
- pressure relief valves for correct operation;

- electrical equipment, including leads and cables;
- warning signs and labels for wear and fading; and
- operation of any warning devices and high level detection systems.

The structural integrity of containers for bulk dangerous goods and associated plant should be checked for fatigue and failure. Evidence of structural problems may be detected by visual checks for the following:

- damage to metalwork, bolts or welds such as surface corrosion;
- damage to supports of containers or tanks;
- settlement, cracking, or damage to concrete, footings, foundations, slabs or exposed plinths;
- corrosion of access points such as ladders, stairs, walkways and platforms, including fixing at attachment points;
- damage to dust or fluid seals, and the integrity of dust control systems; and
- any visible bulging or distortion of containers.

Pressure equipment should be inspected in accordance with Australian Standard AS/NZS 3788:2006 *Pressure equipment – In-service inspection*.

Faults that could cause heat or sparks, such as over-heated bearings or slipping drive belts, need immediate attention if the stored goods are flammable or combustible.

Remedial work

All maintenance and repair work should be carried out by a competent person, and in accordance with the designer's or manufacturer's instructions, including the time periods for inspection and maintenance.

Ensure that all electrical work is carried out only by qualified and licensed persons and to appropriate standards. The appropriate protection is especially critical if electrical equipment is used in a hazardous zone.

Repairs carried out must keep plant within its design limits (if modified, see below).

Maintenance or repair of plant may involve 'hot work' processes that generate heat or introduce ignition sources, such as welding or grinding. The risk of fire and explosion must be controlled. A formal 'hot work permit' system should be implemented. For examples, see Australian Standards AS/NZS 2865 Set:2005 *Safe working in a confined space* (appendix H), AS 1674.1:1997 *Safety in welding and allied processes – Fire precautions and* AS 1940:2004 *The storage and handling of flammable and combustible liquids* (section 9.8.3, appendices D and L).

Purging and work in confined spaces

Purging is used to displace an atmospheric contaminant from an enclosed space. For example, purging may involve the use of an inert gas such as nitrogen to clear flammable gases or vapours before work commences. The risks associated with the gases removed from the space also need to be considered, or exhausted to a location where they do not present a hazard.

Interiors of containers, such as tanks, that have held dangerous goods will usually be confined spaces and special procedures are required if workers need to enter them. Safe entry procedures are necessary to address the possibility of reduced oxygen levels or residual contamination,. Atmospheric sampling, monitoring, or the use of breathing apparatus may be required.

Following purging, the confined space should be adequately ventilated and retested. The reduction in hazard may be temporary (e.g. flammable gases absorbed into the walls of a steel tank, or from deposits, may leach out and recreate the flammable atmosphere). Since contaminants may build up again, consider whether it will be necessary to re-purge the space.

Purging should be undertaken in a manner that will not cause rupture or collapse of the container due to pressure differentials. Avoid damage to the container by over-pressure or a vacuum. Pressure relief valves must be operational. Condensing steam may cause a tank collapse if vents are blocked.

Cleaning

Regular cleaning is essential to reduce hazards resulting from dusts and combustible materials, especially before starting plant. Some dusts are toxic, pyrophoric (ignite spontaneously), combustible or can form an explosive atmosphere, and these risks should be identified.

A regular cleaning program should include removing dust deposits from any exposed surfaces or accumulated material inside a container, such as by internal cleaning. The cleaning process itself may raise dust hazards, fire risks and explosion risks. Any equipment used, such as vacuum systems for dust removal, should be suitable for use in such an atmosphere.

Safe work procedures should be established for cleaning or clearing any plant. When plant and equipment is being cleaned, it should be isolated to prevent operation. A lockout and tagging system should be considered.

Records

Keeping records of maintenance, inspections and repairs will help to confirm that the maintenance program is carried out regularly.

Modifications to plant

Consult the manufacturer or supplier, or an appropriately qualified engineer, before carrying out structural modifications to plant (including a container).

A person modifying a design takes on the legal requirement of a designer and manufacturer. A number of Australian Standards provide advice in relation to plant or containers used with dangerous goods.

2.7 Information and signage

The key information provided to workers includes placards and signs in the work area and site. Details on placarding and signage are provided in Chapter 11. Information on labels and MSDSs is provided in Chapter 3.

2.8 Security of site and storage area

The hazards associated with dangerous goods mean that access to site and work areas needs to be controlled and restricted to people having a legitimate purpose. Operators of sites have a duty, so far as is reasonably practicable, to prevent:

- access to the operator's site by unauthorised persons; and
- unauthorised activities occurring on those sites.

Factors to assess

Security systems and procedures should be developed on the basis of the risk assessment, and could consider:

- need to ensure the security of personnel, dangerous goods, processes, equipment, plant, buildings, records and information systems;
- location of the site in relation to access from the surrounding community and roads;
- likelihood of mischief or sabotage; and
- integrity and reliability of the security system and possible requirements for backup support for systems and security personnel.

Controlling access

When necessary to control people's access to the site, the access control system should include:

- means to identify the extent of access to be permitted for each person;
- means to account for everyone on site at any given time; and
- issuing of restricted access passes to visitors, or prohibiting unaccompanied access.

Depending on the size of the site and risks identified above, security measures where dangerous goods are kept could include the following:

- fencing or enclosing the storage areas (but providing safe access and egress);
- providing locks on doors, windows and other openings to buildings, rooms, compartments or shipping containers;
- continuously supervising areas;
- performing security checks on vehicles entering or leaving the site; and
- limiting access by visitors, customers, contractors or employees to particular areas.

2.9 Entry, exit and emergency exits

Safe entry to and exit from the site, or parts of the site including plant, are required for anyone who may come to the site or works there.

In emergency situations, including leaks, spills or fires, it is essential that dangerous goods have not been located where they could hinder escape from the building, work area or site. It is also important to have clear access readily available to FESA and for emergency equipment (e.g. for fire fighting and clean-up of spills).

To ensure access is available, consider:

- keeping internal routes clear at all times;
- keeping external routes clear for vehicle access (including emergency vehicles);
- keeping doors and gates unlocked when they may be required as exit points;
- having doors and gates open outwards where appropriate
- providing easy exits from work areas, including bunded areas;
- keeping clear areas where FESA connections are necessary for fire fighting, such as water, foam or gas inlets or outlets; and
- providing multiple exits.

2.10 Emergency preparation and response

Operators of dangerous goods site must be prepared to deal with emergencies, and any measures adopted need to be included in staff training and instruction, and developed in consultation with employees.

When a dangerous goods incident occurs at a site, operators have the following duties:

- provide advice to people at adjacent properties of the incident;
- take immediate action to bring the incident under control and make the situation safe;
- report the incident to the Chief (Dangerous Goods) Officer;
- investigate and record the findings of the incident; and
- review the risk assessment of the dangerous goods site.

Note: An emergency planning code for dangerous goods sites and further information on incident reporting is available from the Resources Safety website.

2.11 Training and instruction for workers

Operators must provide anyone involved in the storage and handling of dangerous goods with suitable induction, information, training and supervision.

Information and training must be appropriate with the risks, and the needs of each worker should be determined in the risk assessment process and through consultation with workers. Everyone should be trained to follow systems of work and work practices that enable them to perform their work safely. Training should include matters covered in this code of practice where relevant. All sites should have a drug and alcohol policy.

Note: Guidance material on alcohol and other drugs at the workplace is available from the Resources Safety and WorkSafe websites.

Relevant training needs to be considered for:

- workers who carry out specific tasks, such as operating, maintaining or cleaning plant;
- managers and supervisors who should have training relevant to the dangerous goods in areas they supervise; and
- people with the task of assessing risks and implementing control measures.

Only those who have had adequate training and instruction should be permitted to carry out the work.

Further guidance is provided in Chapter 15.

2.12 Control and coordination of contractors and other persons working at site

There may be multiple organisations or parties working on some dangerous goods sites so duties must be coordinated. At some sites there may be several operators and, consequently, several persons may have duties that must be coordinated.

Health and safety issues should be considered at the time of preparing selection documents and when evaluating the selection. The need for risk assessments and safe work method statements prepared by contractors should be considered at an early stage to ensure that the work is carried out safely.

In order to adequately ensure both the protection of contractors who work at the site (even if only occasionally), and to ensure contractors protect others, operators should check if other persons at the site are using dangerous goods and whether the site is suitable in terms of the site-related control measures described in this code of practice. Supervision or evaluation may be necessary to ensure contractors carry out appropriate procedures, including implementing this code of practice.

It may be important to adopt coordinated procedures for some items, such as:

- permit to work systems (e.g. for hazardous areas);
- isolation and tagging procedures to prevent inadvertent starting or energising of plant; and
- provision of adequate information, induction procedures and training about dangerous goods and associated hazards and risks and established emergency systems (e.g. fire alarms).

Controllers of premises, plant or substances (who themselves are not working at the site) also have responsibilities. An example is when a corporation engages a contract packer at a separate site and provides (and retains ownership of) the goods to be packed. Another example is strata title factory units, where the lessor and the lessee both have duties.

2.13 Supervision

Supervision is an important way of ensuring that workers adhere to safe working procedures. Operators of dangerous goods sites must ensure people involved with the storage or handling of dangerous goods are supervised.

It is important to observe and consult with employees to find out how the job is actually done. People do not always work ‘by the book’, and may devise their own methods of work. Find out what happens during cleaning, maintenance and breakdowns, and during staff absences or shortages. Where a difference is detected between the system of work set out and the way it is implemented, it is important to examine the reason and amend the procedures if necessary or otherwise ensure adherence to safe operating procedures.

Supervision also helps ensure people who are rendered incapable by drugs or intoxication do not increase risks by working with dangerous goods.

3 Identifying dangerous goods and providing information

3.1 Overview

It is essential that relevant information is obtained and passed on to relevant persons. Key information is in the form of labels on containers, placards on storage areas and MSDSs. Where this information is not available, such as for goods created and used within the workplace or emissions, then equivalent information needs to be obtained.

3.2 Identifying dangerous goods

To identify hazards it is important to identify, and make a list of all the substances and goods that are classified as dangerous goods at the site. Incidentally, steps 3 (prepare a list) and 4 (gather MSDSs) below describe how to create a register of dangerous goods for a site, as required by regulation.

Step 1: Identify dangerous goods

The first step is to identify where the dangerous goods are located and the forms they take. Substances and goods can appear in a variety of forms. The site check should include an examination of:

- containers or packages such as cans, bottles or packets;
- large tanks;
- gas cylinders;
- contents of process vessels or vats;
- stockpiles;
- emissions such as vapours, mists, dusts, fumes, gases;
- by-products (including stockpiles); and
- wastes.

In each case, identify the substances, products or emissions involved. Look at each job or task separately and consider:

- handling containers in the storage area;
- mixing, diluting and measuring (e.g. when substances are decanted for use);
- use (e.g. spraying, where the substance may become airborne);
- handling and loading or unloading vehicles;
- the form of storage (e.g. tanks, packages on pallets or bags);
- using dangerous goods with or in plant (e.g. process vessels or vats); and
- generation of dusts or fumes by the work.

Step 2: Check the classification

Identify which of the substances and goods that are used, handled, stored or emitted are classified as dangerous goods.

For substances supplied to the site, identify the type from:

- labels on packages or signs, such as placards, on containers; and
- MSDSs from the supplier.

Some articles will also be classified as dangerous goods (e.g. some types of batteries).

It is the duty of the supplier to provide information in the form of correct labels on packages or containers. Dangerous goods have a 'diamond' label. If the dangerous goods also have a subsidiary risk then there will be a second 'diamond' symbol on the label or placard.

Records in the form of stock lists and inventories could be useful, particularly if inventory is marked with the category of dangerous good at the time of purchase.

The hazards of dusts and other emissions from items not covered by a label should also be considered. When diluted for use, the classification of some goods may change. However, this does not necessarily mean the hazards or risks have been eliminated — spraying a dilute solution may still cause hazards.

Goods too dangerous to be transported

Goods too dangerous to be transported are not classified and assigned class numbers under the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code).

These goods cannot be transported nor can they be supplied. They include very self-reactive substances such as some organic peroxides, explosives and explosive-related material.

More common substances in this category include aluminium dross when wet or hot; charcoal when wet; and coal briquettes or coke when hot. When stored or handled in open atmosphere, they do not normally show the properties of goods too dangerous to be transported.

When mixed with stabilisers or diluents, some of the substances in this category are classified in either the ADG Code or the *Australian Explosives Code* (AE Code), and may be transported under suitable conditions. However, if the goods have lost the stabiliser or diluent, they may become goods too dangerous to be transported.

Step 3: Make a list

Make a list of all the dangerous goods that have been identified. This will help to form a register in step 4. The register is the list (inventory) plus the relevant MSDS (for substance supplied). See Section 3.5 for further details.

Include on the register any additional dangerous goods created on the site (even if these goods are not manufactured with the intent of them leaving the site), such as dust and fumes.

Step 4: Obtain MSDS or equivalent information

It is the duty of the supplier to provide information in the form of a MSDS for each type of dangerous goods supplied for use at work. MSDSs for any new dangerous goods supplied in the future also need to be placed on the register when obtained.

Retailers of consumer packages are not obliged to provide MSDS, but MSDS may be available from the manufacturer or importer for the dangerous goods obtained through retail outlets.

Note: The operator must prepare an MSDS for any dangerous goods produced on site.

Step 5: Obtain health and safety information

Examine the information gathered (e.g. from the label, MSDS). The type and degree of the hazard is indicated on the label and in the MSDS. If the substance is an emission, by-product, or waste, then it needs to be classified using the appropriate criteria. For dangerous goods created and used on the site, comparable information will need to be sought. If the dangerous goods are to be used with plant, check the plant manufacturer's instructions provided by the supplier. Operators should not vary the type of goods used with the plant without an assessment by a competent person.

For each chemical, goods or substance, find out:

- the type of hazard;
- recommended control measures;
- any relevant control conditions necessary to maintain stability — control conditions would include temperatures, proportions and limits for every ingredient that stabilises the dangerous goods (e.g. phlegmatisers, diluents, solvents, wetting agents, stabilisers and inhibitors); and
- any risks arising from incompatibility with other goods (Appendix 2).

3.3 Providing information to workers

Legal requirements

Information must be provided to workers in the form of the following:

- labels on containers, including those when substances are decanted into another container;
- ready access to relevant MSDS;
- placards on bulk storage locations; and
- other signs where relevant.

Placards requirements are covered in Chapter 11.

Labelling goods within dangerous goods sites

Labelling is a key element of establishing a safe method of work. The objective is to allow substances to be used safely and without risks to health.

The identification of all dangerous goods being handled or stored is the first step in hazard identification for the risk assessment (see Chapters 4 and 5), and an opportunity to ensure all are properly labelled.

All containers of dangerous goods supplied to, used in, or handled on the site must be appropriately labelled. This includes wastes. The operator must ensure the label is not removed, defaced or altered.

As a minimum, the label must be in accordance with the ADG Code, with the exception of C1 combustible liquids (see Schedule 4 of the Storage and Handling Regulations) and goods too dangerous to be transported.

Guidance for the labelling of packages (containers of a size less than bulk) is provided in the national *Code of practice for the labelling of workplace substances* (NOHSC 2012:1994, available from the Australian Safety and Compensation Council). Normally the containers supplied to the site will be correctly labelled and additional labelling will not be necessary. However, substances transferred to another container and substances produced and used within the site must be labelled — see the advice below.

Placarding of containers for bulk dangerous goods is covered in Chapter 11.

Labelling of containers and transferred substances

An operator of a dangerous goods site must ensure that any dangerous goods used at a site are held in a container that:

- is clearly labelled with the class label, subsidiary risk label and the proper shipping name of the dangerous goods; or
- otherwise clearly identifies the dangerous goods.

Where a substance is transferred, or decanted to another container, the type of labelling required will depend on whether the substance is consumed immediately or over a longer period of time, and the container size. Even when no labelling or minimal labelling is required, it is important to consider ways of ensuring workers cannot make mistakes by mis-identifying substances, as shown by the following examples.

- A container into which dangerous goods are transferred for immediate use need not be labelled, providing it is cleaned immediately after it has been emptied.
- If not consumed immediately, a container must be labelled to clearly identify the dangerous goods (i.e. a class label, subsidiary risk label and the proper shipping name of the dangerous goods).
- If labelling is required but the container is very small, such as a laboratory test tube, a practical method for labelling should be established, such as attaching the label to supporting apparatus like a test tube rack. Alternatively, a tag may be used to provide the information. A fixed or moveable sign could be placed adjacent to the work area. This could include a key or code to indicate the contents of the small container.

Unlabelled containers

If a container does not have a label or is improperly labelled, action should be taken to correctly label the container as outlined above.

If a person finds a container does not have a proper label, the site operator should immediately be advised.

If the contents of the container are not known, this should be clearly marked on the container, such as ‘Caution — do not use: unknown substance’. Such a container should be stored in isolation until its contents can be identified and properly labelled if it is determined as a dangerous good.

If the contents cannot be identified, they should be disposed in an acceptable manner, in consultation with the relevant waste management authority.

3.4 Material safety data sheets

MSDSs are a key source of information and are important for risk assessment.

MSDS access

Operators at dangerous goods sites must ensure workers have ready access to copies of MSDSs for the dangerous goods. Practical ways of making them accessible should be discussed in consultation with employees (Section 2.3).

Employees who are supervising those working with the dangerous goods should also have ready access to MSDSs.

Access to MSDSs may be provided in a number of ways, including:

- paper copy collections of MSDSs; and
- computerised MSDS databases (e.g. CD-ROM or online).

In each case, the operator should ensure that:

- current MSDSs are available;
- any storage or retrieval equipment is kept in good working order;
- employees are trained in how to access the information; and
- when information is displayed on a screen, there are means of obtaining a hard copy of that information.

Alteration of MSDSs

An MSDS obtained from a supplier must not be altered, except where it is provided from overseas and does not provide adequate information. If an operator wishes to add additional information to the supplier's MSDS, it should be appended to the MSDS. However, it should be clearly marked to indicate that the appended information is not part of the original MSDS. Specific workplace information may be added in this manner and is not considered to be an alteration to the MSDS.

Retailers and retail warehouse operators

Retailers and retail warehouse operators are exempt from the requirement outlined above to hold MSDSs for goods intended for retail sale. The exemption applies to:

- consumer packages held on their site, holding less than 30 kg or 30 L and which are handled in an unopened state;
- containers provided by the purchaser (e.g. jerry can for petrol, portable LP gas cylinder); or
- refuelling vehicles.

Note: If the container is opened (e.g. for repacking) then an MSDS must be obtained and made available to employees and other workers.

Dangerous goods in transit

MSDSs are not required for dangerous goods in transit. However, emergency information provided for dangerous goods transport should be readily available.

3.5 Register of dangerous goods at site

Legal requirements

An operator of a dangerous goods site must ensure a register is maintained of all dangerous goods stored and handled at the site (step 3 in Section 3.2). The register is useful as a source of information and management tool. It is not the same as the manifest (Chapter 14), although in some situations the manifest could be used to perform the same role.

Minimum information needed in register

Under the Storage and Handling Regulations, the minimum information that must be included in a register is a list of all dangerous goods present and any required MSDSs.

Include all substances, such as emissions and dusts generated, since the risks arising from these must also be assessed.

Keeping register up to date

The register must contain entries for all dangerous goods (and hazardous substances) currently used or produced in the site. Also ensure the current MSDSs are in the register, as MSDSs expire after five years.

The register should be updated as new dangerous goods are introduced to the site and the use or production of existing dangerous goods is discontinued.

Access to register

Operators must ensure employees who handle or store dangerous goods have ready access to the register.

Employee representatives and relevant public authorities (e.g. FESA officers, dangerous goods officers) should also have ready access. Practical ways of providing this should be discussed in consultation with employees.

The register can either be located centrally or kept at the site to which it pertains. It may be in electronic form, but this must be accessible to relevant employees — for example, screen-based equipment must be accessible, or hard copies are made available.

Retailers and retail warehouse operators

Retailers and retail warehouse operators are exempt from the requirement to have a register for goods supplied to a retailer or a retail warehouse operator in unopened containers holding less than 30 kg or 30 L.

Dangerous goods in transit

A register is not required for dangerous goods in transit as the transport documents provide sufficient information.

3.6 Identification of dangerous goods in enclosed systems

Dangerous goods contained in an enclosed system, such as a pipe or piping system, or a process or reactor vessel, should be identified to people who may be exposed to the contents. Bulk storages or processes containing dangerous goods must be signed and placarded. Pipes containing dangerous goods should be identified and distinguished.

Suitable means of identification include colour coding in accordance with Australian Standards AS 1319:1994 *Safety signs for the occupational environment* or AS 1345:1995 *Identification of the contents of pipes, conduits and ducts.* Identification such as this should be used in conjunction with suitable work practices such as permit to work systems. Where labelling or colour coding large numbers of pipes is impractical, management systems may be employed, such as providing induction information and generic signage at the site entrance, or marking of pipes by exception.

Where the contents of a reaction vessel undergo chemical changes during the manufacturing process, it is not possible to accurately label or placard the process vessel. A system for providing relevant information should be established. This could be in the form of batch sheets or written instructions. In order to provide information about the hazards and risks that may arise during the process, these should outline the feedstock ingredients and any information regarding any intermediate reaction(s).

When process vessels are used as bulk storage vessels and contain dangerous goods, they must be placarded to indicate the hazards arising from the contents.

3.7 Visitors to dangerous goods sites

An operator of a dangerous goods site must ensure that visitors are provided with supervision and information sufficient to ensure, as far as is practicable, their safety and health during their visit.

Providing information, such as signs is an important control measure. Where there is a risk to a visitor, such as a customer, or where the presence of a visitor may increase risk, visitors should be informed about:

- the hazards to which they may be exposed while on the site;
- appropriate safety measures to be applied while on the site; and
- actions to take in any emergency, such as when the emergency procedure or plan is activated while they are on the site.

The need for a formal system of providing safety information will depend on factors such as the:

- nature and severity of the hazards and risks;
- degree of access to areas of risk; and
- extent of supervision that will be provided.

Methods of providing safety information to visitors may include:

- appropriately placed signs;
- verbal instructions;
- written information, such as a pocket safety card (see Appendix 3); and
- showing a video.

An alternative control measure is to prevent the public accessing areas of risk (see security in Section 2.8).

4 Controlling hazards

4.1 Properties of dangerous goods

Having identified the principal classifications (class or division) and any subsidiary risk of the substances on the site (Chapter 3), the next step is to identify other relevant hazards, including the physical and chemical properties of the goods. These depend on the nature of the substance and other hazards present at the site.

Examples of additional properties that may need to be taken into account include:

- physical state of the goods (e.g. a gas, liquid or powdered solid);
- vapour density;
- relevant physical properties and possibility of hazardous atmospheres or atmospheric contaminants (e.g. is it likely to melt or vaporise at normal temperatures, and what is the vapour pressure?);
- flashpoint and fire point;
- chemical properties such as reactivity, chemical energy, solubility
- reaction or fire combustion products;
- concentration;
- presence of contaminants; and
- physical characteristics such as particle size and electrical conductivity.

For example, some metals in the form of a solid block do not present a hazard, but as a finely divided powder can be readily ignited or react strongly with a common substance such as water. Also, a liquid spill may spread further than a spill of a solid, so for flammable liquids, any ignition source nearby is a hazard.

4.2 Control conditions necessary to maintain stability

An operator must ensure that the stability of dangerous goods is maintained to avoid inadvertently creating new hazards or increasing risks, such as becoming unstable, decomposing or changing specification.

Identify and apply any control conditions specified by the manufacturer to ensure stability of the dangerous goods, such as:

- maintaining the levels of stabilisers such as phlegmatisers, diluents, solvents, wetting agents, desensitisers, inhibitors and any other adulterants that are necessary;
- controlling temperature levels if required, so the goods are stored within any control temperature range specified by the manufacturer; and
- keeping the dangerous goods and the packaging dry, unless the packages themselves are impervious to moisture.

This does not apply where the dangerous goods are about to be used in a manufacturing process.

4.3 Plant used with dangerous goods

If the dangerous goods are to be used with plant, check the plant manufacturer's instructions provided by the supplier. Operators should not vary the type of goods used with the plant without an assessment by a competent person.

A manufacturer, supplier or installer of a storage or handling system or dangerous goods pipeline must ensure the system or pipeline has been designed and built so that, so far as is reasonably practicable, it can be operated with minimal risk to people, property or the environment.

Suppliers of plant should provide information relating to its safe use, including:

- purpose for which the plant was designed;
- testing or inspection to be carried out;
- knowledge, training or skill necessary for persons undertaking testing and inspection of the plant;
- commissioning and use, such as:
  - installation
  - commissioning
  - operation
  - maintenance
  - inspection
  - cleaning
  - transport
  - storage
  - dismantling of the plant, if the plant is capable of being dismantled;
- systems of work necessary for the safe use of the plant;
- emergency procedures; and
- any documents relating to testing and inspection.

Further advice on specific aspects of control measures is provided in Chapters 7 to 9.

4.4 Other on-site hazards

Having identified the hazards intrinsic to the dangerous goods, the next step is to identify hazards that are external to the goods.

This includes all other substances, structures, plant, systems of work and activities:

- used in the storage and handling of dangerous goods; or
- not directly involved with the dangerous goods but that could impinge on safety.

Examples include the identification of all:

- physical components or characteristics that have the potential to cause harm;
- hazardous chemical and physical effects created in a manufacturing or handling process;

- systems of work, including normal operating procedures and the possibility of unusual operating conditions;
- correct procedures and operating parameters, and checking that they are being adhered to, including checking that the type of dangerous goods used is appropriate to the item of plant; and
- possibilities of operator error.

Consider the following hazard sources:

- plant used or moved on the site (e.g. ignition sources from engines);
- vehicle movements on the site;
- deliveries of dangerous goods;
- transfer of dangerous goods between containers on the site;
- visitor access;
- personnel movements in normal and emergency situations;
- fire hazards including buildings, concentrations of combustible material and uncontrolled vegetation; and
- weather conditions such as temperature extremes, wind, lightning, or rainfall including the potential for flooding.

Employees are commonly aware of these hazards and operators should consult them during the identification process.

4.5 Off-site hazards

Risks may arise from hazards external to the site. For example, an adjacent timber yard with stacks of wood is an external fire risk, because if the timber catches fire, this hazard could impinge on the dangerous goods.

External hazards include:

- any dangerous goods or incompatible substances stored at other adjacent premises or public places;
- activities, facilities or installations on neighbouring premises that could create a hazard (e.g. an ignition source);
- the effects of infrastructure such as a road, rail line, airport, pipeline, power line, radio transmitter or telephone tower; and
- fire hazards, including concentrations of combustible material or uncontrolled vegetation on neighbouring premises or public areas.

4.6 Chemical reactions and physical processes

Chemical reactions are those that result in a chemical change in one or more of the goods when they come into contact. Physical processes include dilution, dissolution, abrasion, phase change, leaching and absorption. Consider the following hazards:

- physical reaction from incompatible substances coming into contact (e.g. rapid heating generated by acid mixing with water, causing a steam explosion); and

- chemical reaction resulting from contact with other substances (e.g. an oxidising agent such as pool chlorine coming into contact with an oil such as brake fluid).

4.7 Past incidents — type and characteristics

Incident information, such as past accidents or spills, contributes to knowledge about the risks. Find out about:

- the type of incidents that have occurred when storing and handling dangerous goods at the site, or those at similar sites storing and handling similar types of dangerous goods;
- the cause of these incidents; and
- any information that is available about the effectiveness of controls and about how controls could be improved.

5 Risk assessment

5.1 Overview

The legal requirements for risk assessment are covered in the Storage and Handling Regulations. At sites where there are several operators, each must ensure the responsibilities are discharged in a coordinated manner. To achieve this, the operators will need to discuss with each other their risk assessments and the determination of control measures applying to the site as a whole.

For a dangerous goods site, a risk assessment is a document that:

- identifies all hazards relating to dangerous goods at the site;
- for each hazard, assesses
  - the probability of the hazard causing a dangerous goods incident; and
  - the nature of the harm to people, property and the environment that would result from the occurrence of that incident;
- for each hazard, identifies the risk control measures;
- in relation to each judgment required above, explains the methods used to make the judgment and the reasons for the judgment; and
- has been prepared in a form acceptable to the Chief Officer.

5.2 Assessing risks

Nature of risk

Having identified the dangerous goods and hazards in Chapters 3 and 4, the next step in the risk management process is to assess the risks.

Risk is a combination of the likelihood of an injury or illness occurring and the likely severity of this. In other words, it is the likelihood that a hazard will result in an incident, and how serious that incident will be.

In estimating risk, it may be useful to review historical information at the site or similar sites. It may also be necessary to estimate the frequency with which some tasks are carried out. Include vehicles carrying dangerous goods that are frequently parked at the site, possibly overnight, in the risk assessment and determination of control measures.

Consider other possibilities, such as the spread of a fire or a building collapse when assessing the risks of dangerous goods to buildings, and their consequences for the health and safety of people in them. Other risks may arise from the unintended escape of dangerous goods or unintended consequences during handling.

The risk assessment should include:

- extent of the risk to people (both workers and the public) both at the site and beyond;
- extent of the risk to other dangerous goods, other substances, plant or buildings, both at the site and beyond;
- identification of the factors contributing to the risk;

- determination of the extent and type of controls necessary — controls should be commensurate with risk;
- priorities for implementing control measures; and
- identification of records that need to be kept.

Operators must consult with all relevant employees during this risk assessment process and share information. Operators must keep records of the risk assessment and review the risk assessment at least every five years, or when indicated by other factors (see Section 5.5).

Consequences

In assessing the consequences of a possible incident, consider the potential for:

- injury and illness to people at the site;
- 'knock-on' effects involving increased risks to or from other dangerous goods or substances at the site;
- injury and illness to people outside the site (e.g. could protected works be affected, including nearby facilities such as factories, schools, child and aged care facilities, theatres, shopping centres or residences?); and
- risks to dangerous goods stores or handling areas at or outside the site; and
- adverse effects on critical infrastructure and sensitive environments.

Key risk factors

Factors contributing to the risk need to be identified. Central to risk assessment is an analysis of:

- failure of containment leading to spillage or leakage of goods (e.g. failure of plant containing the goods, including pipe connections during transfer);
- fires and explosions resulting from the nature of the dangerous goods;
- fire load of other substances, including storages of combustible liquids and other combustible materials;
- incompatibility of goods (e.g. they may react with each other or other substances);
- plant used with or near the goods (e.g. heat or ignition sources, including the materials the plant is made from — see Section 7.3);
- the buildings near or in which the dangerous goods are stored or handled, including the materials the buildings are constructed from and the potential fire load;
- the generation of hazardous atmospheres (e.g. flammable atmospheres and the risk of explosions) or atmospheric contamination (e.g. risk of toxicity);
- manufacturing processes, including the temperatures and pressures the goods are subjected to, physical processes such as separation, mixing, absorption, changes of state and chemical reaction;
- confined or enclosed spaces increasing risks; and
- occasional work, such as repairs and maintenance, should be included in the risk assessment, since this may introduce new hazards and increase risks.

These risk factors should be considered with regard to industry knowledge and practice, such as that reflected in relevant Australian Standards.

The site plan that accompanies the manifest (see Chapter 14) is also a useful tool when assessing risks and deciding on controls, particularly in relation to matters such as separation distances and spillage containment (bunding).

An example of a system for ranking risk is given in Appendix 4.

5.3 Qualitative or quantitative risk assessments

Risk assessments may be qualitative, quantitative or a combination of these. The choice will depend on the hazards, risk, complexity of the processes being evaluated, availability and reliability of data, and ability to develop acceptable risk criteria.

In simpler cases, a qualitative assessment may be sufficient, particularly if the guidance in Australian Standards is used.

Quantitative risk assessment may be used where there are reliable data, such as where failure rates are well known. Quantitative risk assessment may be the technique of choice when trying to make a determination between two control measures.

In many cases, semi-quantitative techniques may be used. This means that the assessment has qualitative and quantitative components.

It may be effective in some cases to use a highly structured risk assessment such as a hazard and operability study (HAZOP).

If the same dangerous goods and similar work processes are used in a number of locations, it may be possible to develop a generic risk assessment applicable to all locations, provided all relevant factors and variables are taken into account. By doing this, the number of assessments can be minimised and unnecessary duplication of effort avoided (e.g. in a factory where Class 3 flammable liquids are packaged in three identical packaging lines, one assessment can apply). However, the generic assessment must be valid for each situation or area to which it is intended to apply.

Similarly, a generic assessment undertaken by a trade association as a model to be used by members at a number of sites could be applied, providing all factors are taken into account by the operator of each site.

The application of the relevant Australian Standard is a generic assessment. In many instances, the risk controls identified in Australian Standards have been formulated following analysis of particular hazards and their risks, and will be sufficient provided the control measures stated in the standards are implemented. They need to be directly applicable to the storage and handling situation, and no other hazards may impinge (e.g. there are sufficient separation distances from other dangerous goods).

A generic assessment may not apply or may need to be supplemented by a further risk assessment if the situations are not similar, and people in different sites or areas may be subjected to different risks.

Application of Australian Standards and other codes of practice

Australian Standards on the storage and handling of dangerous goods can be used under the regulations as approved codes of practice if the storage and handling situation is within the scope of a relevant standard. However, in situations where it is outside the scope of an Australian Standard, a structured risk management approach (Figure 5.1) should be taken to minimise risk from the storage or handling systems.

For example, for a proposal to store 10,000 L of petrol in a bunded store that is within the scope of Australian Standard AS 1940:2004 *The storage and handling of flammable and combustible liquids*, the requirements of AS 1940:2004 may be applied as the risk control measure.

However, AS 1940:2004 cannot be used for a process plant of flammable liquids (e.g. petroleum refinery) because process plants are excluded from its scope.

The list of approved codes of practice is presented on the Resources Safety website in the dangerous goods guidance material and publications section.

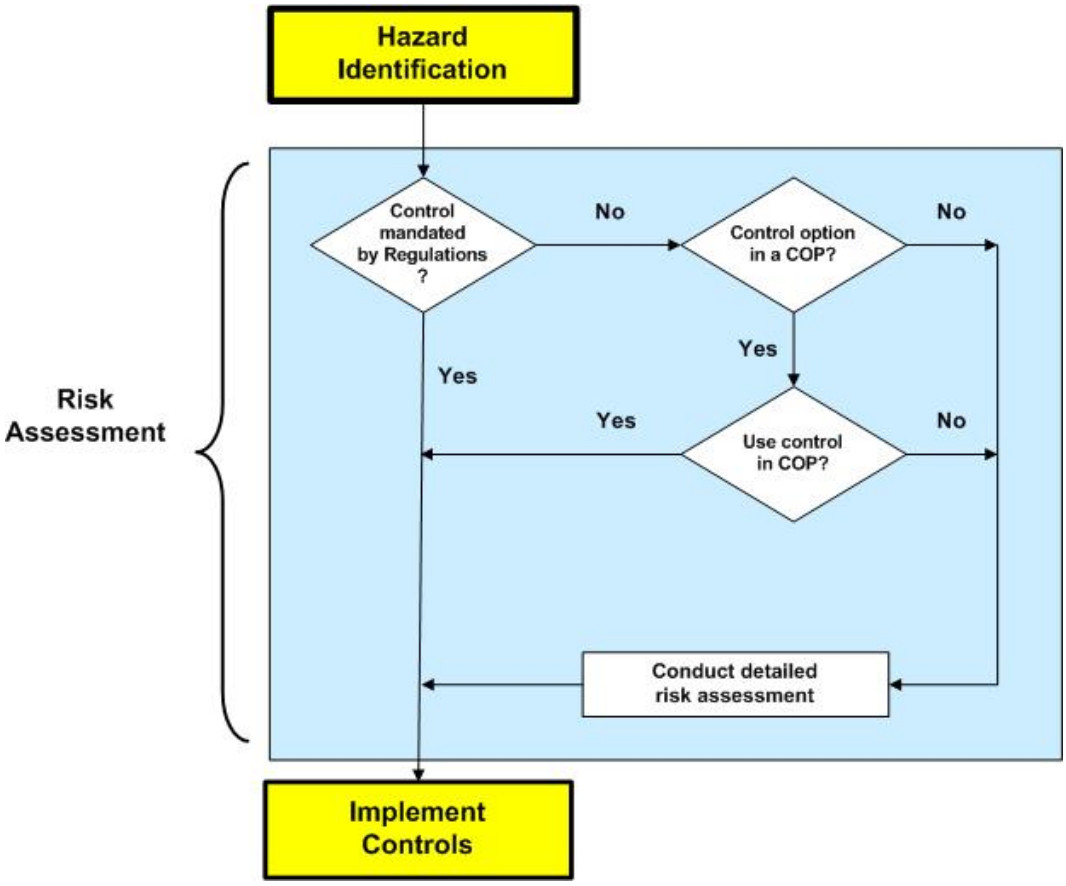


Figure 5.1 Risk assessment approach for different circumstances
Note: COP = code of practice

5.4 Recording outcomes of risk assessment

The operator of a dangerous goods site must ensure that the risk to people, property or the environment from the dangerous goods stored or handled at the site is assessed, and a record kept of the assessment.

If no specific measures are necessary to control risks, make a notation in the register (e.g. on the MSDS). However, if specific control measures are necessary, the risk assessment must be documented, and a copy kept while the risk assessment is being reviewed. The risk assessment records should include:

- date of the assessment;
- name(s) of the assessor(s);
- name(s) of people who provided specialist advice;
- site, storage location, area or process to which the record relates;
- dangerous goods involved in the storage or handling work activity and the particular hazards;
- identified risks, including the likelihood of possible consequences;
- controls necessary to reduce risks to an acceptable level and how decisions about the control were made, such as a determination of what was reasonably practicable;
- existing controls in place, and if they are sufficiently effective;
- other controls that need to be introduced; and
- methods used to make the judgement, such as the sources of information reviewed or used to make decisions (e.g. MSDSs, Australian Standards).

Separate records may be needed for each storage location or process. For simple risk assessments, the record may be a notation in the register accompanying the relevant MSDS.

The risk assessment should include the reasons for determining controls (Chapter 6) and a determination of what was reasonably practicable in the circumstances. The record of the risk assessment will be useful when subsequently reviewing the assessment, or when changes could result in the need for a new assessment (see below). A site plan is a helpful part of the record since key aspects such as separation distances should be shown. This could be the same plan accompanying the manifest (Chapter 14).

The record of the result of the assessment, including the consultative process, must be accessible to any person engaged to work at the site who could be exposed to the risk.

5.5 Reviewing and revising risk assessments

There are circumstances when a risk assessment may no longer adequately apply and needs to be reviewed and revised. New controls may be required. Consult with relevant employees during the review process.

Legal requirements

The operator must prepare a revised version of the risk assessment:

- if there is a significant change to any process or system of work in relation to the storage and handling of dangerous goods;

- if there is any other evidence to indicate that the risk assessment no longer adequately assesses the risks;
- if a dangerous goods incident occurs at the dangerous goods site; or
- in any event, at intervals of not more than five years from the assessment or last review, and that a record is kept of the revised assessment.

The review must take into account the results of any investigation into an incident at the site.

The review is an opportunity to check that control measures conform to accepted industry standards. If it identifies deficiencies, the control measures must be altered or new measures implemented to ensure effective control.

Changes triggering a risk assessment review

The risk assessment should be reviewed when:

- new dangerous goods are introduced;
- quantities of dangerous goods at the site change;
- goods are moved to a different location at the site;
- a process or plant is modified (e.g. a different type of dangerous goods is used);
- new information on the hazards or risks becomes available (e.g. revised information from the supplier) or workers identify new hazards;
- monitoring indicates inadequate control (e.g. escape of goods is detected);
- incidents have occurred;
- new or improved control measures become available or reasonably practicable;
- there are changes on a neighbouring property (e.g. affecting a change to separation distances); or
- there are changes to the site, structures or buildings such as:
  - putting openings into firewalls or screen walls (e.g. for windows, doors, ducts, or vents) that may allow vapours to escape and increase the need for separation distances;
  - changes that will reduce the fire containment rating or fire resistance level;
  - placing roofs over open storage areas or loading docks — fire may plume and spread under a roof and fire fighting becomes more difficult; or
  - changes that affect spillage containment.

If it is known in advance that circumstances may change, the risk assessment should take the projected change into account. This will help ensure that the assessment is still applicable after the changes take place. This also needs to be considered when purchasing new products or plant, moving to a new site or changing production schedules (e.g. increase in quantities used).

The manifest, including the site plan, may need to be amended (Section 14.2) and Resources Safety advised.

5.6 Competency of persons carrying out risk assessment

The process of assessing risks and determining control measures (Chapter 6) should be carried out by a competent person. If the operator lacks the necessary expertise, a person with suitable demonstrated competence should be engaged to carry out this task. The operator should provide that person with all the necessary information and access to the site, so the nature and extent of existing or proposed storage and handling of dangerous goods can be determined.

The competency requirement will vary with the complexity of the task, which depends on the goods present in each actual circumstance (Figure 1.1).

In cases where the quantity of dangerous goods exceeds the placard level, but remains below the manifest level, a greater degree of experience and knowledge may be required, such as knowledge of the relevant Australian Standard and experience in risk assessment.

Additional knowledge and experience in areas such as hazardous areas classification and the protection of associated electrical equipment may be needed where:

- goods are above the manifest level;
- incompatible goods are kept in the same location; or
- processing occurs.

6 Applying hierarchy of risk control and determining risk control measures

6.1 Overview

This chapter applies to dangerous goods sites where the dangerous goods stored or handled are above the placarding quantities shown in Schedule 1 of the Storage and Handling Regulations. In the Storage and Handling Regulations, *risk control measures* are measures that will eliminate or reduce the likelihood and/or the consequences of the incident

The objective of control is to ensure that the risks to people (including the public), property and the environment from dangerous goods are minimised.

6.2 Principles of control

Initially, the hierarchy of control should be applied, as listed below in order of effectiveness together with examples.

1. **Eliminating the risk**

   Use a non harmful substance instead of dangerous goods.

2. **Substituting the system of work, substance or plant for something less hazardous**

   Change the type or reduce quantities of goods kept on site.

3. **Isolating the hazard**

   Introduce a restricted work area, enclosing the system, separating goods from other hazards or segregating incompatible substances.

4. **Introducing engineering controls**

   Install forced ventilation to remove fumes.

5. **Administrative controls**

   Modify the system of work, such as changing the times at which certain tasks are done or using hazard warning signs, specific training and work instructions.

6. **Personal protective equipment (PPE)**

   Provide eye, respiratory and hand protection for the worker (and instruction on when and how to wear them).

After the hierarchy of control has been applied, the controls for dangerous goods occur on three levels:

1. containment of the goods to prevent spills or leaks;
2. spill containment and measures to mitigate risks resulting from spills or leaks; and
3. emergency response, including fire fighting, when other controls have failed.

While the first level is the most important, control measures need to be selected for each of these levels in case the controls at the level above fail. The determination of appropriate measures depends on an assessment of what is reasonably practicable in the circumstances.

6.3 Determining controls — what is reasonably practicable?

When determining the control that is reasonably practicable, the following factors should be taken into account.

- **Likelihood and severity of the hazard or risk in question**

  This is based on the risk assessment. How likely is it that the storage and handling of dangerous goods will result in injury to people, or property damage that could impact on people? How serious are the injuries or damage likely to be and how many people could be affected?

- **State of knowledge about the hazard or risk and ways of removing or mitigating it**

  Take into account what is known about the hazards or risks and the methods of control. What do manufacturers and suppliers know about the hazards and risks? What do other workplaces with similar dangerous goods and processes do to control risks? For example, what are the usual controls used in the industry or in engineering practice? What information can industry professionals and organisations, and other sources provide?

- **Availability and suitability of ways to remove or mitigate the hazard or risk**

  Are the control measures available? Are they suitable for the site and the workers involved?

- **Cost of implementing control measures**

  Are the costs of the control measures commensurate with the benefits gained? Time and money invested in selecting and implementing control measures should result in the elimination or significant reduction of risks.

The assessment and weighing of the above factors is an objective test of what is reasonably practicable in the circumstances of the case under consideration. For example, the determination of control measures should be undertaken having regard to industry practice, such as that shown in relevant Australian Standards or other established industry practices.

6.4 Elimination

The most effective method of risk control is the elimination of the hazard at the source. Consider this when compiling or checking the register or manifest of dangerous goods (Chapter 7). Examples of elimination methods include:

- a physical process rather than a chemical process to clean an object (e.g. cleaning by the use of ultrasound, steam or high pressure water rather than using a solvent);
- water-based paints or glues rather than flammable solvent-based material;
- clips, clamping, bolts or rivets instead of adhesives; and
- electrolysis to produce a gas in-situ rather than supplied from a cylinder.

6.5 Quantity reduction

Operators should consider reducing risks by reducing the quantity of dangerous goods stored or handled on the site. Reducing the inventory levels of dangerous goods usually leads to an overall reduction of risk. Examples include:

- careful attention to inventory levels through effective stock control, such as the use of just-in-time ordering and supply arrangements;
- prompt disposal of dangerous goods not needed, including waste;
- using a continuous handling or manufacturing process, rather than a batch process;
- selecting chemical conversion processes that have a high conversion rate and result in less recycling or stockpiling of materials;
- using just-in-time manufacturing — handling only those dangerous goods necessary for the production shift rather than stock-piling the supply for several shifts in the manufacturing area; and
- ordering a smaller package size — this will also reduce manual handling risks.

In following this advice, the operator needs to ensure that other risks are not increased (e.g. increased vehicle movements or any increased handling do not create further risks).

In some circumstances, reduction may not be practicable, such as in warehousing and contract storage.

6.6 Substitution

Lesser hazard

Operators of sites should consider controlling risks by substituting dangerous goods of a high hazard with goods of a lower hazard. Consider using:

- substance not classified as a dangerous good instead of a dangerous good (e.g. degreasing with detergent instead of a chlorinated or volatile solvent);
- combustible liquid instead of a Class 3 flammable liquid (e.g. using a combustible liquid solvent rather than a flammable liquid solvent in pesticide manufacture);
- substance with a higher numerical packing group number instead of one with a lower packing group number (e.g. PG III for PG II goods);
- less hazardous propellant in an aerosol, such as carbon dioxide (Division 2.2), instead of LP gas (Division 2.1);
- Division 2.2 (non-flammable, non-toxic gas) as a refrigerant rather than Division 2.3 (toxic gas, such as ammonia) or Division 2.1 (flammable gas such as LP gas); and
- dangerous goods of a single hazard rather than goods with a subsidiary hazard (e.g. a single class without a subsidiary risk rather than the same class with a subsidiary risk).

Work methods with lesser risk

Using a work method that has a lesser risk is another method of substitution, such as:

- wrapping palletised goods by stretch wrapping rather than flame heat shrink where there is a fire or combustion risk;

- using a pallet cage rather than stretch wrap where the static electricity generated during the wrapping or unwrapping of the plastics film may be a hazard;
- using a solid substance in a paste or pellet form rather than a dusty powder;
- applying paint by brush or roller rather than from an aerosol can;
- transferring packages by conveyor rather than forklift in hazardous areas; and
- using non-sparking tools in a hazardous area.

6.7 Eliminating or controlling risk through design

Applying design principles

Storage or handling systems (including plant) for dangerous goods must be designed, built, installed, commissioned, maintained, and isolated by means of distance or barriers so that, so far as is reasonably practicable, they can be operated with minimal risk to people, property and the environment.

Isolation and engineering controls should be incorporated into plant and structures at the design stage. Good design is the most effective way to reduce risks. Consideration at the design stage helps to reduce costs, particularly high operational costs caused by poorly set-out sites and costs created by complex systems of work to cope with the constraints of poorly designed sites. An effective design process means that potential problems can be anticipated and solved before they become real problems.

When laying out sites, any external factors such as the risks to and from adjacent premises should be taken into account. FESA's advice should be sought when establishing a fire protection system to determine whether the location and type of fire protection system meet operational requirements (Chapter 12).

Designing a process with lower risk

One of the factors determining the level of risk is the decision about the actual physical or chemical process to be used. Chemical reactions usually involve raw materials, intermediates and finished products. Where there is a choice of chemical reactions available, each possible reaction pathway will have inherent hazards and risks associated with it. Other factors include the complexity of the process, the plant used, efficiency, by-products, cost, reliability and energy demand.

Similarly, there may be a choice in relation to the physical processes that are available to achieve the same product. Some processes involve high temperatures and pressures, while alternatives may involve lower temperatures and pressures, such as evaporation compared to freeze drying. For each of the options, the process hazards should be identified and their relative risks assessed. The processes resulting in the lowest overall risk should be selected, subject to practicability.

Location of storage and handling areas

Dangerous goods should be kept only in a designated storage location observing the separation and segregation principles described in Section 6.9.

One of the most effective design factors is locating the dangerous goods in such a way as to minimise risk factors. Factors for consideration include:

- location well away from other hazards;

- location away from and sensitive facilities, such as critical infrastructure, pipelines and protected works;
- sufficient area to allow for the isolation of incompatible dangerous goods, and spill and firewater retention;
- ease of access so that transfer and transport risks are minimised; and
- location above potential flood levels.

When determining if more than one type or class of dangerous goods can be kept or used in the storage or handling area, risk factors relating to compatibility need to be considered (Appendix 2).

6.8 Design of buildings and storage areas

Buildings should be designed, selected and maintained in a manner that recognises the risks associated with any dangerous goods stored or handled in or near the buildings. Fire risks are particularly important in building design and suitability. Generally, structures such as buildings should:

- be constructed of non-combustible materials;
- not have spaces where dangerous goods could unintentionally accumulate;
- protect dangerous goods from direct sunlight;
- if gases are stored, have roofs designed so that gases cannot accumulate beneath them or in roof voids; and
- have adequate ventilation to prevent the build-up of a hazardous atmosphere (Section 7.9).

The *Building Code of Australia* requirements for design may not be sufficient and the relevant dangerous goods class or type, or specific Australian Standard, should be consulted.

Note: The Building Code of Australia is produced and maintained by the Australian Building Codes Board (www.aib.org.au/buildingcodes/bca.htm).

Storage areas should be paved and kept clear of vegetation.

Shipping containers may not be suitable unless specially adapted for the storage of dangerous goods. Many containers have wooden floors that may absorb substances, create hazards and not retain spills or leaks. Shipping containers need to be adapted to provide the features of suitable storage areas, including ventilation and spill containment.

Some Australian Standards provide guidance on the modification of shipping containers for dangerous goods stores.

6.9 Isolating the hazard

Isolation means separating people, property or things from the dangerous goods by either distance or a physical barrier so they are protected.

Principles of separation

Physical separation is the principal method of controlling risks by separating one hazard from another. This achieves both the purpose of protecting other areas from the dangerous goods and the dangerous goods from hazards arising in these other areas.

Many Australian Standards refer to 'protected works' and define this in terms of different types of occupancies, buildings or structures. Separation may be achieved by the use of effective barriers, such as fire-rated walls or vapour barriers, or a combination of these. The types of barriers used will depend on the nature of the risks to be isolated.

Examples of separation include:

- distancing the dangerous goods from people, other dangerous goods or protected works, pipelines and other property, such that interaction is not possible;
- decanting in a fume cupboard to control emissions;
- storing incompatible dangerous goods in separate buildings, with sufficient separation distance that interaction is impossible and a serious incident in one area will not involve the other; and
- installing screen walls or doors that are vapour barrier and have an appropriate fire resistance level (FRL).

Determining separation distances

When determining suitable separation distances, consider:

- the hazards of the dangerous goods (class and subsidiary risk) and risks posed to other storage areas;
- the quantity of dangerous goods in each location;
- any other activities in the work area that may increase the risk; and
- any other existing control measures that will reduce the risk.

Separation from property on adjoining premises (including protected works)

For most dangerous goods, recommended minimum separation distances are specified in the relevant Australian Standard. Some of these will apply only to storage and not to areas where the dangerous goods are used. These standards apply a variety of distances, depending on class, packing group, quantity and other factors. Consider applying the following alternatives for deciding distances:

- the appropriate class standard (e.g. Australian Standard AS 1940:2004 *The storage and handling of flammable and combustible liquids* for Class 3);
- Australian Standard AS/NZS 3833:2007 *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers* for mixed classes; and

- a risk assessment and the application of other control measures.

Separation distances from on-site facilities

The determination of separation distances from on-site facilities, such as plant, is similar to that for off-site facilities, except that where the operator can apply other control measures to the facilities, a risk assessment may indicate lesser distances.

Applying barriers

Separation distances may be measured around barriers provided they give protection equivalent to the separation distance.

To determine if barriers are an effective alternative for use instead of or in conjunction with separation distances, consider:

- the types of hazards exhibited by the dangerous goods and the risks they pose to the barrier;
- the length and height of the barrier required and its effectiveness in varied climatic conditions;
- appropriate fire resistance levels, especially for flammable goods, including the potential heat load from internal or external fires;
- structural strength necessary to withstand weather; and
- structural strength or weakness necessary to minimise the consequences of any overpressure resulting from a serious incident, such as an explosion, unless weakness is a control measure.

Separation from ignition sources

An operator of a dangerous goods site must ensure that any ignition source in a hazardous area within the site is eliminated or, if this is not reasonably practicable, the risk arising from the ignition source is controlled.

For dangerous goods with a flammability or explosion hazard, hazardous area distances determined from the Australian Standard AS 2430.3:2004 *Classification of hazardous areas – Examples of area classification* series should be regarded as a minimum. Further advice may be found in class - or type-specific Australian Standards.

Typical ignition sources include:

- sparks from electrical equipment (unless protected or intrinsically safe), such as switches, electric motors, transformers, fuse boards, fans, air conditioners, fridges and other equipment with thermostats, power tools, fans, air conditioners, battery chargers, computers, telephones, electric heaters and internal combustion engines (e.g. mowers, pumps and generators);
- naked flames, such as torches for brazing or shrink wrapping, pilot flames in heaters, heaters using gas, liquid or solid fuels, incinerators and barbecues;
- incandescent or heated material, hot surfaces or other sources of radiant heat;
- heat from friction;
- sparks from a mechanical source; and
- sparks from static electricity.

Segregation within a storage area

An operator of a dangerous goods site must take all reasonably practicable measures to ensure that the dangerous goods are isolated so they cannot:

- interact with goods that are not compatible; or
- contaminate any other goods.

Segregation means separation from other substances (including dangerous goods) so a loss of containment cannot cause a serious incident.

If several types of dangerous goods are to be held in the one storage location, incompatibility is an important risk to be considered. Incompatible goods should be segregated. Signage of locations with the appropriate dangerous goods class label (diamond) and marking, such as lines painted on the ground, helps to maintain this. The location should normally be used for one class only. Other goods or items, apart from safety equipment, should not be kept in the location.

Advice on the segregation of packages of incompatible dangerous goods is provided in AS/NZS 3833:2007.

Administrative controls in the form of systems and procedures are needed to ensure segregation is always maintained.

Isolation from other goods

Operators must ensure that dangerous goods are isolated so they cannot contaminate other goods, including food, food packaging or personal use products on the site.

The risk assessment should include the location of the storage of such products. Spill containment (Section 7.7) should ensure that contamination is not possible.

6.10 Engineering controls

Principles

Engineering controls are measures that change the physical characteristics of structures, plant and processes to reduce the risk associated with the dangerous goods.

Engineering controls include ensuring the effectiveness and integrity of:

- valves;
- pipework and connections;
- tanks and pressure vessels;
- packages; and
- containment of firewater.

Consider using engineering controls to:

- minimise the generation of dangerous goods or release to the atmosphere;
- contain or suppress dangerous goods, including controlling vapours or dusts;
- eliminate, confine or control hazardous processes or plant that may pose a risk to the dangerous goods;

- protect the dangerous goods from external hazards and environmental factors such as rain and sunshine; and
- limit the area of contamination in the event of spills or leaks.

Types of engineering controls

The types of engineering control used should be kept as simple as possible. Engineering controls include:

- totally or partly enclosing the dangerous goods or external hazard;
- adequately ventilating to eliminate flammable or toxic atmospheres (see further advice in Section 7.9);
- blanketing exposed liquid surfaces with an inert atmosphere or sparging (bubbling gas through the liquid from below);
- automating processes to eliminate human error;
- fitting sensors and controls for liquid levels, pressure and temperature (e.g. to reduce the risk of overflow or uncontrolled reaction, and to minimise loss or the formation of hazardous atmospheres);
- fitting control devices, alarms or shutdown devices;
- installing appropriately rated (protected) electrical plant and circuitry to minimise ignition hazards;
- providing spill control to contain the largest foreseeable spill, confine spills to avoid risks such as contact with incompatible goods or limit spread in order to assist fire control (see further advice in Section 7.7);
- constructing effective barriers between incompatible goods;
- installing detection systems and alarms for hazardous atmospheres and fires;
- installing suitable devices to protect installations from external hazards (e.g. crash barrier to protect storage tank from damage by moving vehicles); and
- installing suitable fire control systems, including fire suppression devices such as monitors (Chapter 12).

6.11 Administrative controls

Administrative controls are systems of work or safe work practices that eliminate or reduce risk. They consist of properly designed and implemented work practices and procedures.

Administrative controls rely on people to implement them and follow all the agreed work practices and procedures. To assist implementation, the complexity of such controls should be minimised. Workers are more likely to follow procedures if they have been fully consulted when developing and establishing them.

The controls should be matched to the skills and capabilities of the workers who will implement them. Training is important in ensuring workers have full knowledge of the correct procedures.

Supervision must be by a competent person, and be sufficient to ensure that workers follow these procedures.

Examples of administrative controls include:

- safe work procedures that describe the correct methods for performing all work activities, documenting these procedures, and training workers to use them;
- scheduling transfers during ‘off-peak’ times in terms of people and traffic;
- operating procedures that ensure that the integrity of structures and plant is maintained at all times;
- establishing inspection, maintenance, repair, testing and cleaning procedures to ensure other controls are maintained, and to ensure these procedures do not create risks;
- controlling access to the storage and handling areas (e.g. prohibiting the use of the area as a thoroughfare);
- where there is a fire or explosion risk, prohibiting the carriage and use of matches, lighters or spark producing tools;
- regular housekeeping, including cleaning of contamination from walls and surfaces, dust and drip removal from work areas;
- keeping lids on containers when not in immediate use;
- procedures for spill clean up and decontamination;
- procedures for waste disposal, including disposal of clean-up waste and contamination;
- developing and rehearsing emergency procedures;
- procedures to ensure the provision and use of appropriate PPE;
- procedures for ‘hot work’ (e.g. welding or grinding) in or around the storage or handling area, such as using ‘permit to work’ systems; and
- signs giving straightforward, clear instruction.

6.12 PPE and clothing

Using PPE as a risk control measure

PPE includes items such as overalls, aprons, gloves, dust masks, respirators, self-contained breathing apparatus, footwear, goggles or face shields, hard hats and fully encapsulated suits.

PPE should only be used when other control measures are not reasonably feasible, or when, after implementing other controls, a residual risk remains. PPE may be necessary as part of emergency procedures but its use should be carefully considered.

Any new control measures should be evaluated to ensure they are effective and new hazards are not introduced (directly or indirectly).

Where the chosen measures to control risks include PPE, the operator must ensure the equipment is kept at the site and is accessible. The operator must also provide training on its use and maintenance. Careful supervision and monitoring are needed to ensure that workers use and maintain PPE properly.

The use of PPE relies on the users following instructions and procedures correctly. Consequently, a greater level of supervision may be required than for other procedures.

Even where not adopted as a regular control measure, PPE may still need to be readily accessible in the event of a failure of containment or an emergency.

PPE may be necessary if:

- it is not reasonably practicable to achieve adequate control by other means (e.g. installing control measures for infrequent maintenance operations with short duration of exposure to risk); or
- other controls could fail (e.g. where urgent action is required because of plant failure).

Operators must consult with employees about establishing the PPE program, and the selection and use of appropriate PPE.

Suitability of PPE

Consult MSDSs for advice on appropriate PPE. When choosing PPE, ensure:

- the specification provides the required level of protection from the risks associated with the particular work task;
- it meets an appropriate Australian Standard (or other recognised standard) — look for the standard on the label or supplier's information;
- it is suitable for the individual's size and build;
- the wearer's need for mobility, dexterity, clear vision, communication and comfort are considered;
- it is used in accordance with the manufacturer's directions;
- it is readily available, clean and in fully operational condition;
- employees are trained in the use of the PPE, including selection, maintenance and when to discard disposable PPE;
- the employees wear the PPE as intended;
- any necessary maintenance or cleaning is carried out; and
- the risk of secondary injury (e.g. skin rash, heat stress or dehydration) due to wearing PPE is addressed.

Sources of information to help selection

Check that the protective equipment used has the appropriate Australian Standard number on the label. Various standards not only provide specifications but also indicate the type to be selected.

Use labels and MSDSs as a guide. If in doubt, ask the supplier of the dangerous goods for a recommendation on PPE suitable for the intended use and circumstances — preferably obtain this advice in writing. Also check the specifications provided by the PPE supplier.

Eye protection

The eyes are the most vulnerable parts of the body to chemical or physical damage, and the most difficult to repair surgically. In any area where there is the possibility of flying objects or where chemicals might splash, appropriate eye protection should be worn. This could be in the form of safety glasses, goggles, a face shield, or full-face respirator. Splashes are most likely when mixing, pouring and transferring, and under-eye protection

may be necessary. If a worker normally wears ordinary spectacles, it may be necessary to wear coverall safety glasses or a face shield over the top.

Australian Standard AS/NZS 1336:1997 *Recommended practices for occupational eye protection* gives the requirements for the selection of the correct type of eye protection, which should conform to Australian Standard AS/NZS 1337:1992 *Eye protectors for industrial applications*.

Gloves, aprons and other equipment

Gloves may be necessary when decanting or preparing chemicals, or during maintenance and cleaning. Gauntlet gloves are usually appropriate to protect the lower arms and prevent splashes entering the glove. Check the MSDS or supplier for glove type. Rubber gloves are usually not sufficient. PVC, chloroprene rubber or nitrile rubber will be appropriate for certain chemicals, but confirm with the glove supplier regarding suitability of the glove for the dangerous goods used.

Select gloves that conform to Australian Standard AS/NZS 2161:2000 *Occupational protective gloves – selection, use and maintenance*.

Aprons, coats or overalls should be worn when there is a chance of a spill or splash, such as during decanting or cleaning. Hairnets to control long hair may be appropriate in certain situations, such as when using naked flames or rotating machinery.

Respiratory protection

In some situations, respiratory protection will be necessary. An example is the use of a volatile solvent, where the solvent label specifies the use of a respirator or protective equipment. Sometimes the labels will use phrases such as ‘Avoid inhalation of vapour or dusts’. Consult the MSDS for information.

Select respirators that conform to Australian Standard AS/NZS 1716:2003 *Respiratory protective devices*, which is an approved industry code of practice.

Respirators should be used, stored and maintained in accordance with Australian Standard AS/NZS 1715:1994 *Selection, use and maintenance of respiratory protective devices.* A respiratory program conforming to AS/NZS 1715:1994 would ensure maximum efficiency of the respirators.

Depending on the type of dangerous goods used, combined filters (for both particles and vapour) may be necessary.

Footwear

Footwear is an important safety item. Good soles provide a sound grip, reducing slipping injuries. Footwear can also protect against mechanical and chemical damage, especially where splashes are possible. Open footwear such as sandals is not appropriate.

Where impacts, cuts or chemical spills are possible, footwear should conform to Australian Standard AS/NZS 2210:1994–2001 *Occupational protective footwear* series, which provides information on the suitability of footwear, sole designs and materials for different types of surfaces (part 1 provides information on selection, care and use).

Hearing protection

Select hearing protectors that conform to Australian Standard AS/NZS 1270:2002 *Acoustics – Hearing protectors*, which is an approved industry code of practice.

Safety showers and eye washes and hygiene facilities

The need for safety showers, eyewashes or other washing facilities will depend on the actual risk, and may be necessary in addition to appropriate PPE.

For example, the requirements where packages are opened and substances handled with a risk of spills and splashes will be different from those in stores where the closed packages are handled, although the risk could still be accidental breakage or puncture by forklift tines.

Corrosives and toxic substances will need to be removed immediately following accidental contact with clothing or areas of the body.

Where the packages are opened, consider the need for:

- a safety shower conforming to American National Standards Institute ANSI Z358.1:2004 *Emergency eyewash and shower equipment* or a plunge bath — where risk is lower (e.g. service station where batteries are handled), a domestic shower may be adequate;
- eye wash facilities conforming to ANSI Z358.1:2004; and
- water for hand washing.

The facilities should be reasonably accessible, meaning not less than 10 m away, but not within 2 m of the store or work area to avoid possible contamination of the facility itself.

In work areas where the packages are always closed, water for hand washing should be conveniently provided.

Wash facilities should also be considered in areas where tankers are connected via hoses, pipes or valves, or other transfer from bulk storage is undertaken, at a suitable distance, meaning between 2 and 7 m from the transfer point.

General hygiene is also necessary and other facilities, such as toilets and showers, should be checked for adequacy for workers to decontaminate.

7 Risk control measures applicable to dangerous goods

7.1 Overview

This chapter covers the risks and controls typically applicable to dangerous goods. The need to use these controls would be indicated by the risk assessment. These controls are in addition to any specific measures indicated in subsequent chapters.

7.2 Maintaining control conditions to ensure stability

Some dangerous goods are highly reactive, self-reactive or unstable except when kept under controlled conditions. Information about the required level of stabilisers, other control temperatures, or both is provided in the MSDS or other information from the manufacturer or supplier. These control conditions should have been identified at the hazard identification stage (Section 4.2).

Maintain any recommended control conditions such as temperature (e.g. if too low then stabilisers can separate and be ineffective) and specifications such as proportions and limits for ingredients that stabilise the dangerous goods.

Sufficient stocks of stabilisers should be on hand, and allow for potential supply shortages. Check containers for accidental loss of phlegmatisers or stabilisers, which could leak from damaged packages.

If a control temperature must be maintained, ensure there are sufficient back ups or contingency plans to cover a cooling plant failure (e.g. refrigeration system malfunction).

If the dangerous goods react with water, it is essential that the goods be kept dry.

Emergency plans should take into account procedures when control conditions are not maintained or fail (see Chapter 13).

7.3 Controls for associated plant

Examples of plant used with dangerous goods include:

- storage tanks;
- pipework, and associated valves and pumps;
- mixing vats;
- dryers;
- filters;
- pressure vessels such as tanks; and
- gas cylinders.

Hazards and risks associated with the plant itself that could impinge on safety with dangerous goods must be controlled. When planning to use or commission plant, all the

hazards and risks associated with installation must be identified so that appropriate control measures can be incorporated. Plant should be:

- commissioned only after it has undergone appropriate testing and procedures have been developed, with regard to the designer's or manufacturer's instructions, to ensure it can be operated safely;
- operated only by personnel who have received appropriate training; and
- maintained and repaired to ensure that no additional hazards or risks arise due to wear and tear or breakdown.

Portable and mobile appliances powered by LP gas, apart from engines and vehicles, should conform to Australian Standard AS 2658:2008 *LP Gas – Portable and mobile appliances.*

Where industrial trucks, such as forklifts, are used in or near stores of flammable gases or liquids, hazardous areas must be identified. Each forklift used must be suitable for the zone within the hazardous area.

7.4 Containers for bulk dangerous goods

Containers for bulk dangerous goods should be designed, built, installed, commissioned and maintained to suitable standards, such as Australian Standards AS 1692:2006 *Steel tanks for flammable and combustible liquids* and AS 1210:1997 *Pressure vessels*, and America Petroleum Institute Standards API Std 650:2007 *Welded steel tanks for oil storage* and API Std 620:2008 *Design and construction of large, welded, low-pressure storage tanks or equivalent*.

When designing containers for bulk dangerous goods, consider the deterioration of the containers and associated pipework from causes such as chemical reaction, impact, vibration, heat and ultraviolet light.

An operator must ensure that:

- the container and its associated pipework are provided with stable foundations and supports;
- any pipework or plant connected to the container is installed so as to prevent excessive stress on the container, pipework or plant;
- the container and associated pipework are protected from failure by corrosion; and
- the container is inspected at intervals that are sufficient to ensure the integrity and serviceability of the container.

7.5 Underground and mounded tanks

Legal requirements

The operator of a dangerous goods site must ensure that any underground storage or handling systems for Class 3 or petroleum products at the site are designed, installed, operated and maintained so they do not leak.

All new underground storage or handling system for petroleum products must comply with Resources Safety's *Design, installation and operation of underground petroleum storage systems – code of practice* and Australian Standard 4897:2008 *The design,*

installation and operation of underground petroleum storage systems. Existing underground systems that are in need of repair or replacement should be upgraded to current requirements.

The operator must ensure that an underground storage or handling system for Class 3 dangerous goods or petroleum products is tested for leakage every five years for the first 20 years, and every two years after that.

Risks

Placing tanks underground, or covering with mounds, helps to protect them from some risks, but can pose other risks. Underground seepage of a flammable or toxic liquid can accumulate and penetrate into low lying areas such as telecommunication pits and building basements. These risks may not become evident until after heavy rain has raised the watertable and displaces the dangerous goods accumulated in the soil around the tank.

Many parts of Western Australia have highly porous soils, so it is important that underground storage and handling systems are properly installed and maintained so they do not leak and contaminate the site or the environment. These storage or handling systems must be installed to the highest possible standard.

A leaking underground storage or handling system for Class 3 dangerous goods or petroleum products must not be used until the leak is repaired.

Risks related to underground, partly underground or mounded tanks include:

- failure of the structure, usually from corrosion, allowing the gradual escape of dangerous goods into the water table;
- spills from above ground pipework and filling points; and
- risks arising from abandoned underground tanks when they cease to be used.

Controls for underground tanks

The risk control measures for underground tanks typically revolve around prevention of leakage and early detection of leaks. Techniques to monitor the integrity of underground tanks and detect leaks include inventory monitoring, sampling pits and electronic measures. Underground storage or handling systems should have a good inventory monitoring systems in place to confirm the system is not leaking.

Keeping the underground system in good condition includes corrosion protection, and this commonly requires specialist advice.

7.6 Protection from impact and other damage

An operator of a dangerous goods site must take all reasonably practicable measures to ensure that any storage or handling system for dangerous goods at the site is protected against damage from impact. This includes the risk of impacts, imposed loads or mechanical stress.

For example, guard against impact by vehicles, mobile plant, or boats. Mechanical handling equipment for moving containers (e.g. forklifts, overhead lifting grabs) can damage containers, either through mishandling or indirectly by moving the containers into other objects, such as projecting railings, structures or pipes.

The most effective ways to protect containers, their pipework, pumps and attachments from impact are to locate the containers away from trafficable areas or prevent vehicle

access. Where vehicles come close to containers or items such as pumps, the need for physical barriers such as railings, bollards or stanchions should be considered.

Additional protection may be necessary in areas subject to:

- extreme weather (e.g. cyclone-prone areas);
- damaging atmospheric conditions (e.g. salt spray in coastal areas); or
- other environmental hazards (e.g. acid sulphate soils).

7.7 Spill containment

Legal requirements

An operator of a dangerous goods site must ensure that if dangerous goods, except Class 2 dangerous goods, spill or leak from an above ground container or plant at the site, the spill or leak is contained within a drain, sump, tank, compound or other system at the site built to enable the recovery of the spilled or leaked dangerous goods.

Principles of spill containment

Correct design and maintenance of dangerous goods storage or handling system, as outlined in Section 7.4, should ensure that dangerous goods are contained within the primary containment system.

Should there be a failure of the primary containment system, the dangerous goods that have been spilled or leaked must be contained safely within the site, so far as is reasonably practicable.

In terms of the hierarchy of control, Sections 6.7 and 6.8 discuss the application of engineering controls.

Containment should be considered for any location where dangerous goods are stored or handled. All spills or leaks should be contained within a limited area and within the site — risks to adjacent premises or public places should be eliminated. Any area or receptacle designed to contain goods spilt from a tank must not be shared with spill containment for substances that are not compatible.

In the event of a spill or leak of dangerous goods, the operator must:

- stop, clean up and dispose of, or making safe, any spill or leak of dangerous goods from the incident; and
- make the plant and surrounding area safe, so far as is practicable.

Note: Further advice on spill containment is provided in the Australian Standards relevant to the storage and handling of each class.

Extent of containment

Factors that will determine the extent of measures needed for spill containment include:

- how quickly any spill can be detected and recovered;
- consequences of a spill;
- how resistant the containment construction materials are to the hazardous nature of the goods (e.g. fire, corrosivity);

- for a liquid, whether it is mobile or viscous;
- for a solid, whether it will melt in a fire or dissolve in firewater;
- quantity of the dangerous goods and the need to contain the size of the largest container or largest spill possible;
- need to contain or manage firewater (or other extinguishing materials) resulting from an incident;
- compatibility with other goods that could be spilt; and
- need to avoid containing excessive rainwater.

Design

Consider applying the following options for spill containment for liquids:

- providing drains to a purpose built on-site catchment, such as an interceptor or remote impounding basin;
- use of a sump for recovery of spillage and waste water;
- if a bunded compound is used, ensuring the bund and compound floor are impervious;
- risks associated with the operation of the containment system are part of the design consideration;
- spill containment integrity will be maintained;
- grading the surface so that all spills are contained by the contours;
- bunding the area to form a compound;
- using double walled containers; and
- enclosing a tank with a partial or full height bund (in relation to the tank height).

The risks associated with the operation of the containment system should be considered at the design stage and included in the risk assessment. For example, a high bund wall around a package store usually necessitates the provision of long or steep ramps forklift trucks. However, such ramps can cause load instability, so another method of spill control may be more appropriate. For bunded stores, gently sloping floors away from entries may avoid the need for ramps. However, the slopes need to be minimised to avoid instability of materials handling equipment (e.g. forklifts placing loads in high-rise stacking).

Check the following factors to ensure the effectiveness of the containment method:

- spill containment system is sufficiently impervious, and can hold the dangerous goods until the spill is cleaned up;
- materials used in construction, or for absorption, are compatible with the dangerous goods and appropriate to avoid contamination of ground water or soil;
- spill containment areas are separated where the goods are not compatible or where the spread of the dangerous goods increases risks;
- capacity of any compound is sufficient for the volume of liquid to be contained, including a margin for firewater and rainwater;
- any bund wall or barrier should be high enough to catch all leaks;

- absorbent materials, barriers and booms are provided where needed to contain a spill outside the areas where physical containment is provided or to assist clean up;
- contaminated firewater can be removed during an incident if needed; and
- means are available for removing any rainwater that may accumulate in the area or compound when necessary.

Consult with FESA if the design and location of the spill containment system may affect its operations during an emergency.

Bunding

A bund is an embankment or wall, which may form part of the perimeter of a compound, designed to contain spills of liquids. Both the bund and the compound floor must be sufficiently impervious to retain spillage or leakage.

Bunding has the advantage that it can be retrofitted to existing buildings and installations.

For package stores and the transfer of dangerous goods, portable (self-contained) bunds may be suitable as additional containment. Plastic may be an unsuitable material for a portable bund since it can melt in a fire and may be chemically incompatible.

Bunding is a suitable method for above-ground bulk storage installations. Where flammable goods are stored, hazardous areas may need to be determined (Section 7.8).

Suitable materials for bund walls include:

- concrete kerbing, preferably reinforced and integrally constructed with the flooring — if separate, it must be firmly anchored or adhered, sealed and able to withstand any traffic damage;
- brick or concrete block walls — only appropriate where they are protected from damage by material handling operations, such as forklift traffic;
- steel angles or other sections firmly anchored to the floor and sealed (usually with a silicone based sealant) — this may not be suitable for flammable liquids; and
- raised earthen walls (Figure 7.1), bags of sand or other compatible material with an impervious membrane.

Bunds in unroofed areas should be provided with additional capacity to hold rainwater and run off, with a system for the removal of the rainwater and waste water. Rainwater should not be allowed to accumulate. Bund valves should not be left open to permanently drain rainwater. If water is to be pumped out, do not use a petrol powered pump inside the bund of a flammable liquid tank — to avoid an ignition source, use a pneumatically driven pump. Electric or engine driven pumps should not be used inside a bund or associated hazardous area without a hot work permit.

The height of the bund wall needs to allow for liquid squirting from a tank, or the highest package, not just leaks at ground level. The closer the wall is to the tank or packages, the higher the wall needs to be. Spillage deflectors such as shields or double skinned tanks could also be used, if high enough to capture a leak from the top of the tank.

The need for easy egress from the bunded area (e.g. stairs if the bund is higher than 1 m) should be considered, especially in case of an emergency.

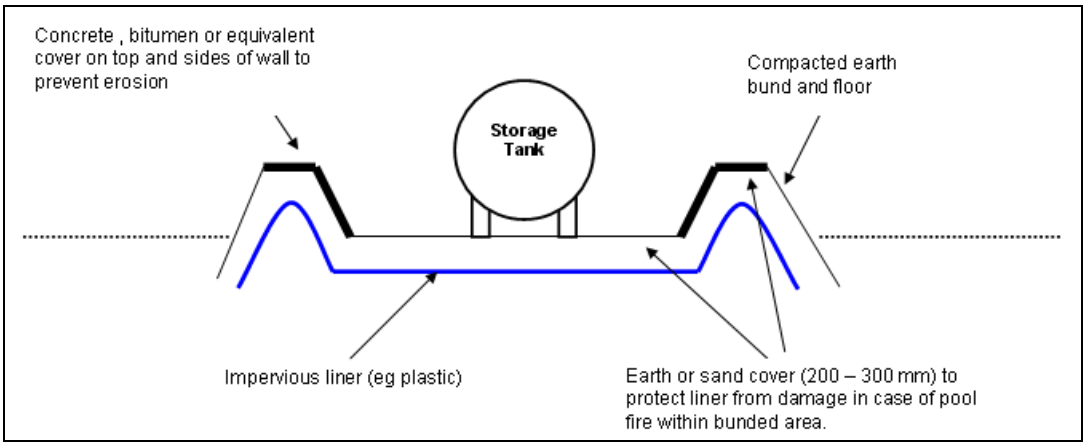


Figure 7.1 Construction example of an earthen spill compound

Ensure rubbish does not accumulate inside the bund. Remove dead trees and shrubs. Brush cutters and lawn mowers are potential ignition sources and should not be used near flammable liquid or gas tanks, especially during transfer. A hot work permit system may be necessary.

Bund areas may require individual hazardous area zoning assessment. There may be circumstances where a bunded area may also be a confined space, for example if the bund walls are high or the tank is in a pit, and special procedures are necessary if workers enter this space.

Draining into sumps and tanks

Draining spilled liquids to an underground sump or tank, or to an external pit, avoids the access problems associated with bunds. However, the drain network, pit, tank or sump themselves become a potential source of hazards. Possible incompatibility of goods drained to the sump and the build up of hazardous atmosphere should be included in the risk assessment. The design needs to be to a suitable standard. Underground or covered sumps or pits should be designed to the standards for underground tanks.

Generally, each such containment system should be exclusively for the effluent from one store or work area, unless all the dangerous goods or combustible liquids are compatible and effective provision is made to prevent flashback through drain pipes.

Since such systems are usually out of sight, controls are needed to ensure they are fully available for use when required. These systems should be prevented from collecting rainwater.

Double-walled containers

Australian Standard AS 1940:2004 *The storage and handling of flammable and combustible liquids* gives guidance on the design of double-walled tanks for flammable or C1 combustible liquids.

Transitional arrangements for existing vertical above-ground container facilities

The majority of spillages from large vertical storage containers are from the tank floors and overfills. Storage tanks are typically installed in leak-proof spill compounds.

A significant number of tanks have been installed in the past without containment directly under the floor of tanks. The Storage and Handling Regulations allow for this by

permitting the application of a comprehensive risk-based storage facility management plan instead of retrofitting spill containment under the tank, which may be impracticable.

Proactive spill prevention strategies should:

- provide an alternative to impracticable under-tank spill containment upgrades;
- minimise the risk of offsite migration of spills; and
- include appropriate spill management resources and documented procedures.

Such strategies should be implemented for installations in place before 1 March 2008 that do not meet current codes or standards, otherwise it is expected that existing non-compliant spill compound floors and bunds will be upgraded so they are impervious and retain the dangerous goods until the spill is cleaned up.

Container (tank) integrity assessments should be conducted for all tanks, risk assessments and documented management plans are integral parts of these assessments, which should include one or more non-destructive testing (NDT) methods (e.g. visual examination, ultrasonic thickness testing, acoustic emission testing, dye-penetration, x-ray, quantitative product mass measurement or equivalent methodologies).

After container assessments are conducted, spill prevention measures applied to tank installations may include:

- installation of automatic leak-detection system;
- installation of overfill-protection and monitoring;
- statistical inventory analysis of inflow and outflows to and from the tanks; and
- installation of under-tank impervious lining.

Spill containment in public drinking water source areas

Certain parts of Western Australia are set aside as public drinking water source areas. The type of spill containment chosen for dangerous goods facilities should prevent impact to these water supplies.

Consideration should be given to the use of additional fail-safe measures that prevent any dangerous goods from leaking out of spill containment areas.

Spill containment for cyanide solutions (UN 1935)

Spill compounds for the storage and handling of cyanide solutions in single-wall tanks should be constructed out of concrete.

The compound should be adequately designed, installed, tested and maintained to ensure its continuous integrity and impermeability for the life of the installation.

Spill containment for ammonium nitrate emulsions (UN 3375)

Ammonium nitrate emulsions (ANEs) are very viscous substances and do not flow easily if spilled.

Operators of dangerous goods sites may dispense with providing spill containment for the storage of ANEs if the following controls are in place:

- the tanks are installed on a slightly raised earth or concrete pad, preventing the accumulation of combustibles under the tanks;
- any spillage is retained on site; and

- there are no diesel fuel tank or fuel lines within 8 m of the ANE tanks.

7.8 Ignition sources in hazardous areas

An operator of a dangerous goods site must ensure that any ignition source in a hazardous area within the site is eliminated or, if this is not reasonably practicable, the risk arising from the ignition source is controlled. This includes controlling the risk of the hazardous zone originating from the site extending across boundaries to adjacent premises.

Identifying hazardous areas

Hazardous areas are areas where flammable or combustible gases, vapours, dusts, fumes and mists may be present in a flammable or explosive concentration, and the risk is that an explosive mixture can form in certain proportions with air.

It is important to identify the hazards contributing to the risk, such as:

- flammable vapours or gas evolving from dangerous goods;
- oxidising agents that may aggravate the risk of fire or reaction;
- ignition sources, including static electricity; and
- accumulation of combustible dust.

Combustible dusts may be stirred up by air currents or mechanical action and form an explosive dust and air combination. Undetected dust deposits are commonly found in ventilation ducts and on top of girders and plant — as little as 30 g of combustible dust suspended in a cubic metre of air may be flammable. Substances that are not classified as dangerous goods may generate combustible dusts, and become an ignition source (e.g. coal dust and many food products, such as flour and nut shells; Section 7.9).

Heat sources can increase the evolution of vapour or cause auto-ignition. When heated to near its flashpoint, combustible liquid that would not normally have a hazardous zone is considered to have a hazardous zone equivalent to that of a flammable liquid.

The extent of the hazardous area needs to be determined in all areas where the flammable dangerous goods or those with a dust explosion hazard are stored or handled, or drain into spill control compounds. This includes identifying those dangerous goods in Class, Division or Subsidiary Risk 2.1, 3, 4 or 5.

An operator should identify hazardous areas by using appropriate modelling and calculations, applicable standards or both, with possible standards including:

- Parts 1 to 9 of Australian Standard AS/NZS 2430.3:2004 *Classification of hazardous areas – Examples of area classification*; and
- Australian Standard AS/NZS 4745:2004 *Code of practice for handling combustible dusts.*

Identifying ignition sources

An ignition source is any source of energy sufficient to ignite a flammable or combustible atmosphere, such as:

- naked flames, including blow torches, shrink wrapping equipment, stoves, heaters using gas, liquid or solid fuels, pilot lights, dryers, cigarettes, lighters, matches, incinerators or barbecues;

- static electricity;
- heat from appliances or chemical or biological reactions;
- heat from friction;
- sparks from moving parts, including fan blades rubbing nearby surfaces;
- sparks from grinding, welding or metal-to-metal impact from tools or plant;
- internal combustion engines, especially spark ignition systems used by LP gas and petrol powered engines used on lawn mowers, pumps, forklifts or generators;
- heated surfaces including hot exhausts or hot carbon particles from the exhaust;
- electrical equipment not rated for the hazardous area, including power points, switches, lighting, appliances, fans, any equipment with a thermostat such as air conditioners, power tools and battery powered forklift trucks;
- radio transmitters and mobile phones; and
- oily material that may self-ignite, such as seed cake from seed oil extraction, oily rags or waste.

Potential ignition sources outside the hazardous area should also be considered in relation to spills or leaks. Flammable liquid vapours are heavier than air and tend to flow by gravity along natural channels and drains.

Controlling ignition sources — electrical equipment in hazardous zones

The ignition risks of electrical equipment located within a hazardous area can be controlled by providing wiring, switching and equipment protection suitable for use in the particular hazardous zone.

Guidance on electrical protection systems is provided in Australian Standard AS 1482:1985 *Electrical equipment for explosive atmospheres – Protection by ventilation – Type of protection v*.

All electrical installations should comply with Australian Standard AS/NZS 3000:2007 *Electrical installations* (known as the Australian/New Zealand Wiring Rules).

Other relevant Australian Standards relating to electrical equipment include:

- AS 1826:2008 *Electrical equipment for explosive gas atmospheres – Special protection – Type of protection 's';*
- AS/NZS 60079.18:2005 *Electrical apparatus for explosive gas atmospheres – Construction, test and marking of type of protection encapsulation 'm' electrical apparatus*.
- AS/NZS 60079.10:2004 *Electrical apparatus for explosive gas atmospheres – Classification of hazardous areas*; and
- AS/NZS 61241.10:2005 *Electrical apparatus for use in the presence of combustible dust – Classification of areas where combustible dusts are or may be present*.

Restrictions on possession of ignition sources

As an administrative control, procedures should be established to ensure that people do not take any substance or article with the potential to be an ignition source into or near a hazardous area. Three metres is a suitable minimum separation distance.

Where an ignition source is required for an operation in or adjacent to a hazardous area, a formal hot work permit system should be used. Some Australian Standards, such as AS 1940:2004, provide detailed guidance on 'hot work' in areas where dangerous goods are stored or handled. The work permit should clearly identify the limit of the work area and prohibit entry into the hazardous area.

Static electricity

Static electricity may be generated by movement such as:

- pouring, pumping, stirring and high velocity flow, particularly dry powders and liquids of low electrical conductivity, such as most petroleum products;
- dry streams of gas (e.g. air or hydrogen);
- personnel, especially when wearing, putting on or removing clothing and footwear of low conductivity — some protective clothing, such as that made from synthetic fibres, may not be static-resistant and care should be taken in its selection;
- application and removal of plastic wrap;
- particulate or aerosol spray (e.g. spray painting, rapid discharge of a carbon dioxide extinguisher); and
- moving plant.

Observe the following to reduce risks from the discharge of static electricity:

- all tanks, pipework, transfer systems (including decanting) and process plant associated with dangerous goods should be electrically bonded to each other and earthed, or otherwise protected — see Australian Standard AS/NZS 1020:1995 *The control of undesirable static electricity*;
- use antistatic additives in non-conductive liquids;
- workers should wear conductive clothing and footwear; and
- avoid the use of non-conducting plastics or rubber hoses, containers or funnels.

7.9 Ventilation and the control of atmospheres

Legal requirements

An operator must ensure that no-one at a dangerous goods site is exposed to any dangerous goods at a concentration exceeding the maximum concentration specified in an exposure standard in relation to those goods for the relevant period of exposure.

An operator must ensure that all risks associated with the presence of a hazardous atmosphere within the site are eliminated or, if this is not reasonably practicable, the risk arising from the hazardous atmosphere is minimised.

Safe atmospheres

Ventilation is a means of maintaining a safe atmosphere by the introduction or recirculation of air by natural, forced or mechanical means. Maintaining a safe atmosphere in a storage or handling area is an important control measure. Recirculation should be avoided unless precautions are taken to detect and avoid harmful contamination and prevent accumulation of contaminants. Recirculation should only be used where temperature control is required.

A safe atmosphere is one in which all of the following conditions are met:

- there is a safe oxygen level for breathing (19.5% to 23.5% by volume at normal atmospheric pressure);
- the concentration of atmospheric contaminants is below the limits set in the relevant exposure standards;
- the concentration of flammable or combustible gases, vapours, mists, fumes and dusts is below 5% of the lower explosion limit (LEL); and
- the build-up of heat and extremes of temperature is avoided, since this may change risks.

To maintain a safe atmosphere, testing and monitoring may be required, consistent with the risks identified in the risk assessment.

Design considerations

A ventilation system should operate exclusively for the particular building, room or space. Where this is not achievable, the system may be linked to another area provided there is not an increased risk from incompatible goods or any other hazard. Ensure that air-conditioning or ventilation does not spread flammable or harmful vapours to other areas or rooms — separate systems may be required.

Local exhaust ventilation may remove airborne contaminants before they reach the breathing zone of personnel in the area. This is usually more effective than an increase in general ventilation. General dilution ventilation should only be considered for contaminants of low toxicity, and where the quantity of contaminants evolved is small.

Ventilation systems should be suitable for the types of dangerous goods on the site. For example, where there are dangerous goods with vapours denser than air, fumes should be removed from the lowest point (just above any spill containment) and fresh air introduced from above. The exhaust system and ducting should be resistant to attack by the vapours, mists or dusts being exhausted. The risk of fire propagation can be dealt with by self-closing fire dampers, but the risk of spreading flammable but not yet ignited vapours, toxic vapours or dusts must also be considered.

Vents that may exhaust flammable atmospheres should be located away from any potential ignition sources. Fresh air should be drawn from a source uncontaminated by exhaust air or other pollutants.

Discharge exhaust air where it will not cause other risks, and comply with environmental legislation concerning discharges to atmosphere. To protect the environment it may be necessary to fit some mechanism to clean the exhaust of atmospheric contaminants prior to discharge to the atmosphere. Suitable mechanisms may include filtration (for particulates), absorbents, catalysts, scrubbers or burners.

Administrative controls are necessary to ensure that vents remain unobstructed by goods or material.

Most of the Australian Standards covering individual and mixed class storage and handling provide further advice on ventilation.

Mechanical ventilation

Inlet and outlet vents should usually be located on opposite sides of the storage area at low levels to provide airflow across the floor.

Where both inlet and exhaust are mechanically assisted, capacities and rates should be adjusted to ensure that the pressure inside the store never exceeds that outside, and prevent airflow into any adjoining work areas and offices from the store.

Local exhaust ventilation

Mechanical extraction of atmospheric contaminants at their source is usually more effective than the provision of general ventilation, and may be necessary to prevent the exposure of workers or the public.

Extraction vents should have sufficient capacity under all atmospheric conditions. Discharge points should be located so as to prevent further contamination of the storage or handling areas, or other work areas.

Extraction ducting should not be linked to multiple items of plant if there is any risk of fire spreading through the ducting. Provision against flashback may be necessary.

Further advice is contained in AS 1482:1985.

Natural ventilation

Most vapours from dangerous goods are denser than air and may accumulate near floor level. To prevent build-up of hazardous concentrations, vents should be provided at a level immediately above any spill containment, on the opposite sides of a room or space, to provide for airflow across the storage or handling area. High level ventilation may be necessary for temperature control, such as roof vents to allow the escape of warm air.

Vents in a screen wall may negate any fire protection or vapour barrier effects.

7.10 Working inside buildings on plant (including tanks and tankers that have contained flammable goods)

Due to the risk of hazardous atmospheres, care is needed in relation to work, such as repair and maintenance, on a tank or tank vehicle (tanker) that has contained flammable goods (Class 3 or Division 2.1 or Subsidiary Risk 2.1 or 3 of PG I or II), if it is inside a building that is enclosed on more than two sides.

If the work involves a tank or ancillary plant that has contained flammable goods, or ‘hot work’ near the tank or plant, the tank should be gas free. A hot work permit system should be used, including a gas-free certificate and possibly continuous monitoring. This usually involves an examination by a competent person to determine it is gas free.

7.11 Buildings

The design and choice of appropriate buildings is an important control measure, especially in relation to fires (building design is covered in Section 6.8).

7.12 Decommissioning, abandonment and disposal

Risks associated with abandonment and disposal of plant and dangerous goods must be identified and controlled, including environmental risks.

When a dangerous goods storage or handling is to be destroyed, dismantled, disposed of or otherwise decommissioned, the system must be free of dangerous goods.

Specific advice is provided in AS 1940:2004, other Australian Standards and industry codes for underground tanks (Section 9.8; Appendix 5).

When decommissioning containers, consider including the following procedures:

- control risks arising from any mechanical cutting, oxy-acetylene cutting, grinding or any other activities involving heat or friction;
- safe storage or disposal of any waste generated; and
- if persons are required to work inside the container, follow confined space entry procedures (Section 7.9).

For gases of Division 2.2 in cylinders, when at atmospheric pressure the container can be regarded as ‘free from dangerous goods’, since any risk is minimal.

The risk of a flammable atmosphere inside the container should be determined. Cleaning methods include chemical neutralisation, curing or deactivation to the extent necessary to ensure there is no risk to health or safety.

Used containers should be cleaned so they are free of dangerous goods, unless arrangements have been made for refilling, refurbishment or other procedures to make them safe (Section 3.3).

Labelling should be retained on used packages that are not free of dangerous goods to identify the hazard. Labels should be removed or obliterated from containers made free of dangerous goods.

Decommissioned plant may present immediate or future risks (e.g. from residues), and the following should be undertaken:

- identification of possible residual or resultant hazards and risks;
- provision of appropriate fire protection where necessary;
- ventilation to prevent build up of a hazardous atmosphere; and
- containment of any effluent.

8 Transfer of dangerous goods

8.1 Overview

Transfer refers to the movement of dangerous goods from place to place:

- within a dangerous goods site;
- between sites; or
- to or from the site.

Transfer may be by any means (e.g. container, pipework, pipeline, vehicle such as a tanker) and includes movement into or from a container, package or vehicle, including pumping, dispensing and decanting.

An operator of a dangerous goods site must ensure that while dangerous goods at the site are being transferred from one storage or handling system to another, all reasonable practicable measures are taken to:

- avoid spillage or overflow of the dangerous goods;
- where relevant, minimise any static electricity;
- minimise any dust, mist or vapour generation;
- ensure that any transfer fittings are compatible; and
- where relevant, avoid ignition sources.

This chapter applies to the transfer of any quantity of dangerous goods.

8.2 Risks during transfer

Transfer generally poses risks greater than static storage, since the goods are either unconfined at some stage of the transfer process (such as when pouring or pumping from one container to another) or plant failure could occur. Unsuitable facilities or inadequate procedures for filling or unloading tanks or tanker vehicles may cause overfilling with its consequent risks, including serious injury to operators. Consider the following additional risks during transfer:

- increased dust, mist or vapour levels in the area around the transfer;
- generation of undesirable static electricity;
- overflow, leakage or spillage;
- spillage or leakage away from any spill containment, such as where the transfer is by pipework or pipeline;
- undesirable heat generation from transfer systems (e.g. pumps, motorised augers); and
- suitability of transfer systems (e.g. pumps and motors suitable for product being transferred).

The risk assessment should evaluate how the following factors affect the above risks:

- hazards associated with the particular dangerous goods;

- flow or transfer rates and quantities; and
- external hazards and nearby activities, such as ignition sources.

8.3 Transfer control measures

Control measures that should be considered for transfer include:

- providing adequate separation distance from transfer location to protected works and other dangerous goods storage or handling facilities;
- overflow protection equipment on receiving vessels or containers;
- flow and pressure regulators on pipework and pumps;
- interlocking of valves and switches;
- ensuring the compatibility of connections for hoses, couplings, fittings and vapour recovery;
- ensuring the continuity of connections for earthing and electrical or electronic data controls;
- systems for detecting losses from pipework and fittings, such as static pressure loss detectors, external sensors or measurement;
- control of static electricity in non-conductive flammable or combustible liquids or finely divided combustible powders by using bonding and earthing conductors between tanks, vehicles and pumps;
- isolating valves (Section 8.4);
- emergency shut down (Section 8.6);
- control of dust, mist or vapour emissions (see the list below);
- pump compatibility;
- generation of excessive heat during the transfer; and
- control of ignition sources when flammable goods are transferred (Section 7.8).

Vapour emissions during transfer can be minimised by:

- using enclosed systems;
- opening lids of containers for the minimum possible period;
- minimising the surface area of liquids exposed;
- avoiding splash filling of liquids;
- minimising the temperature of liquids; and
- providing extraction ventilation.

When decanting into a container, labelling is required (Section 3.3).

For further advice on transfer of goods, consult the relevant class- or type-specific Australian Standard.

8.4 Tank isolating valves

It is important that valves have position indicators to indicate the valve position, either open or closed. The lack of a position indicator on isolating valves has caused spills and accidents. The valve position should be clearly visible from a distance, or outside the bunded area (except for cryogenic vessels covered by Australian Standard AS 1894:1997 *The storage and handling of non-flammable cryogenic and refrigerated liquids*). Suitable valves include:

- rising spindle, where the spindle protruding above the wheel indicates the valve is open; and
- quarter-turn valves, where the status is indicated by the handle position (parallel to the pipe to indicate open).

Other important points are:

- lockable valves should only be lockable in the closed position;
- detachable handles should not be used — if an unavoidable requirement, the handle should only be detachable in the closed position, and reattachment should only be possible in a manner that indicates the correct position; and
- brass valves are unsuitable on large flammable or combustible liquid tanks since they may melt in a fire.

8.5 Loading and unloading dangerous goods vehicles

The requirements relating to the loading and unloading of transport vehicles at the site are contained in the Dangerous Goods Safety (Transport by Road and Rail) Regulations 2007.

Specific transfer requirements are detailed in the ADG Code and various Australian Standards.

8.6 Pump emergency shut-down switches

Quick shut-down of pumps is an important safety measure to control spills or fires. Pumps used to transfer dangerous goods into or out of tanks should have emergency shut-down switches. The emergency shut-down switch should be located so that:

- it can be readily and conveniently operated;
- it is close to the normal position of the operator;
- the operator can reach it to stop the transfer before a spillage gets out of control in an emergency (e.g. even if a pump seal failure sprays corrosive or burning liquid or the transfer hose ruptures);
- it is not inside the bunded area, in the pump seal ‘spray zone’ or on the far side of the tank (or tanker) away from the operator and other controls; and
- access is never obstructed.

Additional control measures for fixed locations include:

- it may be useful to mark the area with yellow paint and a ‘keep clear’ sign;

- provide an appropriate sign (e.g. ‘Emergency pump shut-down’ with letters at least 100 mm high);
- make sure gloved hands can operate the switch — mushroom-type push buttons are usually used;
- if several buttons are used (e.g. start, stop and reset) then ensure the stop button is unmistakeable, even in poor lighting; and
- if the operator has to attend to related tasks away from the normal position (e.g. to manually gauge the tank), transfer should be stopped.

8.7 Fuel dispensing into fuel tanks of vehicles

General advice

This section provides general advice for the dispensing of fuels such as Class 3 liquids, C1 combustible liquid or Division 2.1 gases, and includes retail sale. Examples of typical liquid fuels are petrol, aviation fuel, diesel fuel and gaseous fuels including LP gas, liquefied natural gas (LNG) and compressed natural gas (CNG).

Potential sources of ignition during dispensing should be eliminated by:

- stopping any vehicle engine while the dispensing operation takes place for the vehicle;
- taking all practical steps to ensure ignition sources have been eliminated within 4 m of the vehicle (or other engine) fuel tank filling point or dispenser, including the nozzle, apart from the necessary movement of other vehicles; and
- prominently displaying appropriate signage advising of the above steps, such as ‘Stop engine – No smoking’.

Steps should be taken to prevent unauthorised access to dispensers and anyone under the age of 15 years using a dispenser.

Flammable fuels (both liquid and gas) are commonly dispensed at service stations. Safety is primarily the responsibility of the operator of the site.

Guidance on fuel dispensing operations is given in Australian Standards:

- AS/NZS 1596:2002 *The storage and handling of LP Gas*;
- AS 1940:2004 *The storage and handling of flammable and combustible liquids*; and
- AS 3961:2005 *The storage and handling of liquefied natural gas*.

For a CNG refuelling station, the Australian Liquefied Petroleum Gas Association (ALPGA) standard *AG 901-1996 Code of practice for NGV refuelling stations* should be observed.

LP gas cylinder filling at service stations

LP gas cylinders, such as barbecue cylinders, must not be filled from a dispenser. Exceptions to this are cylinders such as forklift cylinders that have been specially designed to be filled from a dispenser.

8.8 Pipework

Pipework should be labelled to conform to Australian Standard AS 1345:1995 *Identification of the contents of pipes, conduits and ducts* to provide appropriate safety information (also see Section 3.6). The material used for piping and pipework, whether metal, rubber or plastics, should be compatible for the intended use, type of dangerous goods, pressure and location.

There should be sufficient valves to isolate pipework and provide emergency shut off, if required.

8.9 Handling packages

Shrink-wrapping of loads using gas torches is not usually appropriate with dangerous goods due to the fire hazard.

To avoid falls, breakages of containers and resultant spills, packages should not be stacked too high.

8.10 Filling gas cylinders

General procedures

The Australian Standard AS 2030:1985–1999 *The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases* series should be observed when filling gas cylinders.

The ADG Code requirements for gas cylinders, including design and labelling, must be followed when preparing cylinders for transport.

Guidance on filling LP gas cylinders and other containers by decanting from another cylinder is covered by AS/NZS 1596:2008.

Testing and maintenance of gas cylinders

A person must not fill an LP gas cylinder unless the cylinder complies with the requirements of Australian Standard AS 2030.1:1999 *The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases – Cylinders for compressed gases other than acetylene*.

Gas cylinders require periodic testing — at least every ten years for most gases, and more frequently for damp or corrosive gases. Check with the gas supplier for advice.

The last test date is stamped on the cylinder near the valve or on the ‘collar’, or on the foot ring of some small cylinders. If outside the test period, the cylinder must not be refilled before it is re-tested (and receives a new date stamp). However, it is permissible to use up the cylinder’s contents after its test date has expired, prior to testing. Gas suppliers can advise on suitable test stations.

Test stations can advise on disposal of a used cylinder and replacement with a new cylinder.

Test stations should observe the Australian Standard AS 2337:2004–2006 *Gas cylinder test stations – General requirements, inspection and tests* series for inspections and tests.

9 Controls for specific dangerous goods

9.1 Overview

This chapter provides advice on specific classes, divisions or subsidiary risk of the dangerous goods stored or handled at the site.

Many dangerous goods have an associated subsidiary risk. Where the dangerous good has a subsidiary risk, it is necessary to address each risk and more than one code of practice may need to be consulted. Where there is a discrepancy in the requirement, the more stringent section of the code should be used.

Examples of dangerous goods with subsidiary risks include:

- methanol (Class 3, Subsidiary Risk 6.1); and
- hydrazine aqueous solution (Class 8, Subsidiary Risk 6.1).

9.2 Mixed classes of dangerous goods in packages

As alternatives to the class-specific Australian Standards indicated in this chapter, Australian Standards AS/NZS 3833:2007 *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers* and AS/NZS 2507:1998 *The storage and handling of agricultural and veterinary chemicals* provide general advice for the storage of packages applicable to a wide range of situations.

9.3 Class 2 dangerous goods

Storage and handling of gas cylinders — general

In general, it is good practice to ensure that:

- any cap provided for use with a cylinder is kept in place on the cylinder at all times when the cylinder is not being filled and not connected for use;
- the cylinder valve is kept securely closed when not in use, including when empty (unless the cylinder is connected by permanent piping to a consuming device);
- any removable valve protection cap or valve outlet gas-tight cap or plug is kept in place on the cylinder at all times (unless the cylinder is being filled or connected for use);
- the cylinder is kept in an upright position and is secured against unintended movement, such as falling over;
- no attempt is made to lubricate valves or repair leaks — if the valve is not closing properly, immediately remove the cylinder to a safe area outdoors and call the gas supplier; and

- a water hose or fire extinguisher is on hand to put out any small fire close to the cylinder — a water spray can also be used to keep the cylinder cool in the event of a fire.

For example, an LP gas cylinder should always be positioned so that the safety relief device communicates directly with the vapour space within the cylinder. Keep the cylinder upright, unless it has a design where other positions are permitted — this depends on the position and operation of the relief device. If in doubt, check the manufacturer's or supplier's instructions.

Australian Standard AS 4332:2004 *The storage and handling of gases in cylinders* provides additional advice on general precautions.

Used or empty cylinders should be treated with the same precautions as full cylinders, since residual hazards remain.

Gases in cylinders — specific standards

Where Class 2 dangerous goods are stored and handled, observe the relevant Australian Standard, especially in relation to separation distances and ventilation.

The following Australian Standards should be observed for the storage of the following gases in cylinders:

- anhydrous ammonia (Division 2.3) — AS/NZS 2022:2003 *Anhydrous ammonia – Storage and handling*;
- cryogenic and refrigerated liquids — AS 1894:1997 *The storage and handling of non-flammable cryogenic and refrigerated liquids*;
- chlorine, liquefied — AS/NZS 2927:2001 The storage and handling of liquefied chlorine gas;
- natural gas, liquefied (LNG) — AS 3961:2005 *The storage and handling of liquefied natural gas*;
- petroleum gas, liquefied (LP gas) — AS/NZS 1596:2008 *The storage and handling of LP Gas*; and
- where several types of gases are stored or handled, observe the relevant parts of AS 4332:2004 *The storage and handling of gases in cylinders*.

AS 4332:2004 does not apply to cylinders connected for use (except for minor storage), gases in Dewar flasks or other containers not covered by the Australian Standard AS 2030:1985–1999 *The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases* series, or part of a fire control system. Additional advice can be found in the following Australian Standards:

- portable or mobile oxy-fuel gas systems — AS 4839:2001 *The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes*; and
- cylinders of oxygen and acetylene that are connected to a reticulation system — AS 4289:1995 *Oxygen and acetylene gas reticulation systems*.

9.4 Aerosols and small disposable cylinders

Filling disposable containers and charging aerosols with liquefied flammable gas

Disposable containers are filled once only and are not refillable. They are also known as cartridges, cartouches, receptacles and refills. Included in this section are:

- UN 1057 lighters, or lighter refills (cigarettes, containing flammable gas);
- UN 1950 aerosols (non-refillable receptacles with contents under pressure and fitted with a release device);
- UN 2037 receptacles, small, containing gas (gas cartridges) (without a release device, non-refillable); and
- UN 3150 devices, small, hydrocarbon gas-powered, or hydrocarbon gas refills for small devices (with release device).

The charging area should be separated from any other part of the building by a vapour-tight wall, with only a doorway and openings of not more than 0.1 square metre to allow the passage of containers to and from the charging area. The door should open in both directions and be closed as far as reasonably practicable during charging. An explosion blow-out panel should be provided in any unattended charging room.

The charging area, including any pressure vessels and plant, should have mechanical ventilation such that:

- it is separated from the ventilation system for any other area and the ducting does not pass through any other area;
- the concentration of any escaping gas is kept less than 25% of the lower explosive limit (LEL);
- escaping gas does not flow through any doorway or opening; and
- the discharge from the ventilation system is above any roof, or part of a roof measured 10 m laterally.

Gas detectors should be used to detect leaks from the charging plant and pipework. The gas detector should function at above 25% LEL of the gas, produce a sound and visible signal, and shut off any gas flow into the area.

The gas piping connected to plant used for charging (charging machine) should have a manual shut-off valve and excess flow valve at the point where the piping enters a flexible connection to the charging plant. The shut-off valve and its purpose should be clearly identified by signage at or near the valve.

Once filled, the aerosol or disposable container must be tested in accordance with the ADG Code. The container is tested immediately for leakage by immersing in water at a temperature of 55°C, and safely disposed of if found to be leaking. An alternative method may be used if it is of equivalent effectiveness.

AS/NZS 1596:2008 gives advice regarding unodourised LP gas.

Refer to AS/NZS 1596:2008 and AS/NZS 3833:2007 for guidance on safe storage.

9.5 Storage and handling of gases in bulk (tanks)

Item registration of vessels such as tanks

Containers of Class 2 dangerous goods (tanks, receivers and other vessels) need to be registered with Resources Safety (for mining operations) and WorkSafe. This applies to both storage and handling of gas (e.g. it applies to receivers and heat exchangers fitted to plant).

Standards for Class 2 gases in tanks

The following Australian Standards should be observed for the storage and handling of specific gases in bulk, such as tanks:

- anhydrous ammonia (Division 2.3) — AS/NZS 2022:2003 and AS/NZS 1677.2:1998;
- cryogenic fluids — AS 1894:1997;
- chlorine, liquefied — AS/NZS 2927:2001;
- natural gas, liquefied — AS 3961:2005; and
- petroleum gas, liquefied (LP Gas) — AS/NZS 1596:2008.

These standards are adopted as approved codes of practice in Western Australia.

Unodourised LP gas or dimethyl ether — Division 2.1 (flammable gas)

Unodourised LP gas is particularly hazardous due to the absence of any discernable odour. Dimethyl ether (DME) is also commonly used as a propellant.

The following control measures are recommended.

- Keep the storage and handling of unodourised LP gas or DME to a minimum, and restrict uses to those for which no less hazardous alternative is available, such as aerosol propellant.
- The area where it is stored and handled should be:
  - well ventilated;
  - in a room designed for that purpose fitted with explosion ventilation; or
  - in the open.
- Even a small leak, if undetected, may result in the accumulation of any explosive atmosphere, so gas detection equipment should be installed to detect gas where an explosive atmosphere could develop and provide automatic alarm above 25% LEL. The gas detector should emit an audible sound and have a visual display.

Chlorine

The requirements of AS/NZS 2927:2001 should be used for the storage and handling of chlorine.

Table 9.1 Separation distances applying to tanks of toxic gas where a type-specific Australian Standard does not apply

	Quantity of toxic gas (Division 2.3 or Subsidiary Risk 2.3)	
Separation distance from exposure to	Up to 600 cubic metres (STP) if compressed gas or 2,000 kg or L if liquefied	Over 600 cubic metres (STP) if compressed gas or 2,000 kg or L if liquefied
Public place	15 m	30 m
Protected work	30 m	60 m
Another store of dangerous goods (except toxic gas)	15 m	25 m

Note: Quantity is actual volume (not water capacity)

Toxic gas in tanks (bulk) — separation distances

For some toxic gases (other than ammonia or chlorine), there are no relevant Australian Standards. Examples are mixtures of hydrogen and carbon monoxide or other gases, such as those produced by coke ovens. For tanks of such toxic gases (Division 2.3 or Subsidiary Risk 2.3), the separation distances in Table 9.1 should be observed.

9.6 Ammonia refrigeration system

General

Anhydrous ammonia (UN 1005) is a Division 2.3 dangerous good. It is also a common refrigerant known as R717. Ammonia is a gas with a distinctive pungent odour, which can be detected by smell below 5 ppm. It is colourless, lighter than air in ambient conditions and chemically reactive.

Ammonia with metals and alloys

Ammonia is corrosive when in contact with copper, zinc and their alloys. Although this is not a hazard in itself, it can become a serious hazard if replacement parts and components are constructed of these metals or their alloys. The corrosive action of ammonia on these parts will weaken the structure and could lead to possible part failure, which in turn may lead to a serious ammonia leak.

Requirements

The design, installation, testing and operation of ammonia refrigeration systems should comply with AS/NZS1677.2:1998.

9.7 Reticulation of gas within sites

The following Australian Standards should be observed in relation to gas reticulation through pressure piping within a site:

- oxygen (unless medical oxygen) — AS 4289:1995;

- medical oxygen — AS 2896:1998 *Medical gas systems – Installation and testing of non-flammable medical gas pipeline systems*; and
- for cylinders of oxygen and acetylene that are connected to a reticulation system — AS 4289:1995.

These standards are adopted as approved codes of practice in Western Australia.

9.8 Class 3 dangerous goods

General

AS 1940:2004 provides advice on the storage and handling of flammable liquids, including package stores, tank design, pipework and valves, blending and package filling. A separate risk assessment will be needed for plant, as it falls outside the scope of AS 1940:2004.

With flammable liquids, the packing group indicates the flammability risk and therefore the storage conditions are determined by it. Combustible liquids have a lower flammability risk than flammable liquids and are not assigned a packing group. Only C1 combustible liquids are within the scope of the Storage and Handling Regulations. C2 combustible liquids, such as some oils, are outside the scope.

Typical examples of flammable liquids packing groups are:

- diethyl ether — Packing Group I;
- ethanol solution above 70% concentration — Packing Group II;
- petrol and avgas — Packing Group II; and
- household kerosene and aviation turbine fuel — Packing Group III.

Diesel fuel and solvents used in pesticide manufacture are commonly classified as C1 combustible liquids by AS 1940:2004. Check the MSDS for the packing group — generic names such as ‘mineral turpentine’, ‘paint thinner’ or ‘white spirit’ may have widely varying specifications and flashpoints.

Ethanol

Ethanol solutions include beverages, flavours and fragrances except solutions below 24% by volume, which are not classified as dangerous goods.

Ethanol is readily miscible with water, so sufficient dilution with water during fire fighting will eliminate the flammability danger of the alcohol solution. Consequently, for spillage control, dilution may be preferable to containment (but consider environmental protection and disposal). An adequate sprinkler deluge system should provide effective fire protection.

Note: Foams used to fight petrol fires may not be suitable for fighting ethanol fires.

Adequate ventilation in the storage and handling areas is necessary to avoid flammable or explosive atmospheres, and the personal exposure of workers to alcohol vapour to avoid intoxication.

Potable liquids in consumer packages at a retail outlet are excluded from this code of practice.

Paint, glue and other manufactured product in packages

The term ‘manufactured product’ applies to substances containing a flammable solvent and the definition and tests are in the ADG Code. Three criteria apply:

- contains at least 10% non-volatile material;
- less than 3% solvent separation; and
- of a suitable viscosity.

Typical examples are paint and glue. Check the MSDS or with the supplier to determine the classification as manufactured product.

Due to viscosity and low degree of solvent separation, the risks with manufactured product are lower than other flammable liquids. AS 1940:2004 provides for allowances depending on the size of the package (where unopened), packing group and type of site.

However, solvents are frequently used and kept with the manufactured product. Unless separated, these allowances do not apply and the same storage conditions should be applied to the manufactured product as to the solvent.

9.9 Bulk flammable and combustible liquids (tanks)

General

Bulk flammable liquids (Class 3 or Subsidiary Risk 3) and combustible liquids should be stored and handled in accordance with AS 1940:2004.

Underground tanks

Underground storage or handling systems for petroleum products must be designed, installed and operated in accordance with *Design, installation and operation of underground petroleum storage systems — code of practice*, available on the Resources Safety website.

If an underground tank of flammable or combustible liquid is no longer to be used, it needs to be decommissioned and made safe (Appendix 5).

Any work on existing or abandoned underground tanks or associated pipework is potentially dangerous and can cause explosions unless suitable procedures are adopted. Tar-like deposits and oily rust and sludge may have accumulated in the tank and pipework. Flushing with water will not remove them and vapour testing does not detect this. Exposure to the air, sunlight and normal temperatures, or work involving heat, such as the use of grinders or oxy-acetylene cutting, is likely to release vapours that can explode.

If a tank will be converted to use with non-dangerous goods, see the procedures in Section 7.10.

Combustible liquids

While the flammability hazards of combustible liquids are lower than for flammable liquids, they can add to the total fire load. Combustible liquids may have low auto-ignition temperatures (possibly lower than some flammable liquids) and fires can result from contact with hot surfaces.

Some combustible liquids have a reactive risk and are incompatible with some dangerous goods (e.g. brake fluid will catch fire if in contact with granular pool chlorine).

AS 1940:2004 provides further advice. Where heated combustible liquids are handled, an assessment needs to be made if they need to be treated as a flammable liquid.

9.10 Division 4.1 — flammable solids

When storing or handling Division 4.1 flammable solids:

- consider there may also be an explosion hazard (flammable dust explosion);
- consider some products may produce flammable and toxic vapours;
- maintain high housekeeping standards — this is especially important for powdered or granulated forms;
- minimise dust in the atmosphere and on surfaces;
- isolate from sources of ignition, heat and fire hazards;
- provide good ventilation and consider explosion vents;
- the surfaces (e.g. floors and equipment) where it is stored or handled should be incapable of producing a spark; and
- consider some goods are sensitive to light, heat or temperature changes, so protect the goods from the weather, heat and light.

Sulfur

In Western Australia, all forms of sulfur (sulphur) are classified as Division 4.1 dangerous goods for storage and handling.

Guidance on the safe storage and handling of sulfur can be obtained by reference to the *Approved code of practice for the prevention of sulphur fires and explosions*, published in 1993 by the Department of Labour, New Zealand.

Where several classes of dangerous goods are stored or handled with flammable solids, the advice given in AS/NZS 3833:2007 should be followed.

9.11 Division 4.2 — substances liable to spontaneous combustion

When handling or storing Division 4.2 dangerous goods:

- consider there may also be an explosion hazard (flammable dust explosion);
- maintain high housekeeping standards — this is especially important for powdered or granulated forms;
- minimise dust in the atmosphere and on surfaces;
- isolate from sources of ignition, heat and fire hazards;
- provide good ventilation and consider explosion vents;
- some products may produce flammable or toxic vapours, or both;

- some goods are sensitive to light, heat or temperature changes, so protect the goods from the weather, heat and light;
- surfaces (e.g. floors and equipment) where it is stored or handled should be incapable of producing a spark;
- if the dangerous goods will ignite on exposure to air, establish a method to contain any spillage so that air cannot come into contact with the spilt dangerous goods; and
- where the stability of the goods relies on the presence of a inhibitor or stabiliser (desensitised explosives) or needs the presence of water, then
  - a routine inspection and testing regime needs to be implemented,
  - proper stock control measures must be used to avoid prolonged storage,
  - the concentration of any inhibitor present should be checked often enough to ensure the concentration stays within the recommended levels set by the manufacturer, and
  - when the goods are reliant on being wetted, the containers should be inverted gently as often as necessary to prevent the goods in the upper section of the container from drying out.

9.12 Division 4.3 — substances that emit flammable gases when in contact with water

Division 4.3 dangerous goods evolve flammable gases on contact with water and may ignite spontaneously. This makes fire-fighting particularly risky and the correct fire-fighting medium must be used — water is unsuitable. Fire protection for the storage or handling area should be determined in consultation with FESA. Examples are sodium metal, aluminium phosphide, some metal powders and calcium carbide (used to produce acetylene gas).

Matters to consider when handling or storing dangerous goods of Division 4.3 include:

- design containers to prevent the entry of moisture and store away from water sources, in water proof containers, and away from products that need water for fire control;
- some may produce toxic vapours;
- some grain fumigants may fall into another dangerous goods class in some forms — for example, the grain fumigant aluminium phosphide in the form of crystals is Division 4.3 (PG I, UN 1397), but in the form of waxed pellets is Division 6.1 (PG II or III, UN 3048);
- some are sensitive to light, heat or temperature changes, so protect the goods from the weather, heat and light;
- there may also be an explosion hazard (flammable dust explosion);
- maintain high housekeeping standards — this is especially important for powdered or granulated forms;
- minimise dust in the atmosphere and on surfaces;

- isolate from sources of ignition, heat and fire hazards;
- provide good ventilation and consider explosion vents;
- consider some products may produce flammable and toxic vapours;
- surfaces (e.g. floors and equipment) where it is stored or handled should be incapable of producing a spark.
- if the dangerous goods will ignite on exposure to air, establish a method to contain any spillage so that air cannot come into contact with the spilt dangerous goods; and
- where the stability of the goods rely on the presence of a inhibitor or stabiliser (desensitised explosives) then
  - a routine inspection and testing regime needs to be implemented,
  - proper stock control measures must be used to avoid prolonged storage,
  - the concentration of any inhibitor present should be checked often enough to ensure the concentration stays within the recommended levels set by the manufacturer, and
  - when the goods are reliant on being wetted, the containers should be inverted gently as often as necessary to prevent the goods in the upper section of the container from drying out.

9.13 Division 5.1 — oxidising agents

Hazards and risks

The hazard with oxidising agents is that they are reactive and support combustion (while not being classified as flammable). Oxidising agents may react with a wide range of substances, particularly combustible materials including:

- flammable or combustible liquids such as petrol, kerosene, vegetable oil, engine oil, brake fluid, paint or grease;
- organic dusts;
- paper; and
- wood.

The requirements of Australian Standard AS 4326:1995 *The storage and handling of oxidizing agents* should be followed for the storage and handling of oxidising agents, except for solid ammonium nitrate.

Factors to consider when using or storing oxidising agents include:

- keeping oxidising agents away from combustible or readily oxidisable materials, sulfur and powdered metal;
- storing so that they cannot come into contact with a source of heat;
- ensuring any heating equipment cannot heat the goods to within 15°C of their decomposition temperature;
- the risk of dust explosions; and
- assessing the need for protection of electrical equipment.

Ammonium nitrate

The requirements of Resources Safety's *Safe storage of solid ammonium nitrate – code of practice* should be followed for bulk or packaged solid ammonium nitrate.

For explosives precursors, such as ammonium nitrate emulsions (UN 3375), the recommendations of the Australian Explosives Manufacturers Safety Committee (AEMSC) *Code of good practice – Precursors for explosives edition 1 – 1999* should be followed.

Security controls under the Dangerous Goods Safety (Security Risk Substances) Regulations 2007 must be applied to all storage or handling systems for solid mixtures containing ammonium nitrate that exceeds 45%, and ammonium nitrate emulsions, suspensions and gels.

9.14 Division 5.2 — organic peroxides

Organic peroxides are capable of self-reaction and stabilisers are usually necessary. The requirements of Australian Standard AS 2714:1993 *The storage and handling of hazardous chemical materials – Class 5.2 substances (organic peroxides)* should be followed for the storage and handling of organic peroxides.

Some are classified as 'Goods too dangerous to be transported'.

9.15 Division 6.1 — toxic substances

The following Australian Standards should be used as applicable:

- toxic substances in most circumstances — AS/NZS 4452:1997 *The storage and handling of toxic substances*;
- agricultural and veterinary chemicals — AS 2507:1998;
- liquid and liquefied polyfunctional isocyanates — AS/NZS 4081:2001 *The storage and handling of liquid and liquefied polyfunctional isocyanates*; and
- where several Classes of dangerous goods are stored or handled with toxic substances — AS/NZS 3833:2007.

9.16 Class 8 dangerous goods — corrosives

Corrosives may be alkaline or acidic, and these two categories may be incompatible or interact dangerously.

The advice provided in the following Australian Standards should be observed where relevant:

- storage and handling of corrosive substances — AS 3780:1994 *The storage and handling of corrosive substances*; and
- where several Classes of dangerous goods are stored or handled with corrosive substances — AS/NZS 3833:2007.

Eyewash and safety showers should be readily accessible where corrosives are handled or transferred.

9.17 Class 9 dangerous goods — miscellaneous hazards

The requirements of Australian Standard AS/NZS 4681:2000 *The storage and handling of Class 9 (miscellaneous) dangerous goods and articles* should be followed for the storage and handling of Class 9 (miscellaneous) dangerous goods, and AS/NZS 3833:2007 where several classes of dangerous goods are stored or handled with Class 9 dangerous goods.

Some of the goods specifically covered in AS/NZS 4681:2000 include:

- elevated temperature liquids and solids (e.g. bitumen);
- benzaldehyde;
- ammonium nitrate fertilisers (Class 9);
- environmentally hazardous substances (UN 3077, UN 3082);
- stabilised fish meal;
- solid carbon dioxide (dry ice);
- polychlorinated biphenyls (PCBs);
- polymeric beads (UN 2211) and plastic mouldings (UN 3314); and
- airbag inflators (UN 3268), first aid kits (UN 3316), lithium batteries (UN 3091), life saving appliances (UN 2990, UN 3072).

10 Transit, receival and dispatch areas

10.1 Overview

This chapter provides advice on transit and receival or dispatch areas storing any quantity above the placard quantity as listed in Schedule 1 of the Storage and Handling Regulations (which includes all containers for bulk dangerous goods).

It does not apply to dangerous goods located at ports, for which the requirements of the Dangerous Goods Safety (Goods in Ports) Regulations 2007 and Australian Standard AS 3846:2005 *The handling and transport of dangerous cargoes in port areas* apply.

10.2 Transit storage areas

Dangerous goods in transit means the dangerous goods are:

- supplied to a dangerous goods site in containers that are not opened at the site;
- not used at the site; and
- kept at the site for not more than five consecutive days.

Dangerous goods located in a transit area may remain on a vehicle such as the one that brought them to the site (e.g. road trailer, rail wagon) or be removed from the vehicle. Transit storage areas may be found at sites such as truck and rail yards, and warehousing sites.

Advice for transit storage is provided in the relevant Australian Standard for the dangerous goods being stored. AS/NZS 3833:2007 provides advice on mixed classes of dangerous goods in packages and intermediate bulk containers.

10.3 Receival or dispatch areas

Receival or dispatch areas are locations where dangerous goods are held outside the usual storage area, prior to:

- pick-up from the site; or
- moving the goods into an allocated location on site (e.g. dangerous goods store or process), following delivery.

The time and quantity of dangerous goods located in a receival or dispatch storage area should be kept to a minimum commensurate with efficient operation.

10.4 Control measures

Practicable measures need to be adopted to control risks where dangerous goods are in transit at a site or where dangerous goods are being received or dispatched. Other sections of this code of practice apply as equally to transit and receival or dispatch areas as they do to more permanent storage or handling systems.

As with permanent dangerous goods storage areas, transit and receival or dispatch areas need to be designed and managed so that appropriate controls are in place to, as far as reasonably practicable, so they can be operated with minimal risk to people, property and the environment. It is important to identify hazards, assess risks and ensure that appropriate control measures are in place.

Consideration should be given to matters such as:

- controlling ignition sources;
- providing adequate ventilation;
- segregation;
- controlling and cleaning up leakages;
- controlling fire risks; and
- vehicular impact.

Transit and receival or dispatch areas should be clearly delineated and need to be isolated by means of distance or barriers from buildings, dangerous goods stores and people.

Foodstuffs (including medicines and stock feed) and their packagings must be isolated to avoid any potential contamination.

Whether on a vehicle or not, dangerous goods in a transit, receival or dispatch area need to be packaged or contained, marked, placarded and provided with transport documents in accordance with the ADG Code.

11 Placarding and signage

11.1 Overview

This chapter summarises the placarding requirements for dangerous goods sites, which are detailed in Schedule 4 of the Storage and Handling Regulations.

Transit storage locations (dangerous goods in transit) do not require placarding since the load or vehicle signs and placards are sufficient.

11.2 Principles

Placards provide visual warning of the hazards associated with the storage of dangerous goods at the site. This is particularly important for FESA personnel.

Placards must be displayed if the dangerous goods are stored in bulk, or in packages over certain quantities — see the placarding quantity and rules in Schedule 1 of the Storage and Handling Regulations. To determine this, the total quantity of dangerous goods on the site of each class, sub-class and packing group needs to be calculated, as well as the quantities in each storage location. Individual vehicles parked while loaded for transport should be included in the calculations of the quantities, unless the dangerous goods are in transit.

There are three placards types:

- an outer warning placard, known as the HAZCHEM placard, on the outside approaches to the site;
- placards at each location of dangerous goods in bulk (e.g. tanks); and
- placards at each location where packages stored and handled.

Placards are not required for:

- an IBC or bulk container intended for transport that is marked in accordance with the ADG code;
- C1 combustible liquids in a quantity not exceeding 10,000 L;
- dangerous goods of Division 2.1, Class 3, or petroleum products stored in an underground tank at a retail outlet where the goods are used to refuel vehicles (e.g. at a service station); and
- dangerous goods in bulk intended for transport and placarded for transport.

Placards must be readily visible to FESA when approaching the location where the goods are stored or handled so they:

- need to be visible from all normal approaches to the storage location, the main entrance, or both; and
- must be kept legible and unobstructed.

11.3 Types of placards

Outer warning placards

The site must be marked by a HAZCHEM outer warning placard if the total quantity of dangerous goods stored or handled at the site exceeds the placarding quantity on the site for any item shown in Schedule 1 of the Storage and Handling Regulations. An outer placard may be needed even when no specific storage location in the site requires a placard.

These outer warning placards must be displayed at all road and rail entrances to the site where FESA may gain entry. Usually this will be at the main road entrance. However, if the site consists of buildings back from the street, such that the placard at the street entrance would be not be effective, the outer warning placard should be displayed at each entrance of the building that may be used by FESA. If in doubt, consult with FESA about the location.

Bulk storage

Placards are required for each bulk storage location, even where the quantity does not exceed the placard quantity.

Bulk dangerous goods means:

- quantity of the dangerous goods in a container that has:
  - a capacity greater than 500 L or
  - a net mass greater than 500 kg; or
- an undivided quantity of the dangerous goods exceeding 500 kg (e.g. bulk loose piles of ammonium nitrate or sulfur).

Placards for bulk storage are essentially the same as the full size emergency information panel (EIP) required by the ADG Code for bulk transport, with the emergency contact details removed. A bulk container, vehicle or IBC marked in accordance with the ADG Code is acceptable (except for combustible liquids).

The placard must be located on or adjacent to the bulk container, (e.g. tank) or storage. Underground tanks and the associated pipework at a retail service station do not require a placard.

Packaged dangerous goods

Placards must be displayed on or near each storage location for packaged dangerous goods, if the quantity in the storage location exceeds the placard quantity. This quantity should be calculated as the maximum likely (rather than as a minimum) and include factors such as a possible extra load delivered to meet peak demand, or before a holiday.

The groupings of classes, subsidiary risks and compatibilities of packages in each storage location are dictated by the principles of separation and segregation (Section 6.9).

For existing stores of packaged dangerous goods, the signs previously required under the repealed regulations for dangerous goods are usually sufficient.

The class label (including mixed class labels) should be grouped. Grouping need not be in a horizontal line — it can be vertical or diagonal. If there is regular variation in the type of dangerous goods, it may be convenient to use frames for slip-in-and-out labels, such as the type commonly used on vehicles. Vehicles and loads marked in accordance with the ADG Code placards are acceptable.

12 Fire protection and other risk control equipment

12.1 Overview

The Storage and Handling Regulations require operators to ensure that appropriate fire protection and fire fighting methods (including equipment) are provided, installed, and maintained to quickly control and extinguish any fire that might occur at the site. The fire protection system includes fire detection, fire suppression and fire fighting equipment, which may be fixed or portable.

The fire protection for a dangerous goods site may be additional to any fire protection required by the *Building Code of Australia* because that code does not cover the risks involving dangerous goods or deal with items such as dangerous goods in processes, tanks or open air storage.

Using the risk assessment, a competent person should determine the particular fire protection needed.

The Australian Standard relevant to the type of dangerous goods stored on a site provides detailed advice for fire protection for dangerous goods storage or handling systems.

12.2 Fire protection systems

Designing the fire protection system

Fire protection systems are the fixed plant installed at dangerous goods sites to extinguish and prevent the spread of fire.

While the *Building Code of Australia* specifies minimum requirements for fire protection, additional fire protection will usually be required for sites where dangerous goods are handled.

The fire protection system should have the capability to quickly control and extinguish any fire that may occur involving the dangerous goods. It should also effectively protect the dangerous goods from any nearby fire. To achieve this, the fire protection system design and construction for each area in which dangerous goods are handled, and for the site as a whole, should take into account the provisions of this code of practice, and relevant standards and industry codes for particular types of dangerous goods.

The design and construction of the fire protection system should consider:

- particular properties and related hazards of the dangerous goods being handled;
- total fire load (total quantity) of the area being protected;
- location, design, type and materials of construction of any structures, plant and equipment and total floor area of the building or handling area;
- type of operations in the building, handling area, with particular attention to
  - whether the goods are in bulk, or in open or closed packages,
  - extent of containment provided for the dangerous goods,

  - how the dangerous goods are handled (processes and transport systems), and
  - storage configuration, height and density;
- impact of hazards external to the storage or handling area, including those beyond the site, such as
  - other dangerous goods storage or handling systems and operations,
  - other activities, processes or operations,
  - waste storage, and
  - mobile hazards such as vehicles;
- personnel available to operate the system and their capability;
- need to protect external facilities, in particular those occupied by people (e.g. offices, shops, schools, public places);
- relevant environmental considerations; and
- need to protect the fire protection system itself from the impact of fire, so that it remains operational in the event of a fire.

Compatibility of the fire protection system with dangerous goods

The fire fighting media (e.g. water, foam, dry agent) must be compatible with the dangerous goods for which they are to be used. For example, sprinklers and water-based extinguishers should not be used with chemicals that are dangerous when wet.

Water supply

The water supply should be reliable and sufficient to supply both the fire protection equipment at the site and any additional equipment used by FESA to control a fire.

Where sufficient supply is not available from the main water supply, it will be necessary to supplement this with additional water storage or pumps, or, where permitted by the appropriate regulatory authorities, by drawing fire service water from alternative sources such as rivers or dams.

Specific guidance is provided in the following Australian Standards:

- AS 1940:2004 *The storage and handling of flammable and combustible liquids*;
- AS 2419.1:2005 *Fire hydrant installations – System design, installation and commissioning*;
- AS 2419.2:1994 *Fire hydrant installations – Fire hydrant valves*; and
- AS 2419.3:1996 *Fire hydrant installations – Fire brigade booster connections*.

Booster systems may need to be installed to provide sufficient pressure for large-scale fire fighting. This may require:

- installation of fixed or portable pumping equipment; and
- an appropriate number of booster connections and feed hydrants, together with an approved hard standing area for FESA pumping equipment.

Fire alarm systems

Fire alarm systems should be designed and installed in accordance with the relevant Australian Standards so that:

- automatic systems are also capable of being manually activated at clearly identified manual alarm call points at convenient and safe locations near work areas;
- the alarm signal is sufficiently distinguishable from any other signals to permit ready recognition, and is clearly audible throughout the storage installation;
- where high noise levels or the use of protective clothing may prevent the recognition of an alarm signal, an effective visual alarm system is also installed; and
- the system remains operable when the main power supply fails.

Alarm systems for larger installations may need to be directly linked to FESA.

12.3 Requirements for fire fighting equipment

General requirements

All fire protection and detection equipment should comply with the relevant Australian Standards.

Compatibility with equipment used by FESA

When required by FESA, fire fighting equipment at the site must be capable of being operated with the equipment used by FESA, without the use of adaptors.

Compatibility issues that should be considered include:

- ensuring the pressure rating of fire mains and associated equipment is consistent with the pressures that may be imposed by the connection of FESA's equipment; and
- providing fire fighting foam compatible with that used by FESA.

Location of fire fighting equipment

Fire fighting equipment should be located so that:

- all dangerous goods and other items being protected, including high rack storage, can be directly reached by the fire fighting medium;
- it is readily accessible in the event of an incident, preferably adjacent to exit doors or on exit routes;
- it is convenient to the risk being protected; and
- it is in a conspicuous position.

Identification of fire fighting equipment

All fire fighting equipment should be clearly and suitably labelled in accordance with the relevant Australian Standards. Where necessary to assist with the identification of fire fighting equipment, additional signs complying with Australian Standard AS 1319:1994 *Safety signs for the occupational environment* should be installed.

Specific requirements for fire fighting equipment

Fire hose reels

Fire hose reels should comply with Australian Standard AS/NZS 1221:1997 *Fire hose reels* and be installed to Australian Standard AS 2441:2005 *Installation of fire hose reels*.

Where foam hose reels are installed, they should be capable of producing foam to the manufacturer's specifications, suitable for the risks involved. A hose reel that is equipped with foam making capabilities should be identified by conspicuous signage.

Hydrant hose systems may be substituted for fire hose reels if staff is trained to safely use them.

Fire hydrants

Hydrants should be equipped with hose, branch and nozzle except where it is not appropriate or prudent to do so, such as where they are susceptible to theft or there are no personnel properly trained to operate them.

External hydrants should be:

- positioned convenient to, but a safe distance from exit doors;
- easily visible, with appropriate identification signs; and
- capable of providing the appropriate coverage.

Guidance for the selection, installation and location of fire hydrants for use at a site where dangerous goods are stored and handled is found in the Australian Standard AS 2419:1994–2005 *Fire hydrant installations* series, AS 1940:2004 and other relevant Australian Standards.

Monitors

The installation of monitors may be appropriate where fire control requires the direction of large quantities of fire or cooling water at a fixed installation, with minimum exposure of fire fighters. Monitors should normally be installed in accordance with the manufacturer's specifications and in consultation with FESA.

The following matters should be considered when determining the specification of the monitors and their location:

- required water flow capacity — an allowance of 50% over any calculated capacity should be provided to take account of adverse wind conditions;
- type of nozzle that should be provided — fixed or variable pattern and whether it can supply foam as well as water;
- location of the monitor relative to the installation being protected; and
- anticipated heat flux at the monitor location.

Monitors should normally be located 15 to 30 m from the facility to be protected. If monitors are required to be closer to the facility, or where the expected heat flux may exceed 2 kW/m^2, radiant heat protection should be considered for personnel operating the monitor. Alternatively, operate the monitor by remote control.

Automatic sprinkler systems

Where fire sprinkler systems are required, they should be installed in accordance with the Australian Standard AS 2118:1995–2006 *Automatic fire sprinkler systems* series and advice obtained from FESA.

Portable fire extinguishers

Fire extinguishers should be selected on the basis of suitability for the fire risk involved, in compliance with the relevant Australian Standard.

Fire extinguishers should be located, identified and protected so they are:

- clearly visible, unobstructed and readily available to the relevant risk; and
- not adversely affected by hazardous or climatic conditions.

Australian Standard AS 2444:2001 *Portable fire extinguishers and fire blankets – Selection and location* provides guidance on the location and identification of portable fire extinguishers.

Foam extinguishers should be suitable for the particular dangerous goods. For example, alcohol-compatible foam should be used for alcohols and other polar (water miscible) solvents.

Carbon dioxide extinguishers may protect electrical equipment and will minimise clean up and limit damage to the equipment, but have a poor 'knock down' capability, short discharge range, and may be ineffective where there is significant air movement. Dry powder or vaporising liquid may be more effective.

Carbon dioxide and acidic extinguishers such as those based on ammonium phosphate should not be used where cyanides are present. Carbon dioxide should not be used on fires involving magnesium or titanium metals. Where powder-type and foam extinguishers are likely to be used together in an emergency, they should be compatible.

12.4 Inspection, testing and maintenance of fire protection

Fire protection systems and fire fighting equipment should be inspected, tested, recharged and maintained in accordance with the relevant part of Australian Standard AS 1851:2005 *Maintenance of fire protection equipment* and the manufacturer's specifications.

The results of testing should be recorded and records kept for the life of the equipment.

12.5 Actions when fire protection systems fail

Operators must ensure that if any of the components of the fire protection systems or fire fighting equipment are unserviceable or inoperative:

- FESA is notified;
- action is taken to return this equipment to full operation;
- the implications of the equipment becoming unserviceable or inoperative are assessed; and
- alternative measures are taken to control, to the same level of effectiveness, those risks that were controlled when the equipment was functioning fully.

In the simple case of a fire extinguisher, this may involve having the extinguisher serviced or replaced. For more complex fixed fire protection systems, making the system fully operational may take time.

Alternative control measures include:

- ceasing all or part of the operations in the areas affected by the failure if the risk is high;
- providing temporary fire protection systems or equipment until repairs are completed; and
- contacting FESA for advice.

12.6 Other risk control equipment

In addition to fire protection, operators of a dangerous goods site must provide equipment and materials identified in the risk assessment as suitable for use to control risks to people, property and the environment.

The equipment may include, as appropriate:

- leak detection system for the storage and handling of liquids and gases;
- neutralising agents;
- absorbents (e.g. sand bags);
- self-contained breathing apparatus (SCBA); and
- PPE for personnel;
- explosimeters.

The operator must ensure that the equipment is provided on site, properly maintained and accessible at all times to people at the site.

13 Emergency plans and response

13.1 Overview

The purpose of the emergency plan is to minimise the effects of any incident or serious incident involving the dangerous goods, such as the loss of containment of the dangerous goods leading to a spread of liquid or vapour through the site, and possibly into adjacent premises or public places.

13.2 Legal requirements

The operator must ensure that a written emergency plan for dealing with any dangerous situation associated with the storage and handling of dangerous goods at that site is prepared.

If a site is storing or handling in excess of the manifest quantity in Schedule 1 of the Storage and Handling Regulations, an emergency plan must be prepared in accordance with the *Dangerous goods sites – emergency planning code* published by Resources Safety. It is recommended that this same code be used as a guide for preparing the plan for sites storing or handling more than the placard quantity but below the manifest quantity in Schedule 1 of the Storage and Handling Regulations.

If the site stores or handles in excess of ten times the manifest quantity in Schedule 1 of the Storage and Handling Regulations, the operator must send the Chief Officer, in electronic format, parts of the plan specified in the code (i.e. special risk plan).

13.3 Reporting incidents internally

Principles

A system for workers to report incidents should be established within the site and organisation.

Each incident should be investigated to determine its cause or likely cause. The risk assessment should be reviewed, having regard to the results of the investigation, and risk control measures revised accordingly.

The system for reporting should be:

- prepared in consultation with employees (or their representatives);
- documented so that it is readily understood by people who may be affected; and
- able to inform supervisors, employees, representatives and other relevant parties of the results of the investigation.

Setting up a system

A system to investigate incidents on the site should include:

- procedures for staff to report incidents;
- means of recording incidents;

- allocation of responsibility for incident investigation to a responsible person;
- provision for the investigation of the causes of incidents, and record-keeping for these investigations;
- follow-up action to address the causes of incidents and the introduction of control measures to prevent a recurrence; and
- reporting arrangements to Resources Safety.

Records of incident investigations

When recording a dangerous goods incident, such as a leak or spill, consider including whether:

- on-site or off-site emergency plans were activated;
- it had the potential to cause fire, explosion or release of toxic or corrosive materials;
- it had the potential to cause
  - acute or chronic human health effects
  - environmental harm
  - damage to plant or equipment; and
- it affected the quantity or quality of effluent discharged into the sewers.

13.4 Response to dangerous situations

Immediate action should be taken to assess and control any risk associated with an emergency, including fire protection. The immediate response to an incident should be provided for in the emergency plan.

Only people who are essential to the tasks of assessing and controlling the risk associated with the emergency should be permitted to remain in the vicinity of the emergency. The procedures and plan should specify those essential personnel.

An operator of a dangerous goods site must respond to a dangerous situation at a site or pipeline by ensuring that immediate action is taken to assess and control any risk to people, property or the environment associated with the dangerous situation, including:

- bringing any fire, explosion or other release of energy comprising or resulting from the incident under control;
- cleaning up and disposing of, or otherwise making safe, any spill or leak of dangerous goods comprising or resulting from the incident; and
- otherwise making any plant associated with the dangerous situation and the surrounding area safe so far as is practicable.

13.5 Emergency equipment — escape of dangerous goods

Equipment should be available to contain and clean up any escape, spill or leak of dangerous goods at a site and be accessible at all times

Consider the need for:

- over packs such as oversized drums for containing leaking packages;
- absorbent material (suitable for the goods likely to be spilled);
- booms, plates or flexible sheeting for preventing spillage from entering drains and waterways;
- neutralising agents (e.g. lime, soda ash);
- suitable pumps and hoses for removal of spilled liquids;
- hand tools (e.g. mops, buckets, squeegees, bins); and
- suitable PPE for the workers undertaking clean up or other emergency-related tasks such as closing valves.

Establish a procedure for the regular checking, maintenance and replenishment of this equipment to ensure it is serviceable.

13.6 Reporting Incidents to Resources Safety

A dangerous goods incident is a reportable situation under Section 9(2) of the *Dangerous Goods Safety Act 2004* if it resulted in, or but for intervening events could have resulted in, an unexpected:

- spill, leak or other emission of dangerous goods; or
- fire, explosion or other release of energy.

A reporting guideline and form are available from the Resources Safety website.

The Storage and Handling Regulations provide that an operator must ensure:

- any dangerous goods incident occurring at the site or on the pipeline is investigated and that the investigation, so far as possible, determines the cause or likely cause of the dangerous goods incident; and
- a record of the dangerous goods incident and investigation is:
  - made,
  - kept until the site or pipeline is decommissioned, and
  - readily available, on request, to the Chief Officer.

14 Manifests and site plans

14.1 Overview

This chapter describes additional requirements for sites where dangerous goods are stored and handled in relatively large quantities, above the manifest quantities in Schedule 1 of the Storage and Handling Regulations. A written emergency plan is also required at these levels (Chapter 13).

The manifest and site plan requirements are detailed in Schedule 3 of the Storage and Handling Regulations.

14.2 Preparing a manifest and site plan

Legal requirements

A manifest and site plan must be prepared when the quantity of dangerous goods on the site exceeds the quantities listed in Schedule 1 of the Storage and Handling Regulations.

The manifest must include goods loaded onto vehicles (except dangerous goods in transit).

The manifest must be readily available to FESA and dangerous goods officers.

Purpose of manifest

The manifest provides FESA with information on the quantity, type and location of dangerous goods on the site, enabling an appropriate response to a serious incident.

The manifest could also serve the purpose of the list of dangerous goods for the register (Section 3.5).

Location of manifest

The manifest must be kept on the site in a place easily accessible to the FESA and housed in a holder of substantial waterproof construction. It should be located near the outer warning placard at the front of the site (Chapter 11), typically at the main vehicular entrance to the site unless otherwise agreed with FESA.

Contents of manifest

The manifest is a document that includes:

- general information, such as the name of the operator of the site, the address of the site, and the date when the manifest was prepared or last amended;
- emergency contact information for at least two people who may be contacted in the event of a serious incident;
- * summary information about the classes and packing groups (if any) of the dangerous goods at the site;
- information about dangerous goods stored in bulk, other than IBCs;
- * information about packaged goods and IBCs;

- * information about dangerous goods in processes such as manufacture;
- information about dangerous goods loaded onto vehicles, vessels or aircraft (except when in transit); and
- a site plan.

Note: For dangerous goods in transit, items that are asterisked may be in the form of transport documents as provided by the ADG Code.

The manifest must be revised when there is a change in any of the above information.

A sample manifest is provided in Appendix 6.

Site plan

The purpose of the site plan is to identify the places, buildings and structures on the site where dangerous goods are stored or handled. It should be easy for emergency personnel to read and consider when the emergency plan is being developed (Chapter 13).

The plan can also be used as a tool in the risk assessment process. The items included on the plan should be relevant to the risks and include matters significant to the emergency response. For example, the drains included on the plan should be those related to spill control or along which spilt liquids or gases could travel. Underground sewer pipes, for example, would not be relevant.

The site plan should be on a scale that adequately illustrates the details required - an example is provided in Appendix 6.

15 Training

15.1 Overview

The operator must ensure that anyone involved with the storage and handling of dangerous goods at the site is provided with induction, information, training and supervision.

Training needs should be identified in the risk assessment process and training programs developed and assessed in consultation with employees.

15.2 Topics

The following training topics should be considered as a minimum, where relevant to the job:

- types and quantities of dangerous goods and combustible liquids at the site, work location, and the correct manner in which they are stored and used;
- safe work methods to be used on the job, including matters described in this code of practice;
- safe use of any tools, plant and associated equipment, and dangerous goods or hazardous substances to be used on the job, such as fire protection measures and eliminating ignition sources;
- administrative procedures for controlling risks, such as ensuring permit to work systems are followed;
- correct use, care and storage of PPE, including any relevant hygiene issues;
- dust, gas and fire risks that may be present and the controls adopted, including procedures to follow if equipment such as dust extraction fails;
- hazardous areas and restrictions on ignition sources, especially vehicles and portable items;
- recognition of plant failures or other system failures that could lead to an escape of dangerous goods;
- emergency and evacuation procedures (including recognising the fire alarm, fire-fighting measures and the location of fire-fighting equipment and other emergency equipment), confined spaces entry procedures and rescue of entrapped persons;
- how to observe any administrative controls, such as restrictions on entry into areas, and warning signs, including signs attached to containers, controls or valves;
- dangerous goods classification of substances used, stored or handled, and any other relevant safety, or health risks (e.g. dusts, emissions) arising from work, handling or storage;
- security measures, signs and procedures;
- dangers of the containers of dangerous goods as confined spaces, and the confined spaces entry procedures (if entry is planned, or could be required for emergency rescue); and

- how to access health and safety information, such as the register or manifest, reading labels, signs, placards and MSDSs.

The risk assessment process may indicate other training topics that are relevant and necessary.

15.3 Outcomes

The outcomes of training include the ability of workers to demonstrate, where relevant to the particular job, an understanding of:

- the dangerous goods classification system;
- safe work practices relating to the storage and handling of dangerous goods at the site;
- how to interpret information provided on labels, signs and placards;
- how to locate an MSDS and use this information, and where to obtain any other relevant information;
- the nature of the hazards and risks associated with the duties being performed;
- measures used to control the risks and how to apply these;
- proper use, cleaning and replacement of PPE;
- emergency procedures; and
- first aid and incident reporting procedures to be followed in the case of illness, injury, incident or serious incident.

15.4 Reviewing training needs

To ensure training remains effective, it should be reviewed regularly to identify any need for further training. Employees should be consulted so they can help identify training needs. Training should be reviewed when the risk assessment is reviewed (Chapter 5).

Information, instruction and training should be evaluated to ensure that the content is clearly understood by workers. Evaluation could be through on-the-job observation and consultation. Refresher training should be provided as required.

15.5 Records

Records of training must be kept for five years for those employees who are likely to store or handle dangerous goods.

Appendix 1 — Glossary

Aerosol: Non-refillable receptacle made of metal, glass or plastics containing gas compressed, liquefied or dissolved under pressure and fitted with a release device allowing the contents to be ejected as a gas or as solid or liquid particles in suspension in a gas or liquid.

Article: An item (other than a fluid or particle) which is formed to a specific shape, surface or design, has an end use that depends in whole or in part on its shape, design or surface, and which undergoes no change in chemical composition or physical state during the end use except as an intrinsic part of that end use.

Bulk: A quantity of dangerous goods in a container that has a capacity greater than 500 L or a net mass greater than 500 kg, or an undivided quantity of the dangerous goods exceeding 500 kg.

Bund: An embankment or wall, that may form part of the perimeter of a compound, designed to contain spills of liquids. Both the bund and the compound floor must be sufficiently impervious to retain spillage or leakage.

Charging area: The area within a building where aerosols or disposable cylinders are filled with a liquefied flammable gas (Division 2.1).

Class: The class allocated to the dangerous goods under the ADG Code.

Class label: The label specified in the ADG Code for the class of dangerous goods.

C1 combustible liquid: A combustible liquid within the meaning of AS 1940:2004 with a flash point of greater than 60°C but not greater than 150°C and a firepoint that is less than the boiling point

Combustible material: Any type material capable of igniting, including and without limitation C2 combustible liquids and empty combustible containers, such as paper bags, fibre board drums and boxes, plastic containers and liners for containers, and wooden boxes and barrels.

Compatible: Two or more substances or items that will not react together to cause a fire, explosion, harmful reaction or the evolution of flammable, corrosive or toxic vapours.

Compound: An area bounded by ground contours or by a bund, and intended to retain spillage or leakage. This includes the floor of the compound.

Consumer container: A container that is intended for retail display and sale, and includes anything in which a number of such identical containers are transported or distributed.

Dangerous goods: Goods or articles defined under the ADG Code as dangerous goods of Class (or Division) 2, 3, 4 (excluding hay), 5, 6.1, 8 or 9, or goods too dangerous to be transported. C1 combustible liquids and all forms of sulfur are dangerous goods

Dangerous goods in transit: Dangerous goods that:

- are supplied to a dangerous goods site in containers that are not opened at the site;
- are not used at the site; and
- are kept at the site for a period of not more than five consecutive days.

Dangerous goods pipeline: A pipeline that is or is intended to be used to carry dangerous goods across on or more cadastral boundaries.

Dispensing: Fuelling a vehicle, engine or gas container from a dispensing unit, such as a bowser. This includes retail at service stations.

Emergency information: In relation to dangerous goods transported on a vehicle, this means:

- Australian Standard HB76:2004 *Initial emergency response guide*; or
- an emergency procedure guide for the dangerous goods transported on the vehicle and the emergency procedure guide in relation to vehicle fire; or
- for use on trains transporting dangerous goods, the rail operator's dangerous goods emergency instructions for train crews that provides contact numbers for dangerous goods emergencies.

Emergency procedure guide (EPG): In relation to particular dangerous goods, this is a guide outlining procedures to be taken in the event of an emergency involving the goods that is either:

- in the form, or substantially in the form, of an emergency procedure guide for the goods published by Standards Australia; or
- in a form approved by the Chief Officer in relation to goods of that kind.

Employee: An individual who works under a contract of employment, apprenticeship or training scheme.

Fire protection system: Includes fire protection equipment and fire fighting equipment used to combat or mitigate any dangerous situation involving fire occurring at the site.

Fire risk dangerous goods: Dangerous goods of Division (or Class) 2.1, 3, 4, 5 or Subsidiary Risk 2.1, 3, 4, 5, and C1 combustible liquids, that burn readily or support combustion.

Food: A substance prepared, intended or represented as being for human or animal consumption, or anything intended to be an ingredient of, or an additive to, such a substance.

Food packaging: A package that contains, or is designed or intended to contain, food, or material designed or intended to be used in such a package.

Gas cylinder: A particular rigid pressure vessel, exceeding 0.1 kg but not exceeding 3,000 kg water capacity, without openings or integral attachments on the shell other than at the ends, designed for the storage and transport of gas under pressure.

Goods too dangerous to be transported: Goods that are extremely unstable or have other characteristics making them unsuitable for transport. They are named in appendix of the ADG code. The Chief Officer may determine goods too dangerous to transport.

Handling: In relation to dangerous goods includes to manufacture, process, pack, use, sell, supply, carry (including by pipeline), and treat the dangerous goods and to destroy or otherwise dispose of dangerous goods.

Hazardous area: An area or space in which the atmosphere may contain or be reasonably expected to contain any material or substance (e.g. combustible dusts, combustible fibres, flammable liquids, flammable vapours, flammable gases, flammable or combustible fumes) at a concentration capable of being ignited by an ignition source.

Hot work: Work that involves an ignition or heat source.

Ignition source: A source of energy sufficient to ignite combustible dusts, combustible fibres, flammable vapours, flammable gases or flammable or combustible fumes, including:

- naked flame;
- exposed incandescent material;
- hot surfaces;
- radiant heat;
- spark from mechanical friction;
- spark from static electricity;
- electrical arc; and
- any electrical, electronic, mechanical or other equipment.

Incident: Any occurrence that involved dangerous goods that caused or, but for intervening events, could have caused:

- death, unreasonable bodily injury or unreasonable harm to the health of an individual; or
- significant and unreasonable damage or harm to property or the environment.

Incompatible: Substances that are not compatible. See *compatible*.

Intermediate bulk container (IBC): A rigid or flexible portable packaging for the transport of dangerous goods that:

- has a capacity of not more than
  - 1,500 L for solids of Packing Group I packed in a composite, fibreboard, flexible, wooden or wooden container
  - 3,000 L for solids of Packing Group I packed in a metal container
  - 3,000 L for solids or liquids of Packing Groups II and III;
- is designed for mechanical handling; and
- is resistant to the stresses produced in usual handling and transport.

Lower explosive limit (LEL): The lowest concentration of flammable gas or vapour capable of causing that substance to be ignited by an ignition source.

Operator: The legal entity with responsibility for a dangerous goods site. This would normally be the licensee or the operator if the site was not licensed.

Package: The complete product of the packaging of dangerous goods, consisting of both the goods and their packaging. Packaging is the container in which the goods are received or held for transport, and includes anything that enables the container to receive or hold the goods or to be closed. When provided for use at a place of work, packaging is an item of plant

Packaged dangerous goods: These include:

- dangerous goods or C1 combustible liquids in a container that has a capacity of not more than 500 L; and
- dangerous goods in a container that has a net mass of not more than 500 kg.

Packing Group (PG): The Packing Group is allocated to the dangerous goods under the ADG Code. Commonly abbreviated, this is a classification assigned to some classes of dangerous goods based on the degree of hazard — I being the highest and III the lowest level of hazard. It does not apply to gases.

Person: An individual, corporation or body corporate.

Petroleum product: A single substance or mixture of substances:

- comprising at least 70% hydrocarbon by volume refined from crude oil, with or without additives;
- that is used or could be used as a fuel; and
- is liquid at a temperature of 15°C and pressure of 101.325 kPa, and includes C1 combustible liquids

Pipework: A pipe, assembly of pipes or pipeline and associated pipe fittings, valves and pipe accessories used to convey dangerous goods.

Plant: Any machinery, equipment, scaffolding, pipework, appliance, implement and tool, any component of it and anything fitted connected or appurtenant to it.

Protected work: Any of the following:

- dwelling, residential building, place of worship, public building, school or college, hospital, theatre, and any building or open area in which persons are accustomed to assemble whether it is within or outside the property boundary of the installation;
- factory, workshop, office, store, warehouse, shop or building where persons are employed that is outside the property boundary of the installation;
- ship lying at permanent berthing facilities; and
- any storage facility for dangerous goods outside the property boundary of the installation, except for those defined as minor storages in Australian Standards on dangerous goods storage and handling.

Public place: Any place other than private property, open to the public, that the public has the right to use, including public roads.

Risk: In relation to people, this is the probability of dangerous goods causing the death of, unreasonable injury to, or unreasonable harm of, one or more individuals.

In relation to property or the environment, this is the probability of dangerous goods causing unreasonable damage or harm to property or the environment.

Risk assessment: In relation to the dangerous goods site, a document that:

- identifies all hazards relating to dangerous goods at the site;
- for each hazard, assesses
  - probability of the hazard causing a dangerous goods incident
  - nature of the harm to people, property and the environment that would result from the occurrence of that incident;
- for each hazard, identifies the risk control measures;
- in relation to each judgment required above, explains the methods used to make the judgment and the reasons for the judgment; and
- has been prepared in a form acceptable to the Chief Officer;

Rural dangerous goods location: A place:

- outside the part of the State that comprises the metropolitan region as defined in the *Planning and Development Act 2005* section 4(1) or a townsite as defined in the *Land Administration Act 1997* section 3(1);

- with an area of 5 ha or more;
- used by the operator for agricultural, horticultural, floricultural, aquacultural or pastoral purposes; and
- where there are dangerous goods or combustible liquids being stored for the purposes other than resale.

Segregation: Separation or isolation from other substances (including dangerous goods).

Separation: Physical parting or isolation of dangerous goods from a person, property or thing, either by distance or a physical barrier. See also *segregation*.

Small quantity dangerous goods location: A place where dangerous goods are stored or handled in quantities that do not exceed those specified in the column headed 'Placarding Quantity' in Schedule 1 of the Storage and Handling Regulations.

Storage or handling system: A container, plant, pipework or any other thing that can contain dangerous goods.

Subsidiary risk: A secondary hazard of a substance or article as assigned by the ADG Code, the primary hazard being indicated by the class.

Tank: A container, other than an IBC, used or designed to be used to transport or store dangerous goods in the form of a gas or liquid in bulk, including fittings, closures and any other equipment forming part of the container.

Transfer: The movement of dangerous goods from place to place within a site or into or from a container or package, including pumping, dispensing and decanting.

Transport: Includes:

- packing, loading and unloading of dangerous goods, and transfer of the goods to or from a road vehicle or rail wagon, for the purpose of their transport;
- marking of packages and unit loads containing dangerous goods, and placarding of containers, vehicles and rail wagons in which dangerous goods are transported; and
- other matters incidental to transport

Vehicle: Any thing capable of transporting people or things by road, rail or water, including a hovercraft — it does not matter how the thing is moved or propelled.

Water capacity: The total internal volume of a container in litres of water measured at a temperature of 15°C.

The volumes of gas containers are usually measured in terms of water capacity. The reference to litres in relation dangerous goods of Class 2 means the water capacity of the container that holds those dangerous goods.

Worker: Any person working or engaged in the storage or handling of dangerous goods at a particular site.

Appendix 2 — Indication of compatibility based on class

In the absence of more detailed compatibility information about specific products (which should be available from MSDS), this appendix may be used for guidance as to compatibility between the classes of dangerous goods.

Class / Division		2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	8	9
2.1	Flammable gas	A	E	C	B	B	D	B	D	D	C	B	B
2.2	Non-flammable non-toxic gas	E	A	B	E	E	E	E	B	E	B	B	B
2.3	Toxic gas	C	B	A	C	C	C	C	C	C	B	B	B
3	Flammable liquid	B	E	C	A	B	D	B	D	D	C	B	B
4.1	Flammable solid	B	E	C	B	A	D	B	D	D	C	B	B
4.2	Spontaneously combustible	D	E	C	D	D	A	B	D	D	C	B	B
4.3	Dangerous when wet	B	E	C	B	B	B	A	D	D	C	D	B
5.1	Oxidising agent	D	B	C	D	D	D	D	A	D	F	D	F
5.2	Organic peroxide	D	E	C	D	D	D	D	D	G	F	D	F
6.1	Toxic	C	B	B	C	C	C	C	F	F	A	B	B
8	Corrosive	B	B	B	B	B	B	D	D	D	B	G	B
9	Miscellaneous dangerous goods	B	B	B	B	B	B	B	F	F	B	B	A

Note: In this table, combustible liquids should be included with Class 3.

A *Most dangerous goods of the same class have similar primary hazards and are usually considered to be compatible.*

B *With a few exceptions, which should be indicated on MSDS, goods of these two classes are usually non-reactive with each other. However, in an emergency such as a spill, leak or fire, the presence of the second class may lead to different hazards or increased risk such that additional control measures are required.*

C *While goods of these two classes are usually non-reactive with each other, a fire involving the fire risk goods may lead to the release of large clouds of toxic gases or vapours.*

D *Goods of these two classes are likely to interact with each other in such a way as to significantly increase risk. In some cases, interaction may result in fire or evolution of toxic vapours. For those that do not interact, a fire involving one may be violently accelerated by the presence of the other. These classes should not be kept in the same area unless it can be demonstrated that the risks are fully controlled.*

E *If the Division 2.2 has a Subsidiary Risk 5.1, then this is **D**, otherwise it is **B**.*

F. *If the Division 6.1 or 9 is a fire risk substance, then this is **D**, otherwise it is **B**.*

G. *If one material is a concentrated, strong acid and the other is a concentrated, strong alkali, then this is **D**, otherwise it is **A**.*

Appendix 3 — Sample emergency procedures pocket card

This sample emergency procedures pocket card has been designed for a transport depot where dangerous goods are handled. It can be readily be adapted for other premises.

Fire procedures

On hearing alarm:

- Make safe whatever you are doing
- Ensure all roadways and emergency accesses in your area are clear
- Move as quickly as possible to your designated assembly area
- Have your name checked off immediately on arrival
- Watch out for emergency vehicles
- Avoid moving through smoke and any signs of emergency activity
- Follow instructions from area wardens
- Take contractors and visitors with you

If you discover a fire:

- Make sure alarm is raised
- If possible, move materials in danger away from the fire to stop it spreading
- Avoid breathing smoke or fumes
- Fight the fire using extinguisher or hose reel if trained to do so
- If not involved in fire fighting, keep away and go to assembly area

NO HEROICS!

[Company Details]

Site emergency procedures

Emergencies include:

- Fire
- Collision
- Any injury to persons
- Chemical spill or leak
- Any other incident threatening life, health, property or the environment

In any emergency:

- Raise the alarm
- Notify your supervisor
- Warn anyone in danger
- Then give whatever assistance it is safe for you to give
- If not involved with the emergency, keep away from the scene.

NEVER PUT YOURSELF AT RISK

Chemical emergency

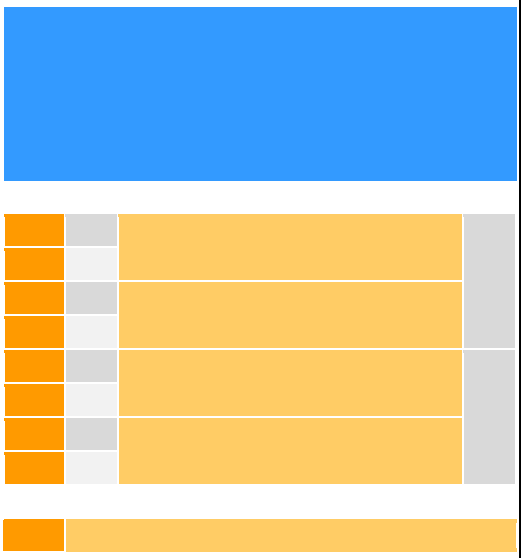
If you discover a dangerous goods or chemical spill or leak:

- Keep away until positively identified
- Keep upwind
- Avoid all contact with material
- Avoid breathing gas, fumes, mist or dust
- Immediately notify supervisor
- Warn nearby persons
- Keep all ignitions sources away
- Assess if it is a serious incident, based on type and quantity of leaking substance
- Raise alarm if serious incident
- Observe HAZCHEM precautions
- Stop leakage if safe to do so
- Prevent spillage from entering drains

Obtain information from:

- Manifest
- Transport documentation
- Labels and placards
- Emergency procedure guide or HB76
- MSDS

HAZCHEM emergency action code



Additional Information

DRY AGENT
Water **must not** be allowed to come into contact with the substance at risk.

ALCOHOL RESISTANT FOAM •2 or •3
Alcohol resistant foam is the preferred medium. If not available:
•2 – use fine spray or water fog
•3 – use normal protein foam

V Substance can be violently or even explosively reactive, including combustion.

LTS Liquid-tight chemical protective suit (LTS) with breathing apparatus (**BA**). Full **FIRE KIT** should also be worn for thermal protection if the substance is:
Liquid oxygen
or Liquefied toxic gas (Division 2.3)
or Toxic gas with sub-risk 2.1 or 5.1
or Class or sub-risk 3
or Division 5.1 PGI with sub-risk 6.1 or 8 carried at temperature >100^{o}C

DILUTE May be washed to drain with large quantities of water.

CONTAIN Prevent, by any means available, spillage from entering drains or water course.

E People should be warned to stay indoors with all doors and windows closed, but evacuation may need to be considered. Consult Control, WA Police and product expert.

Appendix 4 — Example of system for ranking risks

This appendix illustrates methods that may be used to rank risks relative to each other. There are many other methods that are available that range in complexity from relatively simple qualitative methods to very sophisticated quantitative methods.

The level of risk (R) can be determined from estimates of:

- likelihood of harm occurring (L); and
- consequence or degree of harm (C) arising from an incident involving, or exposure to, hazardous chemicals.

Using a formula based on two factors

Assigning L and C

Values are assigned to the likelihood (L) and consequence of harm (C) arising from the handling of the dangerous goods using the tables for L and C below.

likelihood of harm (L)		
L	**Likelihood**	**Description**
0	Totally eliminated	Zero
1	Highly unlikely	Could happen, but improbable
2	Unlikely	Remote, could happen but rarely
3	Likely	Could happen occasionally
4	Certain	Could happen frequently
5	Imminent	More than once a year

Consequence or degree of harm (C)						
C	**Potential consequence**	**Offsite / public persons**	**Onsite persons**	**Community damage & disruption**	**Onsite damage**	**Off-site environment damage**
1	Minor	Slight injury / first aid treatment	Slight injury / first aid treatment	No disruption or damage	No damage No interruption to operations No financial loss	Damage *is not* environmentally significant
2	Moderate	Medical treatment – immediate recovery Hospitalised less than 24 hours	Medical treatment – immediate recovery Hospitalised less than 24 hours Restricted work or lost work less than 4 days	Disruption to essential utilities / road closures / evacuation for up to 7 days	Slight damage. Short-term interruption to operations: less than 24 hours. Minor financial loss	Damage *is not* environmentally significant

3	Significant	Multiple injuries – several people impaired Hospitalised more than 24 hours Delayed symptoms	Multiple injuries – several people impaired Hospitalised more than 24 hours Delayed symptoms	Disruption to essential utilities / road closures / evacuation for up to 30 days	Localised damage Medium term interruption to operations: 1-7 days Moderate financial loss	Damage *is* environmentally significant
4	Major	1 to 3 fatalities or permanent total disabilities	1 to 3 fatalities or permanent total disabilities	Disruption to essential utilities / road closures / evacuation more than 30 days Major damage to offsite private property Private dwellings offsite damaged but still inhabitable	Major damage Prolonged interruption to operations – 1 to 12 weeks Major financial loss	Damage *is* environmentally significant Will recover in *more* than 20 years
5	Catastrophic	More than 3 fatalities or permanent total disabilities	More than 3 fatalities or permanent total disabilities	Disruption to essential duties / road closures / evacuation for more than 90 days Major damage to offsite private property Private dwellings offsite damaged and uninhabitable	Extensive damage Long-term interruption to operations – more than 12 weeks Large financial loss	Damage *is* environmentally significant Extends to *more* than a 500 metre radius around the incident site / facility Will recover in *more* than 20 years

Calculating R and determining priority for action

A calculation is then made of the degree of risk ®, where the level of risk is

R = L (likelihood) x C (consequence)

Using the assessment of the level of risk, the priority for action is given in the following table.

Level of risk (R = L x C)		
R	**Level of risk**	**Priority for action**
1-2	Low	4. Schedule for action after other risks
3-4	Medium	3. Schedule for action after other risks
5+	High	2. Immediate action required
10+	Very high (unacceptable)	1. Shutdown unless additional controls instigated immediately

Using a table based on two factors

Using the same two factors used above (i.e. likelihood and consequence of harm), the degree of risk can be calculated using the table below.

Select L and C

Select the most relevant descriptions of likelihood and consequence from those shown down the left hand side and across the top of the table, respectively.

	Consequence				
Likelihood of harm ↓	**Catastrophic** Fatality Major damage beyond premises	**Major** Permanent injury Major fire, damage or total loss of containment	**Significant** Hospital in-patient treatment Significant fire, damage, loss of containment	**Moderate** Medical treatment Minor fire, damage, loss of containment	**Minor** Negligible fire, damage or loss of control
Highly likely	**Very high**	**Very high**	**High**	**Medium**	**Medium**
Likely	**Very high**	**High**	**Medium**	**Medium**	**Low**
Unlikely	**High**	**Medium**	**Medium**	**Low**	**Very low**
Highly unlikely	**Medium**	**Medium**	**Low**	**Very low**	**Negligible**

Ascertaining R

The estimated level of risk is then read from the table.

Determining priority for action

The priorities for action are listed below.

Very high	Shutdown unless additional controls instigated immediately
High	Immediate action required
Medium	Further improvement required
Low	Schedule for action
Very low / Negligible	Lowest priority

Appendix 5 — Permanent decommissioning of underground petroleum product storage tanks

General requirements

This appendix details the minimum operational standards for all personnel dealing with the permanent decommissioning of underground petroleum product (any flammable or combustible liquid hydrocarbon, including petrol and diesel fuel) tanks.

Australian Standard AS 4976:2008 *The removal and disposal of underground petroleum storage tanks* is the approved code of practice for information on how to comply with regulation 63 of the Storage and Handling Regulations regarding the cleaning of decommissioned storage and handling systems to make them safe. It should also be consulted for all issues surrounding the decommissioning of underground petroleum product tanks, whether temporary or permanent.

Options for permanent decommissioning

AS 4976:2008 sets out procedures for the removal, transport, storage and off-site disposal of underground tanks. It also describes procedures for the abandonment of tanks in-situ where removal is not feasible.

There are two acceptable methods for the permanent decommissioning of a tank after making it safe:

- remove the tank to a disposal site; and
- abandon the tank in-situ.

Timing of decommissioning

The process to permanently decommission a tank should be implemented as soon as the operator of the dangerous goods site has decided that the tank has no further use or it is realised that the tank is leaking. Doing nothing is not an option. Prompt decommissioning is important because disused, nominally “empty” tanks present the hazards listed below.

- A disused tank is likely to contain an explosive atmosphere of flammable vapour. It could explode if an unsuspecting person introduces an ignition source at some time in the future, especially if the site changes hands without records of the tanks having been kept. In the past, disused underground tanks have exploded and caused fatalities when power tools were used to cut into them.
- A disused tank will corrode over time and could fail, causing the collapse of adjacent structures or buildings.
- A nominally “empty” tank can float upwards due to external water pressures and “pop out” of the ground, causing damage to adjacent structures.
- Resources Safety considers out-of-service periods for disused tanks exceeding two years to be unacceptable. Except in unusual circumstances, such tanks should already have been permanently decommissioned.

Decommissioning process

Rendering tanks permanently safe should only be undertaken by people specialising in the installation, maintenance and decommissioning of underground petroleum product tanks, and the process must be done in accordance with AS 4976:2008. A list of appropriate contractors is available from the Petroleum Industry Contractor's Association (www.pica.net.au).

Prior to decommissioning works proceeding, the operator should ensure that documented work instructions and all relevant work permits have been issued to the contractor.

Notifications

Following the decommissioning of tanks at licensed dangerous goods sites, Resources Safety must be notified to amend the dangerous goods site licence. The following details are required:

- dangerous goods site licence number;
- number, size and location of tanks decommissioned; and
- the responsible person to confirm compliance with AS 4976:2008.

In accordance with the Storage and Handling Regulations, adjustments to the dangerous goods manifest and site plan will be necessary, and the amended documents kept on-site. A written record must be made of the details of the decommissioned tank.

The Department of Environment and Conservation should be contacted if soil contamination is suspected.

Removal of tanks

If a site ceases to be used for petroleum product storage, all tanks should be removed for disposal off-site in compliance with section 5 of AS 4976:2008. Section 5 includes the procedures for the removal of tanks and their off-site and on-site purging. It also deals with transport issues. Where the tank has not been gas-freed, the Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007 and ADG Code apply.

Details of the disposal of used tanks and tank material are given in section 8 of AS 4976:2008

Abandonment of tanks in-situ

It is preferable for disused underground petroleum product storage tanks to be removed from the ground but this is not always practicable. For example, there could be engineering constraints because of the close location of the tank to buildings, structures and underground services, and advice from a chartered structural or civil engineer may be required.

If it is not practicable to remove the underground tank or petroleum product storage system, and in-situ abandonment is considered to be the only viable option, then a suitably competent and experienced person must ensure that the abandonment procedure complies with section 4 of AS 4976:2008. This includes pumping out as much product as possible, purging the tank of petroleum product vapours and then filling it with a free-flowing inert solid such as dry sand, fine gravel or slurry of concrete.

The owner of an underground tank abandoned in-situ must retain a record of its size, description and location. As per section 7 of AS 4976:2008, the record must be maintained indefinitely and passed on to any subsequent owner of the site.

Appendix 6 — Sample manifest form

Dangerous goods and combustible liquids manifest Date prepared/updated: 12/06/08

1. General information

Operator: ABC Chemicals Pty Ltd

Address of site: Lot888 Jumpstart Road, Kentstone WA 6888

Site plan number: ABC001

2. Emergency contacts

Name	Position	Telephone	
P J Brown	CEO	B/H 131888	A/H 0444 222 111
J Russell	Production Manager	B/H 131888	A/H 0444 333 222
BD Barkley	Chief Chemist	B/H 131888	A/H 0444 555 777

3. Summary information about classes of dangerous goods

Class	Packing Group	Maximum quantity
2.1	NA	3,000 L
3	II	52,000 L
3	III	36,075 L
4.1	I	50 kg
5.1	II	18,000 L
6.1	III	15,000 kg
8	II	14,100 L
C1	NA	29,000 L

4. Bulk dangerous goods stores

Tank ID no.	Dangerous goods					Tank	
	Name	Class	Sub risk/s	UN no.	PG	Type	Capacity
DG T1	Petrol	3	n/a	1203	II	u/g	30,000 L
DG T2	Combustible liquid	C1	n/a	n/a	n/a	u/g	29,000 L
DG T3	LP gas	2.1	n/a	1075	n/a	a/g	3,000 L
DG T4	Hydrogen peroxide	5.1	8	2014	II	a/g	18,000 L

Key: u/g — underground; a/g — above ground; n/a — not applicable

5. Packaged dangerous goods stores

5.1 Packaged dangerous goods of Packing Group I or Division 2.3

Storage location	Dangerous goods					Quantity	
	Name	Class	Sub risk	UN no.	PG	Average	Maximum
PS1	Sodium cyanide	6.1		1689	I	20 kg	50 kg

Key: PG – packing group

5.2 Other packaged dangerous goods

Storage location	Class	Sub risk(s)	Packing Group	Average quantity	Maximum quantity
PS2	6.1		III	10,000 kg/L	15,000 kg
PS3	3		II	15,000 L	20,000 L
	3		III	15,000 L	25,000 L
	3	8	III	600 L	1,000 L
	C1			15,000 L	20,000 L
PS4	8		II	8,000 kg/L	12,000 L

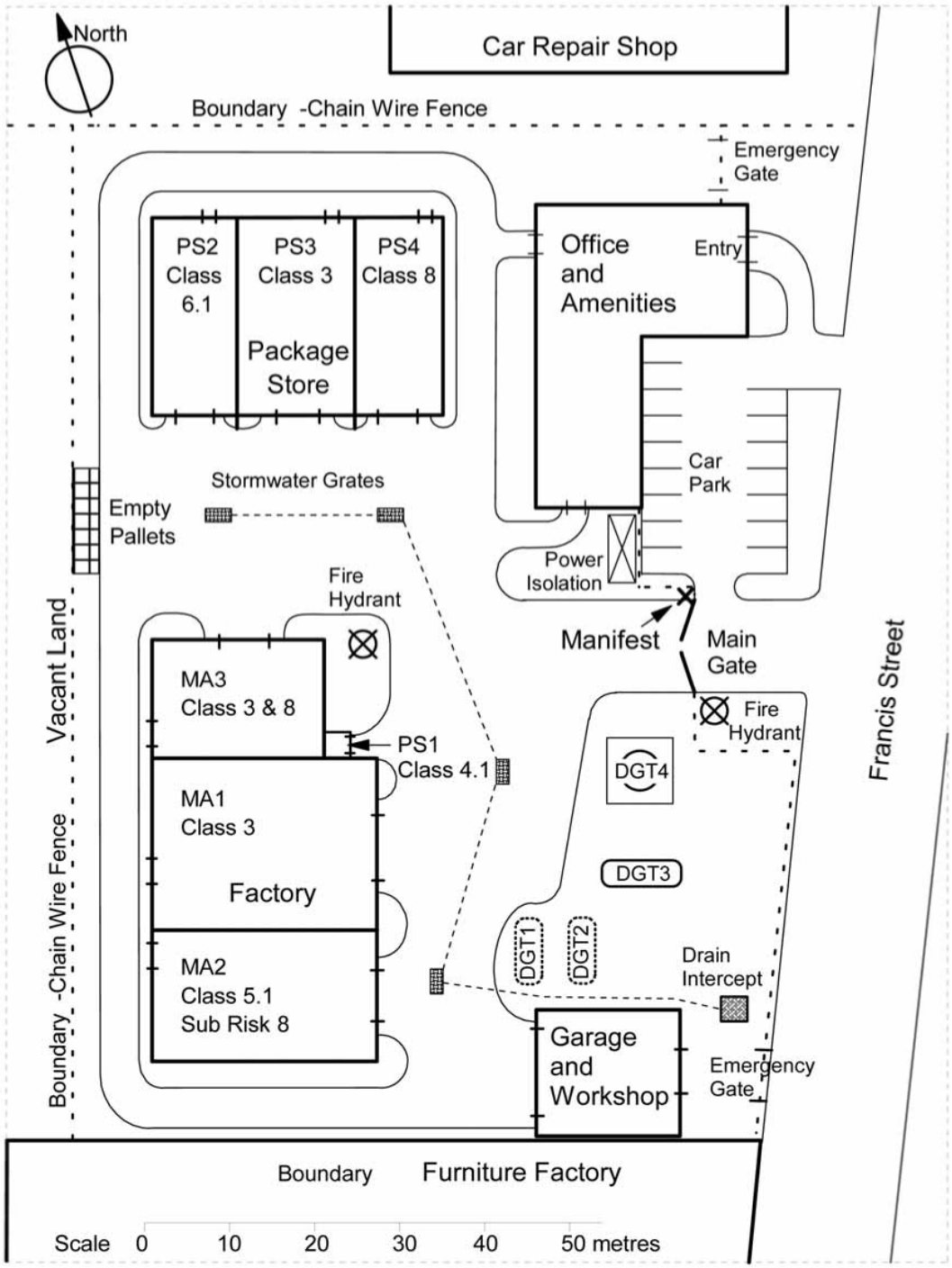
6. Dangerous goods in manufacture or process

Location	Class or division	Maximum quantity
MA1	3	2,000 L
	3	10,050 L
	C1 combustible liquid	2,000 L
MA2	5.1	1,500 L
MA3	3	200 L
	3	25 L
	8	100 L
	8	2,000 L

7. Dangerous goods in transit (i.e. dangerous goods loaded on vehicles)

Loaded vehicles are not kept at the site.

8. Site plan



ABC Chemicals Pty Ltd
Lot 888 Jumpstart Road
KENTSTONE WA 6888
Date prepared: 12 June 2008
Plan no.: ABC001

Legend

PS Package stores
MA Factory manufacturing areas
DGT Storage tanks areas