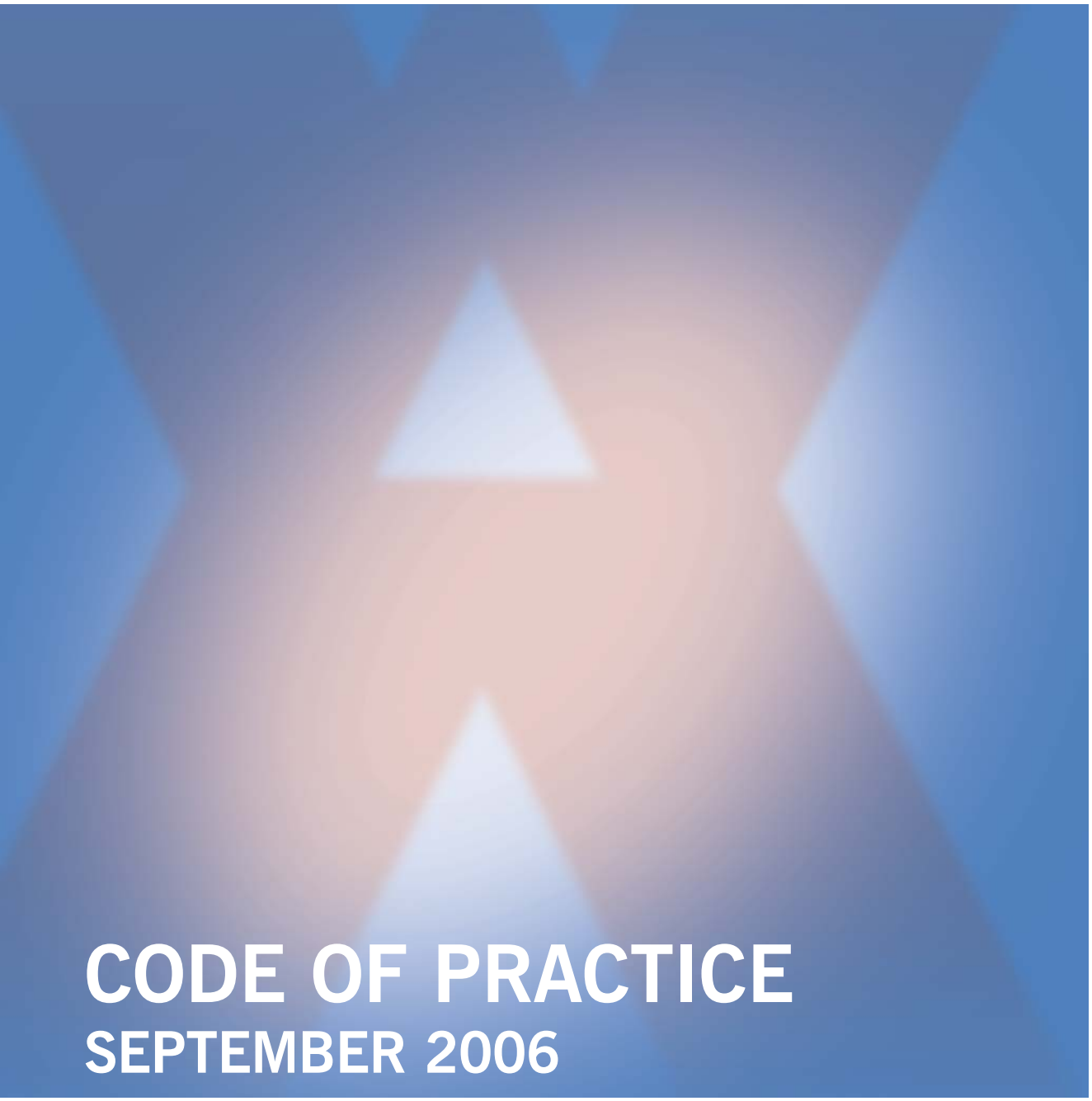
WorkCover
NEW SOUTH WALES

SAFE USE
OF BULK SOLIDS CONTAINERS AND FLATBED STORAGE INCLUDING SILOS, FIELD BINS AND CHASER BINS



CODE OF PRACTICE
SEPTEMBER 2006

WHAT IS AN APPROVED INDUSTRY CODE OF PRACTICE?

An approved industry code of practice is a practical guide to employers and others who have duties under the *Occupational Health and Safety Act 2000* (the OHS Act) and the *Occupational Health and Safety Regulation* (OHS Regulation) with respect to occupational health, safety and welfare.

An industry code of practice is approved by the Minister administering the OHS Act. It comes into force on the day specified in the code or, if no day is specified, on the day it is published in the *NSW Government Gazette*. An approved industry code of practice may be amended from time to time (or it may be revoked) by publication in the Gazette.

An approved industry code of practice should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare at work is being followed.

An approved industry code of practice is intended to be used in conjunction with the requirements of the OHS Act and the OHS Regulation but does not have the same legal force. An approved industry code of practice is advisory rather than mandatory. However, in legal proceedings under the OHS Act or OHS Regulation, failure to observe a relevant approved industry code of practice is admissible in evidence concerning an offence under the OHS Act or OHS Regulation.

A WorkCover Authority inspector can draw attention to an approved industry code of practice in an improvement or prohibition notice as a way of indicating the measures that could be taken to remedy an alleged contravention or non-compliance with the OHS Act or OHS regulation. Failure to comply with an improvement or prohibition notice without reasonable excuse is an offence.

In summary, an approved **industry code of practice:**

- ✓ gives practical guidance on how health, safety and welfare at work can be achieved
- ✓ should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare in the workplace is being followed
- ✓ can be referred to in support of the preventive enforcement provisions of the OHS Act or OHS Regulation
- ✓ can be used as evidence to support a prosecution for failing to comply with or contravening the OHS Act or OHS Regulation.

FOREWORD

Bulk storage containers, such as silos, field bins and chaser bins, and their ancillary bulk handling equipment, are important to operations in a range of industries including agriculture. Bulk containers are used in many industries to store a range of substances such as cement dust, blue metal, plastic pellets, farm products and fertilizer. However they can also be the source of many injuries. Examples are deaths caused by falls, entrapment in grain, asphyxiation, fires and explosions.

This code of practice is intended to help prevent injuries in the use of bulk storage containers and flatbed storage. It outlines typical hazards associated with such storage, and describes means of eliminating or controlling the risks arising from those hazards. Experience has shown that risks are associated with structural collapse, access and entry into a bulk container, lack of fall protection, electrical safety, and the dangerous nature of the stored substance. Risks also arise from the use of ancillary plant, such as augers. The code shows how to deal with these issues through a planned risk management approach, in a manner relevant to each particular work situation.

This will help users of bulk containers comply with their obligations under the *Occupational Health and Safety Act 2000* and the *Occupational Health and Safety Regulation 2001*.

Persons implementing this code of practice should take into account the varying needs for bulk containers and storage areas of different size and construction when applying risk management principles. For example, many on-farm silos are smaller, made of steel and filled by augers, while the concrete silos used at grain terminals are larger, may have several work levels, stairways and bucket conveyors. Risks that vary with the nature of the stored substance will also need to be considered. For example, experience has shown that fires and explosions are a risk in the seed oil and stock feed industry.

This code of practice does not cover health and safety during the actual work of manufacturing, constructing or installing bulk containers, nor the safety and legal requirements when field and chaser bins are towed on public roads.

Advice on safe design is provided in the *Code of practice: Safety aspects in the design of bulk solids containers, including silos, field bins and chaser bins*, which replaces the 1991 *Code of practice: Safety aspects in the design, manufacture and installation of on-farm silos and field bins*, which has been revoked.

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CHAPTER 1 – Establishment

1.1 Title

This is the *Code of practice for the safe use of bulk solids containers and flatbed storage including silos, field bins and chaser bins*.

1.2 Purpose

The purpose of this Code of practice is to prevent injuries by providing practical guidance for the safe use of all types of bulk containers (including silos, field bins, and chaser bins), flatbed storage, and ancillary plant.

1.3 Scope

1.3.1 Matters included

This Code of practice applies to the use of any bulk container, flatbed storage, and ancillary plant, used for the storage or handling of a solid substance (such as an industrial material or product, crop, forage, or stock feed), at all places of work (except mines) in NSW.

This code of practice applies to the following:

- bulk containers exceeding 4 tonne or 4 cubic metre capacity;
- flatbed storage exceeding 40 tonne or 40 cubic metre capacity.

Silos, field bins, chaser bins and hoppers are examples of bulk containers where they exceed the above capacities.

1.3.2 Exclusions

This code of practice does not apply to the following:

- Bulk containers used to contain fluids
- Health and safety during the process of manufacture, construction, installation of a bulk container or making an electrical connection
- Bulk containers used primarily for transport on public roads, by rail, air or sea
- Bulk containers of coal.

1.3.3 Additional relevant standards for dangerous goods storage

Advice for the storage of dangerous goods (other than class 4.2) is provided in Australian Standards specific to the class and type of dangerous goods.

1.4 Authority

This is an industry code of practice, approved by the Minister for Commerce under section 43 of the *Occupational Health and Safety Act 2000,* on the recommendation of the WorkCover Authority.

1.5 Commencement

This code takes effect on 29 December 2006; three months after the day of publication in the *Government Gazette*.

1.6 Repeal of 1991 code of practice

The *Code of practice: Safety aspects in the design, manufacture and installation of on-farm silos and field bins*, published in the Government Gazette on 2 August 1991, and which commenced on 2 August 1992, has been revoked as provided by section 45 of the *Occupational Health and Safety Act 2000*. The design, manufacture and supply of bulk containers is covered by the *Code of practice: Safety aspects in the design of solids bulk containers including silos, field bins and chaser bins*.

1.7 Definitions

The following definitions are mostly taken from the OHS Act or the OHS Regulation, or from other relevant legislation or Australian Standards. Where a definition was developed specifically for this code of practice, this is indicated in a note.

The following terms used in this code of practice have these meanings:

auger means a screw type conveyor.

bulk means more than 4 tonne (net), or more than 4 cubic metre of a substance, not in individual packages.

Note: this definition has been developed for this specific code of practice.

chaser bin means a mobile bulk container that has all of the following features:

- usually towed by a hauling vehicle when being loaded
- primarily used for receiving mechanically harvested crops
- normally unloaded by mechanically tilted means or by an auger.

Note: this definition has been developed for this specific code of practice.

competent person for any task means a person who has acquired through training, qualification or experience, or a combination of them, the knowledge and skills to carry out that task.

confined space, in relation to a place of work, means an enclosed or partially enclosed space that:

(a) is not intended or designed primarily as a place of work, and

(b) is at atmospheric pressure while persons are in it, and

(c) may have an atmosphere with potentially harmful contaminants, an unsafe level of oxygen or stored substances that may cause engulfment, and

(d) may (but need not) have restricted means of entry and exit.

Examples of confined spaces are as follows:

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

(b) open topped spaces such as pits or degreasers,

(c) pipes, sewers, shafts, ducts and similar structures,

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

Note: The interiors of other types of bulk containers may be confined spaces depending on the contents and atmosphere.

container means any type of container intended for the storage or handling of a solid substance in bulk (such as an industrial material or product, crop, forage, or stock feed), usually fitted with a discharge outlet; and includes a silo, field bin, or chaser bin, but does not include flatbed storage.

Note: this definition has been developed for this specific code of practice.

conveyor means an apparatus or equipment operated by any power other than manual power, by which loads are raised, lowered, or transported, or capable of being raised, lowered, or transported or continuously driven by:

a) an endless belt, rope or chain or other similar means, or

b) buckets, trays or other containers or fittings moved by an endless belt, rope, chain or other similar means, or

c) a rotating screw, or

d) rollers;

and includes the related supporting structure and auxiliary equipment used in connection with the conveyor.

Note: This includes an auger, and a vibration or walking beam.

dangerous goods has the same meaning as in the *Australian Code for the Transport of Dangerous Goods by Road and Rail* approved by the Australian Transport Council and published by the Australian Government from time to time.

Note: Sections 10.2.4 and 10.2.5 provide more information on relevant dangerous goods classifications.

field bin means a temporarily located bulk container that has all of the following features:

- intended for the storage of substance such as granular crops and stock feed
- equipped with discharge outlets
- capable of being emptied by gravity, mechanical or pneumatic means
- equipped with fixed, retractable or removable wheels for the purpose of towing it from one location to another.

Notes: Field bins are also called relocatable, moveable or portable silos. Tip trucks are excluded by the operation of the scope section 1.3.2, which excludes containers primarily designed for road transport. This definition has been developed for this specific code of practice.

flatbed storage means a single level building or other structure designed for the storage of solids in bulk of more than 40 tonnes.

Note: this definition has been developed for this specific code of practice.

guard means a device that prevents or reduces access to a danger point or area.

hazard means anything (including work practices or procedures) that has the potential to harm the health or safety of a person.

hatch means a cover or a door over an opening in a bulk container.

individual packages means any form of package or container of less than 4 tonnes and less than 4 cubic metres, and includes bags, cartons and drums.

Note: this definition has been developed for this specific code of practice, for the purpose of defining scope.

manufacture plant includes assemble, install, or erect plant.

manufacturer of plant includes an employer or self-employed person who manufactures plant for his, her or its own use at work.

Note: Importers must ensure that the duties of the manufacturer and designer are met for the containers they import.

manufacturer's instructions means the manufacturer's, designer's or importer's instructions, recommendations and specifications, provided by the supplier.

Note: Where any of these instructions, recommendations or specifications are not available, they should be drawn up by a competent person. Suppliers have a duty to pass this information on to users of plant.

must indicates a mandatory requirement (that is, a requirement of an Act or Regulation).

OHS Act means the *Occupational Health and Safety Act 2000*.

OHS Regulation means the *Occupational Health and Safety Regulation 2001*.

place of work means any place where persons work.

Note: Relevant examples include any premises, any installation on land or any moveable structure where people work.

plant includes any machinery, equipment or appliance.

Note: Relevant examples of plant include silos, field bins, chaser bins, augers, bucket elevators, electrical devices, conveyors, and aerating and drying equipment.

reasonably practicable – see advice in appendix 4, section A4.7.

risk means the likelihood of an injury or illness occurring and the likely severity of the injury or illness that may occur.

should indicates a recommendation.

Note: Such recommendations are evidence in any proceedings for an offence against the OHS Act or OHS Regulation in accordance with section 46 of the OHS Act.

silo means a container that has all of the following features:

- located in a fixed position
- equipped with discharge outlets
- capable of being emptied by gravity, mechanical or pneumatic means.

Notes: This definition has been developed for this specific Code of practice. Relocatable, moveable or portable silos are referred to as field bins for the purposes of this code of practice.

storage means the containment of any substance in any manner, such as in a container or other form of storage such as flatbed storage.

Note: This definition has been developed for this specific code of practice.

use in relation to a bulk container or flatbed storage, means all aspects of use and storage, and includes (without limitation) to work from, operate, maintain, inspect, clean and use as storage.

Note: This definition has been developed for this specific code of practice.

CHAPTER 2 – Planning to manage risks

A summary of legal duties is provided in Appendix 4, including how the law applies to various parties. This chapter focuses on applying risk management principles and planning to work with containers and in storage areas.

2.1 Risk Management principles with bulk containers and storage

'Risk management' is a way of organising your efforts to determine safe systems of work. Following this procedure will help you identify safety issues unique to the nature of your particular workplace. Checklists are provided in appendix 2 to assist with this process.

2.1.1 Steps in risk management

To carry out risk management, go through the following steps:

1. Identify all hazards associated with work processes, plant, substances, work environment, layout and condition, and any other factors that may affect safety. This includes the dangerous goods classification (if any) of the container contents, and any dust or gas hazards that may arise from the nature of the stored substance.
2. Assess the risks, which is a combination of the likelihood and the severity of any harm that the hazards might give rise to. It helps to prioritise them so that the most serious ones can be addressed first. This should include an evaluation of the existing control measures.
3. Eliminate or reduce the risk(s) identified in step 2, applying the hierarchy of control measures (detailed below in section 2.2).
4. Monitor and review the control measures to ensure they are working, and to respond to changes in work practices or other conditions in the workplace. Supervision is essential to ensure workers follow correct practices.

The first 3 steps must be carried out before work commences – this Code will help you do this. Employers must consult with employees when carrying out these steps – see 2.1.3 below.

Use this approach when applying this code of practice and developing safe systems of work.

2.1.2 Key risks to assess with bulk containers and storage

Experience indicates that the possibility of the following risks should be included in the risk assessment, where relevant to the type of storage:

- falls from heights (including falls into the container)
- engulfment or entrapment by stored substance
- entry into confined spaces
- fires and explosions resulting from the nature of the stored substance
- structural collapse of the container
- electrical shocks (eg from faulty equipment, proximity to overhead power lines)
- ancillary bulk handling facilities, plant and equipment (such as augers or conveyors)
- associated delivery of the substance to be stored in relation to the movement of transport (eg trucks or loaders) and other plant (such as augers or loaders)

- entrapment and other hazards due to the lack of safe isolation procedures for plant and processes
- children playing on or near plant or equipment.

The above list is not exhaustive and all risks must be considered (eg manual handling risks). Note that if the contents are classified as dangerous goods or hazardous substances then specific provisions of the OHS Regulation will also apply.

An analysis of the hazards and risks with the particular type of bulk containers in your workplace will indicate which sections of this code of practice are relevant. For example, some aspects of this code may not be relevant to flatbed storage. A systematic application of risk management should indicate relevant control measures, using this code as a guide.

With flatbed storage, this would include factors relating to:

- wall strength
- self-heating leading to fires
- fire fighting measures
- access to storage areas
- using associated plant such as front end loaders.

If monitoring and reviewing indicates ongoing problems, this could indicate a need to redesign the relevant aspect of the container or storage area.

Hazards and risks as identified and reasons for selecting controls should be written down in a suitable form, including the reasons why it is not reasonably practicable to apply ones higher in the hierarchy of control. The lists in *Appendix 2* are checklists that will help with some common hazards and risks, and the possible control measures. These lists are not exhaustive – you may find other risks that are relevant in your workplace.

Further guidance on risk management can also be found in WorkCover's *Workplace Safety Kit*, *Small Business Safety Starter Kit*, and in general terms in the *Code of practice on Risk Assessment.*

2.1.3 Consulting with employees about risk management and implementing this code of practice

Whenever employers undertake a risk assessment or consider the control measures that can be adopted to eliminate or minimise risks, they must consult with employees as part of this process and take their views into account.

As examples, consultation should take place when carrying out the following:

- Evaluating the safety issues as part of the process of purchasing and installing a bulk container. This includes such matters as the safety features of the container, its location and compatibility with other plant or equipment in the workplace.
- Developing safe work procedures for related work tasks such as loading, unloading and using bulk handling equipment.
- Developing inspection and maintenance procedures.
- Developing emergency procedures to address risks such as fires, explosions or entrapment.
- Investigating accidents or safety incidents (such as 'near misses') that may arise.
- Considering modifications to the container or ancillary plant.
- Considering any other changes based on implementing this code of practice.
- Assessing training needs.

When undertaking consultation employers should share all relevant safety information with employees, including:

- safety information provided by the manufacturer or supplier
- health and safety issues that may arise from the installation and use of bulk containers
- how you intend to address safety issues.

Employees should be given sufficient time to consider this information and discuss any issues they may have with their employer.

Examples of particular topics to discuss during consultation include the following:

- Selection of suitable Personal Protective Equipment (PPE), when determined to be a control measure.
- Best ways of communicating health and safety information (including providing information to contractors or other workers at the site).
- Effective ways of providing signage.
- Establishing administrative procedures such as hazard and accident reporting.
- Accessing emergency response procedures for the site.
- Coordination with contractors and other workers at the site (eg vehicle drivers loading or unloading).

A suitable method of consultation must be put in place. Further advice on consultation with employees and setting up suitable arrangements is provided in the WorkCover *Code of practice: OHS consultation*. Legal obligations are summarised in appendix 4, section A4.2.

2.2 Preventing injury – elimination of risks and the hierarchy of controls

After identifying the hazards and assessing the risks, the safeguards or work systems that will keep people safe need to be determined. As indicated above, employers must involve employees when making these decisions.

The control measures, including those described in this code of practice, must be considered in terms of the 'hierarchy of control', described in sections 2.2.1 and 2.2.2 below.

2.2.1 Eliminating the risk

The first consideration is to keep people from being exposed to a hazard in the first place. This is called eliminating the risk.

For example, the electrocution risk associated with overhead power lines can be eliminated by either:

- Locating the storage container to eliminate the need to use mobile augers near overhead power lines.
- Installing fixed conveyors rather than using mobile augers.

Elimination of the risk gives the best level of safety, and must be adopted unless it is not reasonably practicable. If elimination is not practicable, then the following hierarchy of controls must be considered. The term 'reasonably practicable' is explained in appendix 4, section A4.7.

2.2.2 Controlling the risk

In the following 'hierarchy of control', the control measures are listed in the order they must be applied. Work thorough the following sequence, starting with (a) which represents the highest level. Select from the highest level where reasonably practicable and develop each control measure for each risk identified.

(a) Substituting the system of work, substance or plant for something less hazardous (eg installing indicators that show the level of substance stored and that can be observed from ground level).

(b) Isolating the hazard (eg restrict access to an area by the use of barriers or guard rails).

(c) Introducing an engineering control (eg lockable catches to prevent access, guarding on augers, remote control levers).

(d) Administrative controls adopted as part of a safe system of work – examples are:

- modifying the system of work (eg cleaning the container from lower levels rather than from the top);
- developing a safe system of work and written safe working procedures;
- hazard warning signs (eg 'Lower auger before travelling') and specific training and work instructions.

(e) Personal protective equipment (PPE), such as fall arrest devices, eye, respiratory and hearing protection.

In some situations a combination of control measures may be needed.

Administrative measures require frequent monitoring to ensure they are used. Training of workers about each control measure is needed so that workers know how to implement these.

The use of personal protective equipment (PPE) is the least effective measure. PPE should only be used when other control measures are not reasonably practicable, or when after implementing other controls, a residual risk remains. Advice on the selection of PPE is provided in chapter 16.

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

2.3 Site selection, preparation and installation – silos, field bins and flatbed storage

Installation, erection and commissioning (putting into operation) must be undertaken by a competent person at a suitable location (OHS Regulation, subclauses 135 (b) and (c)).

When selecting a site for a silo or field bin consider the following factors when complying with the manufacturer's instructions and guidelines on installation:

(a) Drainage throughout the site – for example, building up silo and field bin sites will help to ensure good drainage.

(b) Ensure that the foundation on which the container or flatbed storage is to be installed is in accordance with the manufacturer's instructions, and is safe and stable, including the capacity of the foundation, footings, plinth or ground to support the loads. Inadvertent movement of plant (including the container) must be prevented (OHS Regulation clause 135(d)).

(c) Truck and wagon access, and the ability to safely load and unload trucks or wagons. Examples are the risk of touching overhead power lines when tipping, and the risk of trucks overturning when tipping or turning if the ground is not sufficiently level and even.

(d) Access to public roads should facilitate safe movement of vehicles and containers such as field bins.

(e) Locate the container, flatbed storage and loading facilities away from overhead power lines, taking into account the possibility of contact from the movement of mobile equipment such as augers and tip trucks, and the use of cleaning and measuring poles or rods (see also chapter 12). Alternatively, locate powerlines under ground. You may need to consult your energy supplier about appropriate clearance distances from overhead and underground services.

(f) For silos with provision for inert gas injection as a fire control measure, provide adequate space for access, including vehicles carrying the gas supply, such as bulk tankers, where necessary.

(g) Provide sufficient space from adjacent buildings, plant, services (eg underground power or gas), roads or rail services, to allow safe work and access, and adequate separation distances for fumigation.

2.4 Preparation for work

If buying or building a new container, check that the manufacturer or supplier of the container confirms that the design is consistent with WorkCover's *Code of practice safety aspects in the design of bulk containers including silos field bins and chaser bins*. Some of the control measures described in this code of practice will have been incorporated by the designer and manufacturer.

Ensure that a suitable manual ('manufacturer's instructions') and all relevant information are provided that clearly describe safety measures, and that the safety measures are incorporated into the design. Ensure that the supplier will provide adequate manufacturer's instructions and guidelines for installation and commissioning.

Preparation should be based on implementing the manufacturer's instructions. Preparation should also include identification and assessment of the following factors:

(a) Climatic and environmental conditions that could affect recommended control measures.

(b) Safe access to and from the work areas, including areas where cleaning or maintenance is required (see also chapters 5, 6 and 7)).

(c) Requirements for regular inspection, cleaning and maintenance (see chapter 3 and preoperational safety checks for structural integrity in section 4.2)).

(d) Specific instructions and training for employees on maintaining health and safety (see chapter 17).

(e) Appropriate signage to display (see section 2.7).

(f) Suitability of plant and equipment for the intended use, and its proper maintenance.

(g) Provision of personal protective equipment, where this has been identified as an appropriate control measure (see chapter 16).

(h) The location of overhead and underground services (eg electric power lines, underground gas pipes) to ensure work is carried out safely with regard to its location.

(i) Establishing emergency, evacuation and rescue procedures in the event of an incident, injury or other emergency, including the means of rescuing people, and arrangements to protect any other people in the vicinity (see section 2.5 below and chapter 7).

(j) The nature of the substance stored, including its dangerous goods classification and the hazardous nature of any dusts or gases that may be evolved, and the size and type of structure of the container (see chapters 7, 9, 10 and 11).

(k) Risks associated with loading and unloading the container and the coordination of safe procedures with the person responsible for receipt or delivery of a load. Plan to ensure safe movements of vehicles such as trucks and wagons.

(l) Any associated handling and storage of dangerous goods, such as solvents (eg hexane), fuels (eg LP Gas), acid or alkali, in terms of the dangerous goods classification, and checking to ensure storage and handling is in accordance with the appropriate Australian Standard.

(m) The need for lightning protection of the container (AS 1768 *Lightning protection* provides advice).

(n) Safe lifting method and lifting points where necessary for lifting plant or bins (eg during maintenance or replacement).

(o) Proper site selection for relocatable containers such as field bins (see chapter 4).

When preparing for filling, discharge, cleaning, or any other work, check that all controls, identified through the risk assessment process, have been put in place.

2.5 Planning to deal with serious incidents – emergency procedures, fires and confined spaces

The need for emergency procedures, such as rescue from a confined space and fire fighting, must be identified and effective measures planned.

The fire risks of combustible substances should be identified, especially those related to the dangerous goods classification of the contents (further advice is provided in chapter 10). All confined spaces should be identified and have signs – see section 2.7.

The following matters should be considered when planning to deal with emergencies and controlling fires:

(a) developing a site emergency plan, including procedures for alerting the fire brigade and cooperation with the fire brigade;

(b) provision of injection points on the container for inert gases to control fires, and access to these where provided;

(c) fire, heat and smoke detection systems;

(d) appropriate location of fire fighting equipment;

(e) maintenance of fire fighting equipment and provision of an adequate water supply;

(f) safe isolation and emergency stop procedures;

(g) control of access to the container and work areas during the emergency;

(h) extra equipment and procedures for entry into a confined space, for rescue or other purposes (see chapter 7);

(i) procedures and means for rescue of persons trapped in containers, confined spaces or hanging on fall arrest devices.

The above measures need to be included in staff training and instruction (see chapter 17).

2.6 Control of contractors and other persons working at the site

In order to adequately ensure both the protection of contractors or other visitors who occasionally work at the site, and to ensure contractors protect others, it is important to adopt procedures such as the following:

(a) permit to work systems, for example for entry into hazardous areas, entry into confined spaces, or hot work permits (for work creating an ignition source such as cutting, welding or grinding);

(b) isolation and tagging procedures to prevent inadvertent starting or energising of plant;

(c) providing adequate information and training about working with the container, ancillary plant and equipment; and the relevant hazards and risks, and emergency systems established (such as fire alarms);

(d) providing induction training for contractors, including safe working procedures.

2.7 Information and signage

Signage is an important way of providing health and safety information.

2.7.1 Mandatory signage

The OHS Regulation requires signage for the following risks:

(a) Where there is a risk of an unsafe atmosphere or atmospheric contaminants, the area must be isolated and appropriate warning signs put in place (Clause 54 of the OHS Regulation). Chapters 9 and 11 give further information on atmospheric contaminants such as dusts or gases. If PPE is selected as a control measure, areas where it must be used are to be clearly identified (OHS Regulation, clause 15(1)(g)).

(b) Clause 75 of the OHS Regulation requires that appropriate signs are displayed at the entry points to confined spaces. The following warning signs are suggested as examples of administrative controls to be applied, where relevant to the safe system of work and control measures applied:

- Adjacent to access openings: DANGER – CONFINED SPACE ENTER ONLY WHEN CONTAINER EMPTY – CONFINED SPACES SAFETY PROCEDURE MUST BE FOLLOWED
- or alternatively, where controls to prevent discharge are in place: DANGER – RESTRICTED ENTRY – CONFINED SPACES SAFETY PROCEDURES MUST BE FOLLOWED
- At all other openings not designed for access but where a person could enter: DANGER – CONFINED SPACE– DO NOT ENTER (or DO NOT ENTER UNLESS AUTHORISED)

(c) If the contents are dangerous goods, signs relating to the classification must be displayed.

(d) All relevant information on emergency procedures relating to plant must be displayed in a manner that can be readily observed by persons who may be exposed to risks arising from the operation of the plant (OHS Regulation, clause 144(2)).

(e) A legible notice specifying the rated capacity (safe working load) of any lifting machinery, including conveyors, must be affixed in a conspicuous place on the lifting machinery. The rated capacity must be specified in appropriate metric units (OHS Regulation, clause 142(1)).

2.7.2 Other risks that may need signage

Other signs that may be appropriate for controlling risks include the following:

(a) The allowable loads on ladders.

(b) A visible sign at each outward opening door or hatch (if applicable), displaying the warning: DANGER OF STREAMING MATERIAL – OPEN WITH CAUTION.

(c) Warning signs for fire fighters, including information concerning the proper fire extinguishing techniques, visible from a safe fire fighting position; such as a warning prohibiting directing water or foam to extinguish the fire through the top openings, where relevant to the contents.

(d) Include information on the nature of the contents so fire fighters are aware of the particular hazards, if the contents are combustible.

(e) Indication of the nature of the type of container (eg whether it is a sealed container or an oxygen limiting silo) so fire fighters can use appropriate methods.

(f) Signs warning of a fumigation process and the danger of presence of toxic gas following fumigation.

CHAPTER 3 – Regular safety checks, cleaning and maintenance of containers and plant

3.1 Risk reduction

Risks can be reduced through regular safety checks, inspection, maintenance and cleaning programs. All plant must be subject to appropriate checks, tests and inspections necessary to minimise risks to health and safety (OHS Regulation clause 136(3)(m)).

Ensure that inspection and maintenance schedules recommended by the manufacturer are kept, or a schedule is developed by a competent person where necessary (OHS Regulation, clause 137(1)(b)). Keeping records of maintenance, inspections, cleaning and repairs will help to ensure the maintenance and cleaning programs are carried out regularly.

It is recommended that a visual safety inspection is carried out on all containers at least once every three months if in continuous use, or at the beginning of each season or work period if the container is not in continuous use.

Arrange for a comprehensive and detailed examination of the container 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 corrosive nature of the stored substance could cause corrosion, to ensure that it is safe for use. If the container or any other item of plant is not safe for use, it must not be used (OHS Regulation clause 136(3)(n)). This examination should be carried out by a competent person at least every 10 years. An inspection report should be kept until the next inspection.

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

3.2 Key areas for inspection and maintenance

Examine the container and all ancillary equipment in accordance with the manufacturer's instructions (operator's manual), or instructions developed by a competent person if the manufacturer's instructions are not available, to ensure it is in safe operating condition. This should be done prior to first using it and on a regular basis. If the container is used only on a seasonal or periodic basis, an inspection should take place at the beginning of each season or work period. Intervals for comprehensive inspection will also be determined by the type of product stored and any external environmental factors.

The following areas should be considered in an inspection and maintenance program, where relevant to each particular container:

(a) structural integrity of the container and ancillary plant – see the list in 3.3 below;

(b) filling devices, unloading and discharge equipment (eg augers and conveyors), including guarding;

(c) guarding of platforms, ladders and other means of access;

(d) safety devices, including a safety line or harness if used as a control measure (see section 5.3);

(e) where pneumatic transfer or dust suppression is used – air or dust filters, and dust control system for operation, cleanliness and integrity (including dust tightness), pressure relief valves for correct operation; operation of any warning devices and high level detection systems;

(f) visual inspection of electrical equipment, including leads and cables for damage;

(g) warning signs and labels for wear and fading;

(h) operation of hatches and control mechanisms;

(i) sealing devices and pressure testing a sealed silo in accordance with the manufacturer's instructions to ensure integrity and efficiency of fumigation.

A preoperational safety check is outlined in section 4.2.

3.3 Structural integrity

Structural integrity checks should include a visual inspection of the following:

(a) metalwork, such as damage, surface corrosion, integrity of bolts or welds;

(b) damage to support struts;

(c) footings, foundations, slab or exposed plinths – problems may be indicated by evidence such as settlement, cracking, spalling or other damage to concrete;

(d) ladders, stairs, handles, platforms and other access points, including the attachment points, for corrosion and integrity;

(e) hatches and latches;

(f) dust tightness of any relevant items and the integrity of dust control systems;

(g) fall prevention barriers or attachment points;

(h) bulging of the container such as the barrel of a silo or field bin.

Note that paint could hide defects such as corrosion or cracking.

A checklist is provided (number 4 in Appendix 2). Arrange for remedial work to be carried out by a competent person if any fault is observed (see below).

3.4 Remedial work

All maintenance and repair work must be carried out by a competent person, having regard to the manufacturer's instructions, including the time periods for inspection and maintenance (OHS Regulation clause 137). Ensure that all electrical work is carried out only by qualified and licensed persons. Repairs carried out must keep the container within its design limits – if modified see section 3.6 below.

3.5 Cleaning

Cleaning reduces hazards and risks arising from dusts, moulds and corrosion. Risks also arise if the substance being stored deteriorates with time, or tends to stick to or corrode the walls of the container.

A regular cleaning program should include the following:

- removing dust deposits from any exposed surfaces (starting equipment may release accumulated dust and create an inhalation or explosion hazard)
- internal cleaning, if accumulated substance presents a hazard inside the container, such as corrosion, fire or explosion hazard, affecting proper discharge of the contents, or changes to the structural load
- general 'housekeeping' to ensure the workplace is clean and free of additional hazards, such as obstructions that could cause slips, trips and falls.

Dust hazards and explosion risks may arise during cleaning, and any equipment used should be suitable for use in such an atmosphere (see chapter 9 on dusts and moulds and chapter 10 on dust hazards and controls).

When plant or equipment is being cleaned, it must be isolated to prevent operation, unless this is not reasonably practicable (OHS Regulation clause 137(2)). A 'tag out' system may be necessary to provide signage to others that the plant cannot be started. Safe work procedures should be established for cleaning or clearing any attached conveyor or auger.

3.6 Modifications to the container

Consult the manufacturer or supplier, or an appropriately qualified engineer, before carrying out structural modifications to a container. A record of modification should be kept for the life of the container.

If you modify a design, you take on the legal obligations of a designer and manufacturer. Further advice is provided in the *Code of practice for safety aspects in the design of bulk containers including silos, field bins and chaser bins*.

CHAPTER 4 – Structural collapse

4.1 Hazards and risks

Structural collapses have sometimes resulted in fatalities. People must be kept safe from risks associated with such a collapse.

Different stored substances have different densities, internal angles of friction and corrosive behaviour. For example, a container that is designed for low density substance is likely to become overloaded if a higher density substance is stored. Manufacturers and suppliers will usually impose restrictions on the manner of loading and unloading substance, and the characteristics of and limitations on, the type of substance that can be stored.

A container may collapse when the stored substance, such as crusted grain, falls internally to the base, creating a vacuum that causes the container to implode (fold in and collapse).

Uneven settlement of foundation or footings is another cause of failures (see maintenance checks in Chapter 3 and remedial work in section 3.4).

Wind forces and the potential for a vacuum to be formed inside the container when doors or hatches are opened should be considered.

4.2 Control measures

When in use, a daily preoperational safety check should be carried out before filling, emptying, climbing or using the container, and in the case of a field or chaser bin, before towing or transporting. Consult the manufacturer's instructions and implement the following measures where relevant to minimise the risks of structural collapses:

(a) Check that the stored substances are within the manufacturer's or supplier's specification.

(b) Avoid overloading. Do not impose additional loads on it (eg supporting other equipment) unless specifically allowed by the manufacturer, supplier, or a competent person such as a qualified engineer.

(c) Load and unload at rates within the specifications of the manufacturer or supplier. Off centre loading or unloading can produce uneven loads on the structure.

(d) Where vehicle movements present a risk, protect the container or structure and support struts or legs from damage by moving equipment and vehicles by providing suitable barriers or vehicle stops.

(e) Before placing a field bin for filling, the site should be assessed to ensure that it is structurally adequate to support the full load of the bin, and that the bin is supported on level surfaces.

(f) Field bins should only be transported or towed on firm and even ground, and only when they are empty and within towing limits of the towing vehicle, and with a rigid linkage. When stationary, secure the bin from unintended movement.

(g) Where high winds may create a hazard, keep hatches closed.

(h) Do not use rails, ladders or other points as an anchorage point for a fall arrest system unless approved by the manufacturer of the container or structure, or determined to be suitable by a competent person.

CHAPTER 5 – Falls from heights

5.1 Hazards and risks

Falls from a container roof or ladder, or from a surrounding work area or platform, can result in serious injuries or death. Risks of falling must be eliminated or controlled to protect people working at any height. This includes the risk of falling into the container.

The OHS Regulation in subclause 56(1) provides that:

> An employer must ensure that risks associated with falls from a height are controlled by the use of the following measures:
>
> (a) provision and maintenance of:
>
> (i) a stable and securely fenced work platform (such as scaffolding or other form of portable work platform), or
>
> (ii) if compliance with subparagraph (i) is not reasonable practicable – secure perimeter screens, fencing handrails or other forms of physical barriers that are capable of preventing the fall of a person, or
>
> (iii) if compliance with subparagraph (ii) is not reasonably practicable – other forms of physical restraints that are capable of arresting the fall of a person from a height of more than 2 metres,
>
> (b) provision of a safe means of movement between different levels at the place of work.

Consider the risks of gaining access to the roof of a container, or surrounds of a below ground container, for work such as:

- opening and closing the roof hatch or cover, or access for loading or unloading;
- fumigating, inspecting, sampling, temperature measurement or servicing;
- determining the amount of substance stored;
- maintenance and cleaning;
- work near pits such as boot pits.

The more frequent the need for access, the higher the risk. This risk can be aggravated by fatigue from frequent climbing of stairs or ladders.

5.2 Control measures for work at heights – applying the hierarchy of control

A safe method of working at heights and moving between different levels must be determined.

Reducing the need for access to heights is the key to implementing control measures. Examine the methods of access and consider applying the following measures where reasonably practicable to control the risk of falls:

(a) Minimising the need to gain access to elevated areas such as the roof by providing and using measures such as the following:

- a system that conveys substances to the container that is accessible from ground level, such as through a filler pipe or a bucket elevator;
- a remote lever to open and close the roof filling cover, operated from ground level;
- sight gauges or weight indicators visible from ground level to show the storage level;

- ground level access hatches (eg to allow cleaning);
- extension poles to clean the inside of the container.

(c) Substitute a less hazardous means of access. For example, using an inclined ladder (at a gradient between 70^{o} and 75^{o} to the horizontal) instead of a vertical ladder where access is necessary, if reasonably practicable.

(d) Use fall protection such as barriers, guardrails and ladder safety cages, where reasonably practicable. AS 1657 *Fixed platforms, walkways, stairways and ladders – design construction and installation* provides further advice.

(e) Use a safety harness and fall arrest equipment, in conjunction with structurally adequate anchorage points (see section 5.3 below). This option should be considered only if all other means (b, c and d above) are not reasonably practicable.

(f) Prevent unauthorised access to ladders by either:

- blocking the base of the ladder safety cage with a lockable or fixed barrier;
- adding a lockable cover to the access ladder up to a height of 2 metres;
- folding up or sliding up the lower two metres of the ladder;
- using a detachable ladder up to a height of 2.5m. When not in use, such a ladder should be secured away from the container to prevent access by unauthorised persons.

(g) Where a ladder is used as a means of access, it should not be used as a work platform. The narrow rungs do not provide adequate ergonomic support for prolonged use.

(h) Provide warning signs about the hazards associated with access.

Further advice on applying the hierarchy of control to falls is provided in section 1.5, figs 1.1 and 1.2, of AS 1891.4 – 2000 *Industrial fall-arrest systems and devices – Part 4: Selection, use and maintenance*.

5.3 Use of fall arrest devices

5.3.1 Legal requirements

If a fall arrest devise is provided, the OHS Regulation in subclause 56(2) has the following requirements:

(a) all anchorage points must be inspected by a competent person before first use and on a regular basis so they are capable of supporting the design loads;

(b) if the load bearing capacity of an anchorage point is impaired, the anchorage is immediately made inoperable so as to prevent its use;

(c) any harness, safety line or other component of the device that shows wear or weakness to the extent it may cause the device to fail is not used;

(d) all persons using the device have received training in the selection, assembly and use of the system; and

(e) adequate provision is made for the rescue of a person whose fall is arrested by a fall arrest device.

5.3.2 Practical guidance on fall arrest devices and anchorage points

Practical guidance is provided in AS/NZS 1891.4 – 2000 *Industrial fall-arrest systems and devices – Part 4: Selection, use and maintenance.* This standard is an approved industry code of practice in NSW.

This part also provides advice on anchorage points for fall arrest devices. Anchorage points must be sufficiently strong to withstand potential forces. The force exerted on an anchorage point when arresting a person is considerable. It is as much as 110kN, which is the equivalent to suspending a large station wagon from the anchor. Fall arrest devices are not appropriate if suitable attachment points are not available. For example, existing ladders may not have sufficient strength.

When using a fall arrest device, a person should not work alone or unmonitored. Serious health problems, or even death, can result from a person left suspended in a harness for as little as 20 minutes.

When selecting a system, confirm with the supplier that it complies with AS/NZS 1891 *Industrial fall-arrest systems and devices* (all parts of this standard are approved industry codes of practice in NSW).

5.4 Infrequent, occasional or temporary access to heights

Occasional access to heights may be necessary for infrequent tasks such as inspection or maintenance. Consider using a stable and securely fenced work platform, such as scaffolding or a boom-type elevated work platform.

CHAPTER 6 – Entrapment in grain or other flowable substances

6.1 Hazards and risks

One common cause of death is suffocation as a result of engulfment in a flowing substance such as grain. Often the victim has entered a silo of flowing grain unaware of the dangers.

Flowing grain is hazardous because it acts like quicksand. It can take four to five seconds to be trapped up to knee level and less than 20 seconds to become submerged. Once trapped knee deep in the grain, a person is helpless to escape due to the immense force the flowing grain exerts on the body.

For example, to rescue a 25kg child caught in knee deep grain, an adult would have to be able to lift 32 kg. If the same child were shoulder deep in grain, it would require a force of 110 kg.

Sometimes appearances can be deceiving. Grain may crust over and look solid, but a cavity can develop underneath the crust. Someone walking on top of the crust can break through and become submerged in the grain.

The collapse of vertically crusted grain usually occurs in a partially emptied grain silo when spoiled grain remains stuck against the wall. As the worker attempts to dislodge it at the base, the wall of grain can give way and bury the worker.

Emergency rescue of a trapped person may be necessary. Because of the danger of engulfment and other hazards, a silo is classified as a confined space and special entry procedures are required (see chapter 7).

Examine the need to enter containers and eliminate or minimise the occasions when entry is necessary.

Consider applying the measures in sections 6.2 and 6.3 below where reasonably practicable, applying the principles of the 'hierarchy of control' (as explained in section 2.2).

6.2 Eliminating risks

Prevent entry unless it is absolutely necessary (for entry procedures see chapter 7). Instead, observe procedures such as the following:

(a) Break up crusted grain or substance from the outside of the container by either:

- Using a long pole inserted through the roof door or hatch. If there is any risk of the pole coming into contact with or within proximity of overhead power lines use non-conductive poles (such as wood or plastic)
- Using a weighted line thrown from the roof door or hatch
- Using rotating flails operated from outside the container.

(b) Do not enter a container from the bottom if the grain or substance is vertically crusted. Vibrate the sides of the container to break the crust.

(c) When unloading flatbed storage, persons should not enter the areas of overhang left after loaders have removed the stored substance.