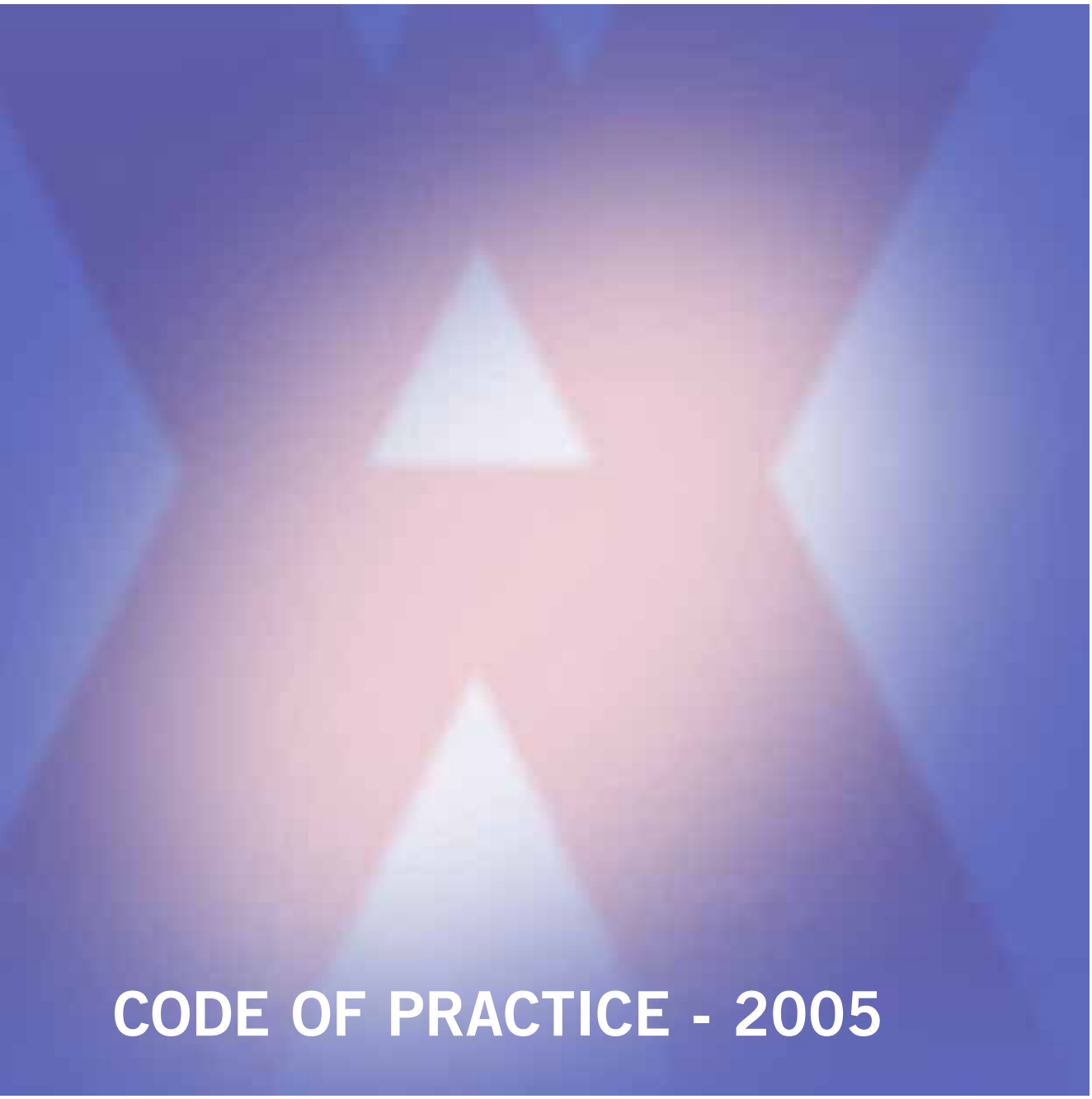
WorkCover
NEW SOUTH WALES

SAFETY ASPECTS
IN THE DESIGN OF BULK SOLIDS CONTAINERS INCLUDING SILOS, FIELD BINS AND CHASER BINS



CODE OF PRACTICE - 2005

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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.

PREFACE

This Code of practice provides practical guidance for designers, manufacturers, importers and suppliers on safety aspects of the design of all types of bulk solids storage containers above four tonne or four cubic metre capacity.

Bulk containers, such as hoppers, silos, field bins and chaser bins, and ancillary bulk handling equipment, are important to operations on farms and in other industries. But they can also be the source of many hazards. Examples are deaths caused by falls, asphyxiation, fires and explosions. Experience has shown that risks are associated with structural collapse, lack of fall protection, entry into the container, electrical hazards, entrapment in augers and the dangerous nature of stored substances. An important principle of the occupational health and safety legislation is that such risks must be eliminated or controlled, so that such plant is safe when supplied to users.

This code of practice outlines typical hazards associated with bulk containers and their ancillary equipment, and describes means of eliminating or controlling the risks at the design stage, helping manufacturers, importers and suppliers provide a safer product.

This code of practice will help designers, manufacturers, importers and suppliers comply with their obligations under the *Occupational Health and Safety Act 2000* and the *Occupational Health and Safety Regulation 2001*. The 1991 code of practice applying to on-farm silos has been revoked, since it has become outdated as a result of the 2001 Regulation. Designers will also need to have regard to Australian Standards that have been adopted as codes of practice, relating to the design of access (eg stairs and ladders), conveyors and fall arrest systems. Australian Standards relating to hazardous areas for dusts and flammable atmospheres will also need to be taken into account where relevant to the contents to be stored.

This code of practice applies a risk management approach that provides flexibility to take into account the varying needs for containers of different size, construction and contents. 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. The nature of the substance intended to be stored will indicate if there are fire and explosion hazards that need to be controlled. The risks relevant to the type of container to be produced must be eliminated or controlled. Information on safe use, that is applying the intended control measures, must be provided to users, and this code of practice provides advice on the contents of the manual for operators.

This code does not apply to coal storage or containers of liquids, nor to containers used primarily for transport. It does not cover safety in the actual process of manufacture, construction or installation of containers. Advice relating to the storage of dangerous goods of class 4.2 (combustible solids) such as ‘seed cake’ and meal from seed oil extraction is specifically included.

Check the *Code of practice for the safe use of bulk solids containers and flatbed storage including silos, field bins and chaser bins* for advice on location and operations.

CONTENTS

CHAPTER 1 – Establishment

1.1 Title

This is the *Code of practice: safety aspects in the design of bulk solids containers including silos, field bins and chaser bins*.

1.2 Purpose

This Code of practice provides practical guidance on the design of bulk solids containers, such as silos, field bins and chaser bins, and ancillary plant. This will assist designers, importers, manufacturers and suppliers provide bulk containers that are safe and without risk to health when properly used, and provide relevant safety information.

1.3 Scope

1.3.1 Matters included

This Code of practice applies to designers, manufacturers, importers and suppliers, for the safe structural and operational design of bulk containers and ancillary plant, intended for use at work in NSW (except at mines) for the storage and handling of solid substances, such as industrial materials or products, crops, forage, stock feed or waste.

This code applies only to containers with a capacity exceeding four tonne or four cubic metre.

Silos, field bins and chaser bins are examples of bulk containers.

1.3.2 Exclusions

This code does not cover the following:

- health and safety during the process of manufacture, construction, installation of a bulk container, or making an electrical connection
- requirements for bulk containers used primarily for transport on public roads, or by rail, air or sea, nor field or chaser bins when towed on public roads
- bulk containers for coal.

While not included in the scope of this code, some aspects may be relevant to smaller containers, or to other forms of storage such as flatbed storage, or the storage of liquids. When carrying out a risk assessment when planning such storage, advice in the various parts of this code should be applied where the risk assessment of each case indicates it is relevant.

Advice on location and operation of bulk containers, such as silos and bins, is provided in the *Code of practice for the safe use of bulk solids containers and flatbed storage including silos, field bins and chaser bins*.

1.3.3 Additional relevant standards for dangerous goods

Additional advice about the storage of dangerous goods (other than class 4.2) is also provided in Australian Standards specific to the class and type of the 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 of practice commences on 26 August 2005.

Note: The commencement dates of the *Occupational Health and Safety Regulation 2001* (OHS Regulation) are relevant. This Code of practice provides advice on implementing the OHS Regulation, and in particular the new plant provisions. Compliance with the OHS Regulation is necessary for:

- designers (or importers) – all plant designed after 1 September 2001
- manufacturers (or importers) – all plant manufactured after 1 September 2002
- suppliers (eg supply by sale, hire or lease) – all plant supplied after 1 September 2002.

1.6 Repeal (revocation) of 1991 Code of practice

This Code of practice replaces the *Code of practice: Safety aspects in the design, manufacture and installation of on-farm silos and field bins*, published in the *NSW Government Gazette* on 2 August 1991 (that commenced on 2 August 1991), which is hereby revoked as provided by section 45 of the *Occupational Health and Safety Act 2000*.

1.7 Definitions

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

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

auger means a screw type conveyor.

bulk means more than four tonnes (net), or more than four cubic metres, of 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 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.

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

- is not intended or designed primarily as a place of work, and
- is at atmospheric pressure while persons are in it, and
- may have an atmosphere with potentially harmful contaminants, an unsafe level of oxygen or stored substances that may cause engulfment, and
- may (but need not) have restricted means of entry and exit.

Examples of confined spaces are as follows:

- storage tanks, tank cars, process vessels, boilers, pressure vessels, silos and other tank-like compartments,
- open-topped spaces such as pits or degreasers,
- pipes, sewers, shafts, ducts and similar structures,
- 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 cargo holds).

Note: The above criteria should be applied to the design to determine if it is a confined space.

container means a container intended for the storage and handling of bulk solid substances (such as industrial materials or products, crops, forage, stock feed or waste), usually fitted with a discharge outlet, and includes a silo, field bin or a 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:

- an endless belt, rope or chain or other similar means
- buckets, trays or other containers or fittings moved by an endless belt, rope, chain or other similar means
- a rotating screw
- 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 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: Relevant examples of dangerous goods are included in section 7 of this code.

designer means a designer of plant and includes an employer or self-employed person who designs plant for his, her or its own use at work.

Note: A person importing plant from outside NSW (either from another state, territory or from overseas) must ensure the responsibilities of a designer and manufacturer are met.

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

- intended for the storage of substance such as crops and stock feed
- equipped with a discharge outlet
- 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.

Note: Field bins may also be called relocatable, moveable or portable silos. 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.

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

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

individual packages – see package.

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.

Notes: Importers must ensure that the duties of designers and manufacturers are met. Import includes import from other states or territories and import from overseas.

material specification means, in relation to the material a container is made from, the mechanical and chemical composition of the material as defined as a particular grade by an Australian or international Standard.

must means a mandatory requirement (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.*

Note: This Regulation is reviewed every five years with a change of date in the title.

package 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.

plant includes any machinery, equipment or appliance.

Note: Examples of plant mentioned in this code include: silos, field bins, chaser bins, augers, bucket elevators, electrical devices, belt conveyors and aerating and drying equipment.

reasonably practicable – see advice in appendix 2, section A2.4.

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

should means a recommendation.

Note: Such recommendations may be used evidence in any proceedings for an offence against the OHS Act or OHS Regulation as provided by section 46 of the OHS Act.

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

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

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

CHAPTER 2 - Implementing this code of practice; applying risk management principles

An important principle of the occupational health and safety legislation is that all risks must be eliminated or controlled, so that plant is safe when supplied to users and properly used. This chapter focuses on applying risk management principles to the design of bulk containers. This will assist designers, manufacturers, suppliers and importers of plant comply with the duties placed upon them by occupational, health and safety (OHS) laws. A summary of how the law applies to various parties is provided in Appendix 2.

2.1 Risks

Experience has shown that significant risks when using bulk containers include the following:

- entrapment or engulfment by material
- confined spaces entry (eg asphyxiation)
- falls from heights (eg from roof tops and ladders)
- fires and explosions from the nature of the stored material
- structural collapse, and stability of foundations
- equipment and machinery, such as augers or conveyors used with the container (eg lack of suitable guarding).

These risks are addressed in this code of practice. However, while the above are important, other risks may need to be addressed in each design, such as ergonomics and the health risks of dusts.

2.2 Relevant factors to consider

2.2.1 Differences in designs

This code applies to a variety of different bulk containers intended for different uses. When interpreting this code, and determining how to apply the recommended control measures to your design, a risk management approach should be applied in a manner that takes into account the variations in designs, different types of storage method and the nature of the intended use (including contents).

2.2.2 Key factors in risk assessment

Factors that may be relevant to the risk assessment include the following:

- size of the container, and the nature of access by persons to heights, to storage piles and to the interior of containers
- construction materials and strengths
- the nature of the material intended to be stored for fire and explosion risks
- the method of loading and unloading, including the use of ancillary plant such as conveyors and augers
- guarding of ancillary machinery
- electrical safety.

This list is not exhaustive and all possible risks need to be considered, such as manual handling risks, the health hazards from dusts that may be released, and other hazardous substances.

The conclusions from the risk assessment process provide a basis for determining control measures that are suitable and reasonably practicable for each type and design of bulk container and ancillary plant. The control measures chosen may need to be described in the operator's manual (see section 10.3), to ensure that they are applied properly.

2.2.3. Flatbed storage and small bins - guidance

While containers smaller than four cubic metres and flatbed storage are not specifically addressed, some of the risks listed above might apply in a particular circumstance. Following a risk assessment of such situations, the advice in this code should be used as guidance where relevant. For example, a small container in an elevated position may have access and fall risks. In flat-bed storage, this may include risk factors relating to wall strength, self-heating leading to fires, emergency procedures such as fire fighting, access and egress and the use of ancillary plant such as machinery.

2.3 Applying the hierarchy of control

The risks relevant to the type and design of the container to be supplied must be eliminated or controlled at the design stage. To do this, the 'hierarchy of control' must be applied (see clause 5 of the OHS Regulation), having regard to what is 'reasonably practicable'. This term is not defined in NSW legislation, and advice on interpreting the meaning of 'reasonably practicable' is provided in Appendix 2 (see section A2.4).

2.3.1 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, eliminating the need for workers to access elevated work areas can eliminate some of the risks associated with falls from heights.

Elimination of the risk gives the best level of safety, and must be adopted unless it is not reasonably practicable. If elimination is not reasonably practicable, then the hierarchy of controls shown in section 2.3.2 below must be considered.

2.3.2 Controlling the risk

The following hierarchy of control measures is listed in the order it must be applied. Work thorough the following sequence, starting with (a) which represents the highest level. Select from the highest level reasonably practicable to develop each control measure for each risk identified.

(a) Substituting the system of work, substance or plant for something less hazardous (eg installing material level indicators 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 safety cages).

(d) Administrative controls adopted as part of a safe system of work – examples are:
- modifying the system of work (eg cleaning the silo from lower levels rather than from the top)
- providing hazard warning signs, training advice and work instructions.

(e) Personal protective equipment (PPE), such as fall arrest devices, eye, respiratory and hearing protection. The use of PPE, such as fall arrest systems, must be considered last and only where a residual risk remains, or other control measures are not reasonably practicable.

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

2.3.3 Implementing this code of practice

The advice in this code should be considered in terms of applying the 'hierarchy of control' to each specific design, by focusing firstly on elimination, then isolation (such as guarding) and engineering controls, and finally on PPE.

In some cases there are specific requirements and the code references the relevant clause of the OHS Regulation to highlight these.

Advice on the control measures determined must be passed on to users (OHS Regulation, clauses 95 and 105). For example, where a fall arrest system is chosen, information about the application and use of this must be provided in the manufacturer's instructions (see section 10.3).

The provision of advice on operator training or induction, while essential, does not make an unsafe design safe to use. Regard must be had to the fact that operators may not at all times comply strictly with safety instructions. Designers need to take into account the potential for inadvertent misuse, deliberate misuse, operator inattention or carelessness. The OHS legislation also imposes obligations on the users of bulk containers, and it will help end users if containers are designed in a manner that assists safe use.

CHAPTER 3 - Structural design and safety risks

The risk of structural collapse of containers must be assessed and controlled. This chapter addresses key risk factors.

3.1 Loads

The container and its supporting structure should be designed to resist all relevant loads. The following loads should be taken into account:

(a) Permanent loads, including: the self-weight of the container, support structure, access ladders and platforms, and ancillary mechanical plant and equipment.

(b) The in-service loads, including the movement or displacement of material, such as the following:
- gravity loads from stored material
- initial loads on container walls
- loads induced by flow of stored material
- concentric and eccentric discharge or filling of the container
- forces from conveyors and feeders reacting against the container
- live loads on stairs, ladders, platforms and roofs
- internal gas or air pressure, or suction, including pressure from pressurised delivery systems (including filtration systems)
- impact caused by falling material (such as produce)
- forces from any attached structures
- loads associated with potential impact of vehicles, loaders or trains where these enter into the container area and could create a risk of collapse
- loads resulting from persons falling, where the structure to which the anchorage point is fixed is part of the container. Advice on anchorage is provided in section 3 of AS/NZS 1891.4 - 2000 *Industrial fall arrest systems and devices – Part 4: Selection, use and maintenance* (which has the status of an approved industry code of practice in NSW).

(c) Environmental loads including:
- wind loads (for advice see Australian Standard AS 1170.2 - 2002 *Minimum design actions on structures* (known as the SAA loading code) – *Part 2 Wind actions*)
- seismic loads (for advice see Australian Standard AS 1170.4 – 1993: *Minimum design loads on structures – Part 4 Earthquake loads*)
- loads due to differential settlement of foundations
- loads due to differential temperature
- swelling of stored material.

(d) Travelling loads for field bins and chaser bins resulting from:
- acceleration and deceleration forces
- loads resulting from the nature and slope of the grounds over which they are allowed to travel

(e) Rescue loads, if entry to the container from the roof, or elevated side access, is permitted. This should include the following:

- the weight of at least two persons on the roof
- the weight of the rescue equipment
- the load required to lift the person being rescued
- anchorage points and loads for the attachment of personnel fall arrest devices, lanyards and restraint lines (see section 4). Advice on anchorage is provided in section 3 of AS/NZS 1891.4 - 2000 *Industrial fall arrest systems and devices – Part 4: Selection, use and maintenance* (which has the status of an approved industry code of practice in NSW).

(f) Loads on foundations, footings, or other supports to ensure stability (see section 3.7), and providing suitable construction or erection information to constructors, erectors or users to ensure the installation can support the loadings (see section 10.3).

Further advice for granular solids is provided in Australian Standard AS 3774 - 1996 *Loads on bulk solid containers.*

3.2 Design of structures

Advice on structures can be found in the following standards, as relevant to the type of material used:

AS/NZS 1664.1	*Aluminium structures - Allowable stress design*
AS/NZS 1664.2	*Aluminium structures - Limit state design*
AS 3600	*Concrete structures*
AS 3990	*Mechanical equipment - Steelwork*
AS 4100	*Steel structures*

Structures may be designed using the *allowable stress* design method or the *limit state* design method.

3.3 Cladding, internal lining material and other internal components

Cladding or internal lining material should be durable, require minimal cleaning and not react with stored substances, or gases and chemicals generated or used (eg pesticides) inside the silo. It may need to be insect and vermin proof if the container is intended for the storage of crops or food products. Such proofing reduces the need for pesticide use. Components such as copper piping or copper electrical contacts can be corroded by grain fumigants.

3.4 Corrosion protection and mitigation

Steelwork should be protected against corrosion. Recommendations for corrosion protection may be found in Australian Standard AS/NZS 2312 Guide *to the protection of iron and steel against exterior atmospheric corrosion*.

Connection of dissimilar metals such as Aluminium and Steel may result in accelerated corrosion and so is not recommended.

The design should allow for an appropriate corrosion allowance (eg 10 per cent above the design wall thickness).

3.5 Accumulation of water and other substances

3.5.1 Corrosion prevention

Accumulation of water and other substances on the structural members can result in their corrosion leading to eventual structural collapse. The design should prevent, or if this is not practicable, minimise the water and material traps inside and outside the bulk container. To achieve this observe the following:

- position steel angles and channels with their legs pointing downward
- allow for sloping surfaces to drain water
- seal joints by continuous rather than intermittent welds
- overlap joints in a way that will avoid accumulation of water and material
- provide drain holes (eg cut the corner of gusset plates to allow drainage)
- seal joints with suitable compounds.

3.5.2 Prevention of dust and pests

Structures and plant should be designed to avoid accumulation of dusts or waste, inside or outside the container. For example, avoid ledges and other places dust could accumulate, such as by providing sloping surfaces.

This will reduce the risks of dust explosions. It will also reduce the need for pesticide use since pests are less likely to be attracted and nest in parts of the container or ancillary plant.

3.6 Stability

The stability of containers against overturning or being blown from a stationary position should be considered. In the case of relocatable containers, also consider the means to prevent rolling from a stationary position, such as being blown or rolling on sloping ground.

The designer should specify the maximum sloping ground on which a fully loaded container (eg a field or chaser bin) can be safely supported or moved. Such specification should allow for the type of ground and conditions.

Consider the worst loading combinations, including the following:

- when the container is empty and is subject to wind loads
- in the case of a field or chaser bin, when the bin is fully loaded and is supported on its maximum allowable sloping ground.

Provide means to maintain the stability of relocatable containers when travelling and when stationary, and adequate brakes for chaser and field bins including both stationary loads and loads when being moved.

Advice and information on foundations, footings, plinth, and for relocatable containers (such as field bins and chaser bins) the towing capacity required, must be provided in the specification plate and manual (see chapter 10).

3.7 Explosion relief

Explosion relief allowance may be needed, depending on the assessment of the nature of the contents (for example if there is a fire or explosion risk from the intended stored substance, see section 7). This could be in the form of panels, roof sections or doors that blow out under pressure. A form of restraint is needed to prevent such items creating a new hazard by being propelled from the container.

3.8 Pressure systems

Where pressure may accumulate in the container or ancillary plant (such as in a filtration system removing airborne dust) from systems such as pneumatic transfer, or fumigation of a sealed (or semi-sealed) silo; pressure relief such as venting or valves may be necessary to control both positive and negative (vacuum) pressure.

Pressure testing of sealed silos is usually necessary for correct operation and fumigation, and a suitable system should be provided.

CHAPTER 4 - Means of access by persons

4.1 Access by persons to parts of the container or work areas

4.1.1 Risks

Risks during access that need to be assessed are the potential for:

- falls from any height, such as from roofs, ladders or sloping interior floors of containers
- contact with power lines
- entrapment in substance such as flowing grain
- dangers of the confined space inside the container and other plant areas (eg. the boot pit of a silo)
- entrapment in ancillary plant (such as an auger).

4.1.2 Eliminating or controlling risks

Where possible, measures to eliminate or control risks should involve reducing the need for access and frequency of access.

Examine the methods of access and consider applying the following measures to the extent reasonably practicable:

(a) Minimise the need to gain access to the roof by providing and using measures such as the following:
   - a system that conveys substance 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 hatch (top inlet cover), operated from ground level
   - sight gauges or weight indicators to show the storage level (visible from ground level)
   - ground level access hatches (eg to allow cleaning)
   - extension poles to clean the inside of the container.

(b) Substitute a less hazardous means of access. For example, using an inclined ladder instead of a vertical ladder where access is necessary, if reasonably practicable.

(c) Use fall protection such as guardrails and ladder safety cages, where reasonably practicable.

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

(e) 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 two metres
   - folding up or sliding up the lower two metres of the ladder
   - using a detachable ladder up to a height of 2.5 metres. Such a ladder should be secured away from unauthorised people when not in use.

(f) Where a ladder is used as a means of access, it should not be provided as a work platform (as the narrow rungs do not providing adequate support for prolonged use).

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

(h) Prevent unauthorised access by suitable guarding (see sections 4.4 and 4.5 below).

For further advice, see the hierarchy of control options in section 1.5 and figures 1.1 and 1.2 of AS 1891.4 *Industrial fall arrest systems and devices – Part 4: Selection, use and maintenance*. This Standard has been adopted as an approved industry code of practice.

Even though the reasons for access have been reduced, access to hatches, openings, controls or other parts of the container may be necessary for the following purposes:

- maintenance, such as replacement of top inlet rubber seals and linkages
- operational and inspection functions, eg access to the inlet and discharge control levers, inspection doors, and loading or unloading areas, or for carrying out fumigation
- in an emergency, such as fire fighting or rescue.

Where there is a need for access, provide safe means of access and exit to all points. Frequency of access is a risk factor – for example, regular monthly inspections of the contents may be necessary.

At each point intended for access to inside the container or plant area (except ground level access), that has been identified as a confined space, provide attachment points for the use of lines, lanyards and safety harnesses for the purposes of fall arrest or emergency rescue, as relevant to the purpose.

At elevated points, attachment for fall arrest devices may be necessary. Advice on anchorage is provided in section 3 of AS/NZS 1891.4 - 2000 *Industrial fall arrest systems and devices – Part 4: Selection, use and maintenance* (an approved industry code of practice in NSW).

The following sections, 4.2 to 4.5, provide advice on the high-risk areas of heights, access structures, openings and internal access.

4.2 Means of access to heights

4.2.1 Performance criteria

The type of access will vary with the size and structure of the container.

Falls from heights, either into the container, outside the container, or within the container, are risks that need appropriate controls. Ergonomics and the prevention of fatigue are additional factors that need to be considered for fall risks. An ergonomically sound and safe method of moving between different levels is necessary. Designers must have regard to ergonomic design principles, and appropriate handholds and footholds should be determined (OHS Regulation, clause 89(2)). The practicability of control measures should take frequency of access into account – with more frequent access, stricter engineering controls will be needed.

Since users of bulk containers must also control the risk of falls, and so the designer should provide advice on the means chosen and the use of this means, in the manufacturer's instructions (see section 10.3).

4.2.2 Controlling risks

To reduce risks, consider providing means of access to parts of the container in the following order of preference, from:

- ground level
- a floor, level walkway or platform
- a sloping walkway or stairway
- ladder.

Ladders should not be provided for use as a work platform and are not appropriate where work requires both hands to be free of ladder handholds.

4.3 Access structures - ladders, stairways and platforms

Structures providing access, such as fixed platforms, walkways, stairways, and ladders, should be designed to eliminate or minimise the risk of slips, trips or falls. Fall protection, or the provision of attachment points for fall arrest devices, is an important consideration.

To prevent falls, designers should observe AS 1657 - 1992, *Fixed platforms, walkways, stairways and ladders - Design, construction and installation*, which has the legal status of an approved industry code of practice.

Experience has shown that the following features of AS 1657 are important and should be considered where determining each design:

(a) Access ladders and their fixings should be designed to withstand a minimum live load of 1.5 kN (150 kg).

(b) Fall protection should be provided for all access ladders and access points, such as safety cages where reasonably practicable, and attachment points for fall arrest devices provided.

(c) Guard railing should be provided around the edges of platforms and walkways where there is a risk of a person falling in excess of two metres (eg from the roof). Alternatively, fall arrest attachment points should be provided, if other means of protection are not reasonably practicable, and notices advising of the need to use a fall arrest device displayed.

(d) Access ladders should be made inaccessible to unauthorised persons. Means of achieving this include:
   i. Blocking the base of the ladder safety cage by providing a lockable or fixed barrier.
   ii. Adding a lockable cover to the ladder rungs up to a height of two metres.
   iii. Providing means to fold up or slide up the lower two metres of the ladder - such means should not create a manual handling hazard.
   iv. Providing a detachable ladder up to a height of two metres in conjunction with provisions to prevent the top of the ladder from lateral movement.

(f) The angle of slope of rung ladders should be between 70 and 75 degrees to the horizontal, where reasonably practicable. Where angled ladders are not practicable, vertical ladders should be less that six metres in height, and have fall protection provided (such as a ladder cage or fall arrest attachment points). The ladder cage should be joined to guard railing at roof level to prevent falls during roof access.

(g) To reduce fatigue, ladders should have a rest platform (landing) located every six metres, where reasonably practicable. For practical reasons, this may not necessarily result in a change of direction, but should be staggered.

(h) Stiles of ladders should be continuous so that a continuous ergonomic handgrip while climbing is possible. Stiles should project at least 900 mm above their landing, or be integrated into a ladder cage or platform guardrails.

(i) The sheet metal shell of a container may need local reinforcement for supporting the ladder.

(j) Rungs should be spaced not less than 250 mm nor greater than 300 mm. Where rungs provide hand grips (eg a vertical ladder), the rungs should provide adequate ergonomic grip and support, and be not less than 20 mm outside diameter.

(k) Rungs should be securely fastened to the stiles (eg by welding or swaging). To reduce corrosion, they should be completely sealed at the point where they enter into or contact the stiles, and the ends of tubular rungs should be left open.

(l) The minimum clearance at the back edge of the rung of a rung ladder with the container shell should not be less than 200 mm.

(m) Walkways should not be sloped in excess of 20 degrees (1 in 2.7). Slip resistant surfaces, such as cleated or grated walkways, should be provided where a walkway is sloped at an angle greater than seven degrees (1 in 8). Walkways should have a clear width, measured between the inner edges of the guardrails, of not less than 550 mm.

(n) Access along container roofs that are sloped at an angle of more than 20 degrees should be either via a stairway or horizontal platform, with guardrails.

(o) A toe board or other protection to prevent falling objects should be provided at the edge of a walkway, platform or landing where an object could fall more than two metres.

(p) If the access point is under six metres in height and no fixed ladder is provided, and where access is intended by the use of a temporary or removable ladder (eg for maintenance only), a permanent attachment point (such as a hook) or tie off point, should be provided to prevent the ladder slipping.

(q) Attachment points for fall arrest and rescue devices should be included at heights over two metres.

4.4 Access openings

Access openings (where provided) should be located near the base of the container or field bin and allow for safe ground level access.

The area of an access opening should not be less than the equivalent area of 450 mm x 450 mm.

Further advice on access openings is provided in Chapter 5 below.

4.5 Internal access

The internal spaces of bulk containers may be classified as confined spaces – refer to the definition to make a determination and then determine which procedures are applicable. Consider the additional risks of sloping floors of self-emptying containers.

The type of access may include permanent access, or design allowance for the installation of temporary access. Attachment points for fall arrest and rescue should be included, where appropriate.

The container should be designed so that internal access is not required, or the need minimised and restricted. Means of achieving this include the following:

- providing outlets and external facilities for cleaning the inside of the container
- designing the structure and the mechanical parts so that maintenance can be carried out without requiring entry
- providing means for activities such as sampling from outside the container
- reducing the need for internal ladders by providing entry at the base (or at floor level)
- warning signs (see section 10.2)
- where hatches allow entry onto sloping floors or sides of a container, provide additional measures to aid entry and exit (eg a handle and/or step).

Further advice on openings is provided in chapter 5 below.

CHAPTER 5 - Container openings and hatches

Risks arise with entry into a container, and stored substance streaming from the container, that need to be eliminated or controlled.

Preventing or restricting entry, such as reducing the size of openings or providing locking mechanisms for gates and hatches, can reduce risks. If entry is essential for the operation, other controls should be indicated in the manufacturer's instructions (see section 10.4).

5.1 Openings above maximum level of stored substance

Provision should be made to prevent or restrict entry into openings above the maximum level of stored substance and to prevent falls into the container. This should include the following:

- limiting openings to an area equivalent to 150 mm in diameter
- providing fixed guards that require tools to dismantle or keys to unlock. Such guards should have openings of an area no greater than the equivalent of 150 mm diameter. A hinge or other attachment should be used to permanently attach the guard to the container.

5.2 Openings below maximum level of stored substance

- Outward-opening gates, doors or covers located below the maximum level of stored substance and potentially in contact with the stored substance, should have adequate control measures to prevent accidental release. As examples, the design should ensure the following:
  - ✓ they cannot open accidentally (eg by vibration, or by being knocked by people or vehicles)
  - ✓ mechanical means restrict the extent of initial opening
  - ✓ opening is effected from a position, and with a procedure, that protects the operator from injury
  - ✓ a suitable readily visible sign is affixed, warning of potential dangers of streaming substance (see section 9.1).

- The doors and catches should be sufficiently structurally sound to take the load of the stored substance without bursting open.

- If access to the container is possible while it contains stored substance, consider providing access for emergency rescue that opens outward to enable the stored substance to be removed rapidly to release anyone that may be trapped inside. The bottom hatch (normally used for unloading) could meet this requirement, however, usually more than one point will be required to eliminate structural stresses and allow substance to empty freely.

CHAPTER 6.0 - Loading and unloading the container

Loading and unloading may present risks relating to streaming substance, pressurisation and access when operating plant or checking substance levels within the container.

6.1 Controls for the discharge gates and valves

Controls for the discharge gates and valves should have the following features:

- protected, or placed in a position to prevent their inadvertent operation
- placed so as to allow operation of the flow from a safe position and to allow visual monitoring of the discharge
- lockable when not in use, to prevent unauthorised access.

6.2 Material level indicating devices

To minimise the need for access to heights, a device visible at ground level should be incorporated to indicate the level of substance stored within the container (eg sight glasses).

Where containers are filled by pressurised transfer systems, pressure sensors and high level sensors could be necessary to prevent over-pressurisation.

6.3 Clearance under discharge gate – conical silos

The minimum clearance under the discharge gate of a silo with a conical base should be adequate to allow for easy placement of a discharge conveyor, auger with an inlet chute, or other device, where such systems are to be used. Clearance should be sufficient to allow proper guarding of the auger or conveyor.

6.4 Cone angle – self emptying containers

To assist complete emptying, and to eliminate the need for entry or other means of releasing stored substance, the base cone angle of self-emptying containers should be at least three degrees greater than the angle of repose of the intended stored substance.

6.5 Guarding of machinery

Plant used for loading and unloading, such as augers, should have appropriate guarding (see advice in chapter 9).

CHAPTER 7 - Preventing fires and explosions in containers

7.1 Hazards and risks

7.1.1 Causes of fires and explosions

The risks of fires and explosions need to be assessed from the hazards presented by the nature of the substance intended to be stored in the bulk container, and the risks arising from any associated processing plant (eg solvent extraction of seed oil). Advice on restrictions or recommendations on the substance that can be stored, must be specified and provided in the manufacturer's instructions (see section 10.4). Common substances that should not be stored must also be specified.

Grain and organic dusts, metal dusts and other substances can become an explosion risk. Examples of the way explosive atmospheres can be created include the following:

- gases generated within containers
- airborne dust generated during loading or unloading
- dust deposits on surfaces can be stirred by mechanical action or air drafts and become airborne
- certain bulk solids emit flammable gases during storage, creating a potential fuel for gas explosions.

Explosions can occur when an ignition source comes into contact with a combination of air and fuel mixture. It is important to ensure that dust or flammable vapours in containers is prevented from coming into contact with sources of ignition such as flames, electrical arcing, mechanical sparking, and static electricity. Consequently, potential ignition sources, such as flames, electrical sparks and lightning, must be identified and controlled. Dust layers can self-heat and smoulder, thereby creating an ignition source.

Containers associated with food processing, such as flour milling, dried powder production, sugar processing and the spray drying of milk or coffee, have an explosion risk.

The fire and explosion risks of any associated use and storage of solvents or fuels (eg LP Gas used for heating and drying) also need to be assessed in relation to dangerous goods legislation and relevant Australian Standards.

The use of water in fire fighting can create additional hazards, either by chemical reaction or stirring up deposits.

Sealed containers can be designed to have all their openings sealed to prevent oxygen from entering or to allow fumigation. The top and bottom openings are normally sealed with rubber-gasket hatches. When the hatches are tightly closed and the container is filled, the oxygen concentration should be insufficient to support a fire. However, if the container is not properly sealed or is not operating as designed, enough air may enter and provide oxygen to allow a fire to smoulder, causing combustible gases to accumulate (due to incomplete combustion). Any increase in air, such as by opening hatches, can create an explosive atmosphere. These risks may also apply to other types of oxygen limiting containers or semi-sealed containers.

7.1.2 Dangerous goods classification

Designers must have regard to the dangerous goods classification of the intended stored contents of the container, and provide equipment that is suitable and safe for use with the dangerous goods.

Some agricultural products are classified as dangerous goods Class 4.2 *Substances liable to spontaneous combustion*. The classification of typical agricultural products includes:

- UN 1363 Copra (dried coconut kernels)
- UN 1364 Oily cotton waste, including cotton hulls and lint from cotton gins
- UN 1373 Fibres, animal or vegetable with oil (includes seed cake with more than 5 per cent oil content)
- UN 1374 Fish meal (fish scrap) unstabilized (Class 9, UN 2216, if stabilized)
- UN 1386 Seed cake (more than 1.5 per cent oil and up to 5 per cent, and not more than 11 per cent moisture) (classified as UN 1373 if more than 5 per cent oil content)
- UN 2217 Seed cake (if not more than 1.5 per cent oil and not more than 11 per cent moisture)
- UN 3088 Self-heating solid, organic, not elsewhere specified.

UN 1373 also includes fabrics and synthetic fibres if they contain oil. 'Seed cake' is derived from a number of crops including coconut, cotton seed, peanut, linseed, maize, soy, rice and sunflowers. This could be in the form of pellets, flakes, or meal as well as cake.

Solvent extracted soybean meal containing not more than 1.5 per cent oil and 11 per cent moisture, and which is substantially free of flammable solvent, is not classified as a dangerous good.

Farms and other industries could also store ammonium nitrate fertiliser, class 5.1 or class 9 depending on the exact classification. Wet cotton is also classified as dangerous goods (UN 1365).

7.2 Control measures

Control measure should focus on reducing the concentration of dusts and eliminating ignition sources. Fire suppression measures may also be needed. The OHS Regulation specifically requires that the build up of unwanted substances or material is minimised (clause 89(2)(c)).

If the stored substance may generate flammable or explosive atmospheres, or if dangerous goods are stored or used, hazardous areas should be identified in order to determine suitable control measures.

To control fire and explosion risks consider the following:

(a) Provide explosion relief vents or doors where the risk assessment indicates a risk of dust or gas explosions (see advice in section 3.8).

(b) The design should eliminate near horizontal internal surfaces, ledges and overlaps where dusts may deposit and accumulate.

(c) To determine the location of electrical plant and/or the level of protection required, classify the hazardous areas in relation to combustible dusts, and also flammable atmospheres, where relevant. See AS/NZS 61241 series*, Electrical apparatus for use in presence of combustible dust*, particularly *Part 3 – Classification of areas*. For flammable gases, determine the area classification using Australian Standard AS2430.3– *Classification of hazardous areas* (all parts). Note that AS2430.3 will also need to be observed if the container is associated with a solvent extraction process.

(d) Locate electrical equipment, eg motors, control stations, switches, motor starters, lighting fixtures, socket outlets and plugs, away from the hazardous area. If that is not practicable, ensure adequate protection (see points (f) and (g) below).

(e) Avoid the use of mechanical equipment that can produce sparks inside the container.

(f) If electrical equipment is to be used in or near containers, provide electrical equipment designed to reduce the risk of dust explosion. See AS/NZS 61241 series*, Electrical apparatus for use in presence of combustible dust*. For further information see section 9.2.

(g) Where electrical equipment is necessary, hazardous areas should be identified to determine the suitability of electrical plant. In hazardous areas, provide plant that complies with Australian Standard AS 2381 – *Electrical equipment for explosive atmospheres - Selection, installation and maintenance*. To make decisions about the level of protection required, determine the area classification using Australian Standard AS2430.3 (all parts) – *Classification of hazardous areas.* Note that AS2430.3 (all parts) will also need to be observed if the silo is associated with a solvent extraction process.

(h) The possible build up of a static electrical charge by equipment also needs to be considered as an ignition source. Further advice is provided in AS/NZS 1020 *Control of undesirable static electricity*.

(i) Lightning may present an ignition hazard. Advice on lightning protection is provided in AS 1768 *Lightning protection*.

(j) Where the contents are potentially spontaneously combustible (eg dangerous goods of class 4.2), provide means to allow the injection of inert gas (such as carbon dioxide or nitrogen) from ground level, to extinguish or control any internal fire. Appropriate fittings (eg gas tight threads) compatible with the proposed method of gas injection should be considered. Allowance for space for vehicle access to supply gas (such as a bulk tanker) may be required when determining location requirements for the design.

CHAPTER 8 - Additional design considerations for oxygen limiting silos (including sealed and semi-sealed silos) to prevent fires and explosions

8.1 Hazards and risks

Sealed containers can be designed to have all their openings sealed to prevent oxygen from entering or to allow fumigation. The top and bottom openings are normally sealed with rubber-gasket hatches. Some have pressure equalisation devices such as breather bags, while others are semi-sealed by having limited openings.

The design should consider the effects of pressure and temperature changes resulting from the following:

- discharge or filling
- changes in the air temperature inside the silo (resulting from extreme hot or cold weather conditions)
- heat caused by the absorption of moisture, decomposition or reaction of substance stored within the silo (see advice and classification in Chapter 7)
- aerating or drying systems
- fumigation systems.

When the hatches are tightly closed and the container is filled, the oxygen concentration should be insufficient to support a fire. However, if the container is not properly sealed or is not operating as designed, enough oxygen may enter to allow a fire to smoulder, causing combustible gases to accumulate due to incomplete combustion. Any increase in oxygen in such an environment can create an explosive atmosphere. These risks may also apply to other types of oxygen limiting containers or semi-sealed containers.

The risk assessment should include a consideration of the variation of the internal pressure and temperature outside of the design parameters that could lead to structural collapse, fires or explosions.

8.2 Control measures

To control the above risks, an oxygen limiting or sealed silo should be provided with the following:

- a pressure relief device to ensure that its internal pressure is within the limits allowed by the design, and where necessary a vacuum breaker device to prevent implosion
- a pressure gauge to measure internal pressure
- provision for a temperature gauge or other means to measure internal temperature
- a means of warning when internal temperature exceeds that allowed by the design, or internal pressure is outside the limits allowed by the design
- warning signs displayed to warn fire fighters that the silo is in fact a sealed silo or other oxygen limiting type - see section 10.2(e).

These controls are in addition to those outlined in Chapter 7 for fire and explosion risks.

8.3 Provision for pressure testing

To enable the user to check the effectiveness of the seals, sealed containers such as silos should have a pressure relief valve and a valve or method to allow the user to conduct a pressure test, to determine whether the silo is sealed, so an effective and safe fumigation can be conducted. The testing method should be one that is easily administered by the operator (eg appropriate for farmers).

CHAPTER 9 - Ancillary equipment safety

9. 1 Machine safety and guarding

All ancillary plant, such as augers, conveyor drive shafts and pulleys, should be guarded to prevent anyone coming into contact with moving parts of the machinery. Further advice is provided in AS 4024.1 - *Safeguarding of machinery Part 1: General principles*.

If conveyors are fitted or supplied, the requirements of AS 1755 - 2000 *Conveyors - Safety requirements*, which has the legal status of an approved industry code of practice in NSW, should be observed.

Appropriate controls and emergency stops should be provided - for details see clauses 91 and 92 of the OHS Regulation.

Electrical installations associated with the bulk container, for example to provide power outlets or lighting, must comply with AS/NZS 3000 - *SAA Wiring rules*, which references other relevant standards, as required by the *Electricity Safety (Electrical Installations) Regulation 1998*. Power outlets must be RCD protected.

9.2 Electrical protection – dusts, water and vermin

If the container is to be used for substances that could produce dusts with a combustion or explosion hazard, associated electrical equipment needs to be intrinsically safe, or protected – ie rated for the hazards that could be present (including the dangerous goods classification of the intended stored substance).

Provide electrical plant (or components) designed to reduce the risk of explosion from use near containers (for example, provide equipment complying with Australian Standard AS 2381 – *Electrical equipment for explosive atmospheres - Selection, installation and maintenance*). To make decisions about the level of protection required, determine the area classification using Australian Standards in the AS/NZS 61241 series *Electrical apparatus for use in presence of combustible dusts*. The equipment must be explosion protected and have approval for the applicable zone, and the relevant Gas Group and Temperature Rating where relevant.

To prevent shocks during cleaning with water, ensure that electrical equipment is protected against penetration by water. Minimum required protection is IP65 to Australian Standard AS 1939 - 1990 *Degrees of protection provided by enclosures for electrical equipment*. Consider the impact of water during washing of the container for cleaning purposes.

Where vermin could chew through electrical cabling, steel wired armoured cable should be considered.

9.3 Wheels on field bins, including retraction and extension equipment

Fatal and serious injuries have resulted from the inability to control the sudden change of loads on spring-assisted or eccentrically operated levers when lowering or raising the wheels of field bins.

The risk assessment must identify and assess manual handling risks associated with the wheeling of field bins, and control measures must be determined. This should include consideration of the following:

- the effort required to operate the lever for raising or lowering the wheels of the equipment
- the ability to control the full stroke of the lever when raising or lowering the wheels of the equipment under all foreseeable modes of operation such as the removal of the wheels for maintenance or repair purposes
- the effort required to place a tow hitch onto a tow ball

- the effort required to set up the bin for towing. This may require the fitting of adjustable stands or jockey wheels
- the effort required to move the bin. This may influence the selection of the size and type of wheels to be used and may require the fitting of jacks or winches.

CHAPTER 10 - Provision of information

10.1 Legal obligation

The designer must specify systems of work and operator competencies where necessary (OHS Regulation clause 95). Designers, manufacturers, and suppliers including importers of plant must provide (or arrange for the provision of) adequate information to allow users to work safely (the obligations for various parties are in the OHS Regulation, clauses 96, 105, 122, 132). This needs to include advice on the control measures determined by the designer, manufacturer or supplier, and included in the safety features of the container supplied. Ways of doing this include: warning signs and markings, a specification plate, and safe installation and operating instructions, in English, and in SI units where appropriate. Signage relevant to emergency services should be considered.

10.2 Warning signs and markings

The following points should be considered in relation to providing suitable signs, marking or labels.

(a) Warning signs and markings should be permanent (eg resist fading and erosion by wind blown dust) (for advice see AS 1319 *Safety Signs for the Occupational Environment*).

(b) Control levers and buttons should be labelled to indicate their intended purpose, and indicate hazards created if used outside the designer's intended use.

(c) Warning signs providing administrative controls for confined spaces and other hazards, such as the following, should be displayed where relevant to the control measures chosen, as examples:
- adjacent to access openings: DANGER – CONFINED SPACE ENTER ONLY WHEN CONTAINER EMPTY – CONFINED SPACES SAFETY PROCEDURE MUST BE FOLLOWED
- at all other openings greater than 250 mm: DANGER - CONFINED SPACE - DO NOT ENTER (or DO NOT ENTER UNLESS AUTHORISED)
- a visible sign should be permanently affixed to each outward opening containment device displaying the following warning: DANGER OF STREAMING MATERIAL - OPEN WITH CAUTION.

(d) The allowable loads on ladders should be permanently displayed. If fall arrest attachment points are provided, a notice should advise of the need to use these.

(e) Warning signs regarding fire fighting, such as:
- information for fire fighters concerning the proper fire extinguishing techniques, visible from a safe fire fighting position
- a warning prohibiting directing water or foam to extinguish the fire through the top openings as this may result in an explosion, or collapse due to product expansion
- identification of the type of silo or container – eg whether it is a sealed or semi-sealed design, so that fire fighters can adopt an appropriate procedure.

(f) Signs relating to the identification of the intended contents, including the dangerous goods classification of the contents if applicable.

(g) Towing and braking requirements for relocatable containers such as field bins and chaser bins.

10.3 Specification Plate

A specification plate showing the following information where relevant should be permanently attached to the container:

- manufacturer's name and contact details
- model type
- serial number
- year of manufacture
- maximum allowable load of stored substance in tonnes
- type of substance or produce that may be stored (or not stored)
- silo design type if sealed or semi-sealed (ie oxygen limiting)
- maximum allowable filling and discharge rates, and/or pressures
- whether or not eccentric (ie off-centre) filling is allowed, and if so the allowable eccentricity
- maximum allowable pressure or vacuum in the container and/or operating temperature
- material specification (ie of the material the container is made from)
- specification of internal or external cladding
- corrosion allowance
- for relocatable containers (such as chaser or field bins) the weight of the container, towing and braking requirements and the maximum allowable ground slope
- for containers with wheels such as field bins and chaser bins, the correct tyre pressure
- any other restrictions aimed at ensuring the container is used only for its intended purposes.

The items on the specification plate should also appear in the manufacturer's instructions (eg in the form of an operating manual, described below in section 10.4).

To prevent overloading, provide users with a description of storage capacity. For cylindrical farm silos, see Australian Standard AS 3729 - 1989 *Farm Silos - Determination of storage capacity* for advice on determining this.

10.4 Safe installation and operating instructions

Designers must develop information on safe use. Ultimately, the supplier of the bulk container is the person who must ensure that their clients are provided with all necessary information that relates to the safe use. This should be based on information that was provided, in turn, by the designer and manufacturer. Where this is not available, for example, for second hand equipment or for items imported without the information provided in English, it must be developed by a competent person.

Safe installation, operating and maintenance instructions should be provided in the form of a manual (the 'manufacturer's instructions'), including systems of work and operator competencies. This needs to describe how the control measures determined by the designer are to be used.

Information provided should include the following:

- Identification of the various components and features of the container relevant to safety.
- Advice concerning the safe assembly, installation, dismantling and disposal of the container, including site requirements, foundations, loadings and any tests required, such as the pressure testing of sealed silos.
- Operating instructions and systems of work (including preventing fires and explosions) to ensure safe use, loading and unloading instructions, such as transfer rates and pressures, any loading limitations, and restrictions on entry. Advice on the safe operation of wheel retraction mechanisms, if fitted to relocatable containers such as field bins.
- Safe entry and access instructions, including access to stairs, ladders, roofs, base and interior of the container, and the use of fall arrest and rescue points.
- Maintenance and cleaning instructions, including any testing and inspections, and any special conditions that require attention, such as faults, deformation, corrosion, subsidence indicators and lopsided storage. The time periods and method for maintenance, inspection and cleaning should be specified, including the period for major in depth inspection (overhaul inspection), taking into account environmental variations and location (eg those installed in marine environments may need more frequent inspection).
- The type of substance or produce that may be stored, limits on the angle of repose, and the relevant hazards and risks, such as rotting of stored substance, gas or dusts that may be generated, the dangerous goods classification of contents, any hazardous substances classifications that may be relevant (eg grain dust is classified as a hazardous substance) and related hazards such as pesticide use.
- Instruction on how to extinguish fires and other emergency procedures related to the nature of the container and its contents. Include any special measures for oxygen limiting silos such as inert gas injection, drenching or purging systems. Provide advice on monitoring the temperature and the appropriate temperature range to assist early detection of potential over-heating and fires.
- A list of recommended spare parts and safety critical maintenance (eg renewing seals).
- Other relevant safety information, including the operation of any ancillary plant and equipment provided such as conveyors.
- All relevant training of operators that is required for healthy and safe operation, and other relevant criteria such as fitness of operators.

APPENDIX 1 - Relevant Standards and WorkCover publications

The publications listed below provide guidance. Some have been adopted as codes of practice and this is indicated.

Australian Standards

AS/NZS 1020	Control of undesirable static electricity
AS 1170.2	Structural design actions - wind actions
AS 1319	Safety Signs for the Occupational Environment
AS 1657 – 1992	Fixed platforms, walkways, stairways and ladders – Design, construction and installation (Note that this standard is an approved industry code of practice in NSW, adopted by the Code of Practice for Technical Guidance, commencing on 21 September 2001.)
AS 1755 – 2000	Conveyors - Safety requirements (This standard is an approved industry code of practice in NSW, adopted by the Code of Practice for Technical Guidance, commencing on 21 September 2001.)
AS 1768	Lightning protection
AS/NZS 1891.2 – 2001	Industrial fall-arrest systems and devices – Part 2: Horizontal lifeline and rail systems. (This standard is an approved industry code of practice in NSW, adopted by the Code of Practice for Technical Guidance, commencing on 21 September 2001.)
AS/NZS 1891.4 – 2000	Industrial fall-arrest systems and devices – Part 4: Selection, use and maintenance. This part provides advice on anchorage points. (This standard is an approved industry codes of practice in NSW, adopted by the Code of Practice for Technical Guidance, commencing on 21 September 2001.)
AS 1939	Degrees of protection provided by enclosures for electrical equipment
AS/NZS 2312	Guide to the protection of iron and steel against exterior atmospheric corrosion
AS 2381	Electrical equipment for explosive atmospheres - Selection, installation and maintenance
AS2430.3 (all parts)	Classification of hazardous areas
AS 2865	Safe working in a confined space
AS/NZS3000	Electrical installations (known as the Australian /New Zealand Wiring Rules) (Note that this standard is mandatory in NSW.)
AS 3729	Farm silos- Determination of storage capacity
AS 3773	Bulk solid containers - Safety requirements
AS 3774	Loads on bulk solid containers
AS 4024.1	Safeguarding of machinery Part 1: General principles
AS/NZS 61241.3	Electrical apparatus for use in the presence of combustible dust – classification of areas

WorkCover Publications

Code of practice for the safe use of bulk solids containers, including silos, field bins and chaser bins

Summary of the OHS Act 2000

Summary of the OHS Regulation 2001

Plant guide 2001

Fact Sheet: Plant hire and lease

Code of practice: noise management and protection of hearing at work

For further information contact the Rural Information Hotline on (02) 8882 4235.

APPENDIX 2 - Legal duties of suppliers relating to health and safety at work

This appendix is intended to provide a summary only, and is not to be construed as waiving or modifying any legal obligation. To ensure compliance with legal obligations, suppliers need to refer to the *Occupational Health and Safety Act 2000* and the *Occupational Health and Safety Regulation 2001*, and become familiar with the specific requirements applying to the containers they design, manufacture or supply.

A2.1 Duties of designers, manufacturers, importers and suppliers of plant and substances

(a) The OHS Act

Section 11 of the *Occupational Health and Safety Act 2000* (OHS Act) places duties on designers, manufacturers, and suppliers of plant and substances for use at work to:

- ensure that the plant or substance is safe and without risks to health when properly used, and
- provide, or arrange for the provision of, adequate information about the plant or substance to the persons to whom it is supplied to ensure its safe use.

'Manufacture' includes the assembly, installation and erection of plant.

(b) The OHS Regulation

Duties are further specified in chapter 5 of the *Occupational Health and Safety Regulation 2001* (OHS Regulation).

Designers must identify foreseeable hazards, assess risks and eliminate the risks, or if elimination is not reasonably practicable, control the risks. Hazards include all those that could arise during the lifetime of the item of plant including: manufacture, installation, erection, commissioning, use, repair, dismantling, storage or disposal.

Note that suppliers of plant also include:

- plant hire companies (who have specific duties in chapter 5 of the OHS Regulation)
- importers, who must ensure that the duties as designers and manufacturers are met (see clauses 85 and 99 of the OHS Regulation)
- persons who sell or transfer plant (including second hand dealers), (see clauses 121 to 123 of the OHS Regulation).

Further, Chapter 5 of the OHS Regulation prescribes specific requirements in relation to designing, manufacturing and supplying plant. This includes the following:

- some specific requirements in the identification of hazards, assessment and control of risks
- provision of certain information to persons who have responsibilities under the Regulation such as installers and users of plant
- guarding, operational controls and emergency stops
- specification of competencies for users in all aspects, including erection and commissioning.

Risks must be eliminated, or if this is not reasonably practicable, risk must be controlled. Clause 87(2)(e) specifically includes an obligation to take into account control measures required by the Regulation, even when the

obligation falls on other persons, such as users of plant. When controlling risk, the OHS Regulation (clause 5) specifies that the 'hierarchy of control' must be used.

Specifically, clause 89(2) of the OHS Regulation requires designers to ensure that plant is designed:

(a) having regard to ergonomic principles and,
(b) so that safe access can be gained to the various components for purposes of maintenance, adjustment, repair and cleaning and,
(c) so that the build up of unwanted substances or materials that create a risk are minimised and,
(d) in the case of plant designed to work near electrical conductors, having regard to such safety requirements as insulation, earthing and appropriate access to controls.

Clause 95 requires the designer to specify systems of work or operator competencies if they are necessary for the safe manufacture, installation, erection, commissioning, use, repair, maintenance, dismantling or disposal of plant.

Clause 96 of the OHS Regulation requires designers to provide information to other persons who have responsibilities under the OHS Regulation with all available information about the plant that is necessary to enable the other persons to fulfil their responsibility with respect to following: identifying hazards, assessing risks arising, eliminating or controlling those risks and providing information. The designer must ensure that the manufacturer (including a person manufacturing the plant for their own use) is provided with information to enable the plant to be manufactured in accordance with the design specifications. As far as practicable, the information about the item of plant must include the following:

- the purpose for which the plant is designed
- testing or inspections to be carried out
- installation, commissioning, operation, maintenance, inspection, cleaning, transport, storage and dismantling
- systems of work necessary for safe use
- knowledge, training and skill necessary for persons undertaking inspection and testing of the plant
- emergency procedures.

The duties of manufacturers and sellers in relation to the assessment and control of risks are also set out in chapter 5 of the OHS Regulation.

A2.2 Duties of controllers of work premises, plant or substance

Section 10 of the OHS Act sets out the duties of persons who have control of work premises, plant or substances as follows:

1. a person who has control of premises used by people, as a place of work must ensure that the premises are safe and without risks to health
2. a person who has control of any plant or substance used by people at work must ensure that the plant or substance is safe and without risks to health when properly used.

A place of work is essentially any place where persons work, including any premises, any installation on land or any moveable structure.

Examples of persons who have control of work premises, plant or substances related to farm bulk handling and storage include:

- owners who lease farms or rural equipment
- persons who have, under any contract or lease, an obligation to maintain silos, augers, conveyors and other bulk handling equipment.

A2.3 Coordination of duties and multiple responsibilities

Note that a responsibility may fall on more than one person, in which case the parties need to ensure that their responsibilities are discharged in a coordinated manner (OHS Regulation, clause 8).

Similarly, one person may have several of the responsibilities described above.

A2.4 Reasonably practicable

NSW legislation requires employers to do certain things when it is 'reasonably practicable'. This code of practice also uses these words. This term is not defined in legislation, but has been considered in case law.

Deciding what is 'reasonably practicable' means having regard, as the context permits, to the:

- severity of the hazard or risk
- state of knowledge about the hazard or risk and ways of eliminating or controlling these
- availability and suitability of ways of averting, eliminating or controlling the hazard or risk
- cost of implementing the ways of averting, eliminating or controlling the hazard or risk
- the likelihood of the risk occurring.

These factors need to be weighed up against one another and applied to the circumstances of each case. For example, costs need to be weighed against the severity of the risks.

While the information given in this appendix is for your guidance, in considering these factors you may need legal advice on applying the obligations under the Act and Regulation to each particular situation and circumstances.

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