What is a Code of Practice?

The term "code of practice" has a particular meaning under the Victorian **Occupational Health and Safety Act 1985** (the Act). Other codes of practice, such as the advisory codes developed by the National Occupational Health and Safety Commission or Standards Australia, voluntary codes agreed in an industry, or codes adopted by other states or countries do not come within the meaning of the term used in the Act. The Act provides for codes of practice "for the purpose of providing practical guidance to employers, self-employed people, employees, occupiers, designers, manufacturers, importers, suppliers or any other persons who may be placed under an obligation by or under this Act. . ."[S.55(1)].

A code of practice approved by the Minister comes into effect when "notice of approval is published in the Government Gazette or on such later day as may be specified in the notice, . . ." [S.55(6)]. A code of practice does not have the same legal force as Regulations. Contravention of, or failure to comply with, Regulations made under the Act is an offence [S.47(1)]. Failure to observe a provision of an approved code of practice is not in itself a breach of the Act [S.55(8)].

A health and safety representative is able to cite an approved code of practice in a Provisional Improvement Notice as a means by which an alleged non-compliance with the Act or Regulations may be remedied [S.35(2)(a)]. Similarly, an Inspector may cite an approved code of practice as a means of remedying alleged non-compliance when issuing an Improvement Notice or Prohibition Notice [S.45(2)(a)].

The Act provides for codes to be used as evidence of contravention or failure to comply with a provision of the Act or regulations under the Act. The relevant section is section 56 and it is reprinted below.

Where in any proceedings under this Act it is alleged that a person contravened or failed to comply with a provision of this Act or the regulations in relation to which an approved code of practice was in effect at the time of the alleged contravention or failure-

(a) the approved code of practice shall be admissible in evidence in those proceedings; and

(b) if the court is satisfied in relation to any matter which it is necessary for the prosecution to prove in order to establish the alleged contravention or failure that-
(i) any provision of the approved code of practice is relevant to that matter; and
(ii) the person failed at any material time to observe that provision of the approved code of practice-

that matter shall be taken as proved unless the court is satisfied that in respect of that matter the person complied with that provision of this Act or the regulations otherwise than by way of observance of that provision of the approved code of practice.

The practical effect of this section is that provisions in the code constitute compliance with the provision of the Act or a regulation to which the code is giving practical guidance. The provisions in a code are, however, not mandatory. That is, a person may choose to comply with the relevant provision of the Act or regulation in some other way, provided that the alternative method used also fulfils the requirements of the Act or regulations.

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What is the effect of incorporating standards in a code of practice?

Incorporation of a published technical standard in a code of practice has the effect of making that standard form part of the code. The standards listed in this code provide guidance to designers and manufacturers of plant which includes or is likely to include a confined space, and to employers on how to comply with their duties under the Occupational Health and Safety (Confined Spaces) Regulations 1996.

It is important to note that the standards themselves have not been written specifically as guidance on how to comply with the duties under the Regulations. As such, following the provisions of an incorporated standard may not constitute full compliance with the relevant duties. This is because the standard itself may not deal with all the matters relevant to hazard identification, risk assessment and risk control for the confined space in question. Appropriate judgement needs to be exercised in such circumstances.

To the extent that provisions of an incorporated standard are relevant to a duty under the Regulations, following those provisions (as is the case with any code provision) is deemed by the Victorian WorkCover Authority to be compliance with the relevant duty under the Regulations.

A designer or manufacturer of plant which includes or is likely to include a confined space or an employer or self-employed person may have followed the provisions of a relevant standard that is incorporated in this code prior to the Regulations coming into operation. In that case, they need to re-appraise the action they have already taken to comply with previous legislation covering hazards and risks associated with confined spaces, to assess whether or not they are in full compliance with the duties under these Regulations. However, as with other code provisions, provisions of an incorporated standard are not mandatory - alternative measures may be used in order to comply with the duties under the Regulations.

It should be noted that many of the published technical standards listed in this code contain provisions expressed in a mandatory manner, that is, they state that a person "shall" do some action. The mandatory provisions in the published technical standards are not mandatory for the purpose of the code. They should not be treated any differently to other provisions in those standards.

Summary

1. Purpose

This code of practice provides practical guidance on how people can meet the requirements of the Occupational Health and Safety (Plant) Regulations 1995. The aim of the Regulations is to protect people against the risks plant and associated systems of work can pose to their health or safety at work.

2. What is Plant?

Plant is defined in the Regulations to cover items such as lifts, cranes, pressure equipment, machinery, hoists, powered mobile plant, amusement structures, lasers, turbines, explosive-powered tools, scaffolds and temporary access equipment. The Regulations do not cover ships, boats, aircraft, road and rail vehicles, hand-held plant and plant which relies exclusively on manual power for its operation. This code of practice only deals with the types of plant covered by the Regulations.

3. Hazard Identification, Risk Assessment and Risk Control

The Regulations require the identification of hazards, assessment of risks and control of risks posed by plant and associated systems of work. The Regulations apply to designers, manufacturers, importers and suppliers of plant, employers and self-employed persons. The code explains what these processes mean and how they can be performed by designers and employers. Examples are also provided.

4. Duties of Designers

Proper attention to hazards and risks at the initial design stage can prevent or minimise many subsequent problems with plant. The code explains how designers can identify hazards, assess and control risks in the design process. A range of common hazards and risk control options are outlined, together with advice on issues such as the use of published technical standards in designs, appropriate record keeping practices and information provision.

5. Duties of Manufacturers, Importers and Suppliers

Manufacturers, importers and suppliers of plant can also play an important role in minimising risks by ensuring that hazard identification, risk assessment and risk control are done and that people supplied with the plant receive appropriate information on the use of the plant. The code explains the types of information that manufacturers, importers and suppliers need to give to people to whom the plant is supplied to ensure the plant is safely used.

6. Use of Plant

Positive and cooperative workplace arrangements are an important part of any injury and illness prevention strategy. The code offers employers advice not only on hazard identification, risk assessment and risk control measures, but also discusses issues such as consultation and employee training, information and instruction. A range of measures for controlling risks arising from the operation of plant are outlined. Examples are also provided of risk control measures for specific types of plant.

1. Authority

This code of practice is approved pursuant to section 55 of the **Occupational Health and Safety Act 1985** (the Act).

2. Purpose

The purpose of this code of practice is to provide practical guidance to persons on how they can meet the requirements of the **Occupational Health and Safety (Plant) Regulations 1995** (the Regulations), the objective of which is to protect people at work against risks to health or safety arising from plant and systems of work associated with plant.

3. Scope of This Code

This code of practice applies to all employers as defined under section 4 of the Act and to all designers, manufacturers, importers and suppliers of plant to workplaces. It also applies to self-employed persons who are required to comply with Part 7 of the Regulations as if they were an employer. *Note 1*

Note 1 (Note: a self employed person's duties under the Regulations only relates to people who may be exposed to a risk arising from the conduct of the undertaking of the self-employed person.)

The code applies to all the types of plant covered by the Regulations (as set down in regulation 106(1)). This includes pressure equipment, tractors, earthmoving machinery, lasers, scaffolds, temporary access equipment, explosive-powered tools, turbines and amusement structures. *Note 2* It also includes plant that lifts or moves people and material, such as lifts, escalators, cranes, hoists and elevating work platforms.

Note 2 (See Appendix 1 for definitions of the types of plant covered by the Regulations.)

The Regulations also apply to plant that processes material by way of a mechanical action which–

- cuts, drills, punches or grinds the material (for example, woodworking saws, drill presses, clicking presses, bench grinders);
- presses, forms, hammers, joins or moulds the material (for example, power presses, die casting machines, forging hammers, plastic injection moulding machines); and
- combines, mixes, sorts, packages, assembles, knits or weaves the material (for example, dough mixers, packaging machines, knitting machines).

Plant not covered by the Regulations and therefore this code of practice (as set down in regulations 106(1)(b) and 106(3)) are:

- ships, boats, aircraft;
- vehicles designed to be used primarily as a means of transport on a public road or rail (for example, motor cars, locomotives *Note 3*);
- plant which relies exclusively on manual power for its operation (for example, block and tackle, hand or foot pumps, trolley vehicle jacks); and
- plant that is designed to be primarily supported by hand (for example, electric hand drills, hand-held spray guns, jack hammers).

Note 3(Employers' duties under part 7 and self-employed persons' duties under Part 8 of the Regulations apply to a vehicle designed to be used primarily as a means of transport on public roads or rail, if that vehicle is being used in a workplace other than a public road or rail)

The jack hammer, either electric or pneumatically powered, is not covered by the scope of the Regulations as this equipment will fall to the ground if released by the operator. The jack hammer is therefore considered to be equipment that is designed to be primarily supported by hand. In contrast, a pedestrian forklift that requires manual propulsion but incorporates an electric raising and lowering mechanism, will come under the scope of the Regulations as it is not primarily designed to be supported

by hand. That is, the release of the pedestrian control bar will not cause the pedestrian forklift to fall or topple over. Also, these are not manually powered plant.

Hydraulic, air or electrically powered hand tools suspended over a work station are not within the scope of the Regulations as they are primarily designed to be supported by hand for their operation. The prime purpose of suspending the tools over a work station is to provide the operators with ready access to the tools rather than as a means of providing support to the tools for their operation.

A hand-held spray gun is powered by a small compressor. Although the spray gun itself does not come under the scope of the Regulations, the compressor, if not designed to be supported by hand, comes under the scope of the Regulations as it is powered.

Plant that may be registrable for public road or rail travel, but which has not been primarily designed for this purpose, comes under the scope of the Regulations. Examples of such plant include forklift trucks, front end loaders, excavators and tractors. For example, a forklift truck is primarily designed to lift and carry loads around warehouses, storage areas and the workplace, not for travel on a public road.

4. Background and Objectives

Plant is associated with a significant proportion of accidents and consequent compensation claims in the Victorian workplace. Approximately 60% of the workplace fatalities investigated by the Health and Safety Organisation in Victoria between 1985 and 1994 were associated with unsafe plant or unsafe systems of work associated with plant. The most common types of plant-related fatalities include:

- falls from, crushing by, run-over and roll-over of tractors;
- entrapment in manufacturing machinery;
- falls from, crushing by, and run-overs by forklift trucks;
- crushing and run-overs by mobile cranes; and
- crushing by fixed cranes.

Plant-related death and injury incurs substantial costs to industry, government and the community. The 186,000 plant-related workers' compensation claims made in Victoria between 1985 and 1994 represent 28% of all compensation claims lodged over this period, with total payments to date of approximately $2 billion. Plant-related accidents can also incur other significant costs - costs that are not so easily quantified. These other costs can include human suffering, lost productivity and the costs of damage to plant and property.

Given the risk associated with the use of plant, Governments over the years have enacted a number of measures to reduce both the incidence and severity of workplace accidents. Until recently, plant safety in Victorian workplaces was regulated by 36 sets of Regulations. Plant is now regulated by only 3 sets of Regulations. These are:

- Occupational Health and Safety (Plant) Regulations 1995;
- Occupational Health and Safety (Certification of Plant Users and Operators) Regulations 1994; and
- Equipment (Public Safety) (General) Regulations 1995.

The Occupational Health and Safety (Plant) Regulations 1995 are a set of broad performance-based regulations which place specific duties on persons to ensure that plant used in workplaces is designed, manufactured, installed, commissioned and used in ways that eliminate or, where this is not practicable, reduce risks to health or safety. The Regulations are intended to protect the health and safety of people at work from risks arising from plant, by ensuring the identification of hazards and the assessment and control of risks arising from exposure to the hazards.

This code of practice aims to assist persons achieve compliance with the Regulations. It is not possible to deal, in the code, with every or even most situations that may confront a designer or manufacturer or that may be found in the workplace. In using this code, discretion and judgement will be needed. Readers should always consider the appropriateness of the advice contained in this code or publications recommended by the code, having regard to the unique characteristics of the plant and the circumstances of the workplace where it is to be used.

5. Definitions

There are a number of key terms used throughout this code. Some of the terms are defined in Section 4 of the Act and others are in the Regulations. The terms are included here for the reader's convenience.

'**Administrative controls**' means controls which use systems of work to eliminate or reduce risk to health or safety and which do not involve engineering controls or use of personal protective equipment.

'**Alter**' in relation to plant means to change the design of, add to, or take away from the plant in such a way that may affect health and safety, but does not include routine maintenance, repairs or replacements.

'**AS**' followed by a number and designation means the Australian Standard to which that designation relates as published by Standards Australia and amended from time to time.

'**AS/NZS**' followed by a number and designation means the Australian Standard/New Zealand Standard to which that designation relates as published by Standards Australia and amended from time to time.

'**Commissioning**' means performing the necessary adjustments, tests and inspections to ensure plant is in full working order, in accordance with the requirements specified in the design of the plant, before the plant commences normal operation for the first time.

'**Employee**' means a person employed under a contract of employment or under a contract of training.

'**Employer**' means a person who employs one or more other persons under contracts of employment or under contracts of training.

'**Engineering controls**' means controls which use engineering measures to change the physical characteristics of plant to eliminate or reduce risk.

'**Hazard**' means the potential to cause injury or illness.

'**Practicable**' means practicable having regard to–
(a) the severity of the hazard or risk in question;
(b) the state of knowledge about that hazard or risk and any ways of removing or mitigating that hazard or risk;
(c) the availability and suitability of ways to remove or mitigate that hazard or risk; and
(d) the cost of removing or mitigating that hazard or risk..

'**Published technical standard**' means a document which gives technical information, guidance or advice on plant, that is published by–
(a) an Authority; *Note 4* or
(b) Standards Australia; or
(c) the British Standards Institute; or
(d) the International Organisation for Standardisation (ISO)–
or an organisation with substantially equivalent objectives in regards to the publication of technical information, guidance or advice on plant as any of the organisations mentioned.

> Note 4 (*'Authority means a person that has the power under the law of the commonwealth of Australia or the law of an Australian State or Territory to require design notification or registration of plant in a manner that is reasonably equivalent to the requirements under Part 10 of the Occupational Health and Safety (Plant) Regulations 1995.)*

'**Risk**' means the likelihood of injury or illness arising from exposure to any hazard.

'**Self-employed person**' means a person who works for gain or reward otherwise than under a contract of employment or apprenticeship, whether or not that person employs one or more other persons.

'**Use**' when used in relation to plant, includes operate, maintain, service, repair, inspect and clean.

'**Vicinity**' means the area in or around the plant within which persons may be exposed to a risk arising from that plant.

Any reference in the Regulations and this code to "designer", '"manufacturer", "importer" or "supplier" is a reference to a person who designs, manufactures, imports or supplies (as the case may be) plant for use in a workplace.

Further definitions of a technical nature are provided in Appendix 1, including definitions of plant types.

6. Systems of Work

The objective of the Regulations is to protect people at work against risks to health or safety arising from plant and systems of work associated with plant. "Systems of work" describes a wide range of activities which can contribute to safe work. Where relevant to the plant and associated work practice under review, systems of work may include:

- the company's policy and procedures for purchasing plant;
- the definition and allocation of roles, responsibility and accountability within the workplace;
- the arrangements or systems in place to ensure quality of instruction, competency assessment and supervision;
- systems of communication while performing a task or within the organisation generally;
- the organisation of work including:
  - the speed of the process line;
  - traffic around the plant (people and vehicles);
  - time spent on monotonous or repetitive tasks;
  - the amount and type of manual handling required;
  - shift work arrangements;
  - any production incentives that may affect health and safety;
- the arrangements or systems in place to ensure skill and experience of the employees allocated to particular tasks;
- work practices and procedures including maintenance and repair schedules;
- and emergency procedures, for example, first aid and evacuation.

7. Generic Hazard Identification and Risk Assessment

The Regulations provide (regulation 202):

> *If a person is required under these Regulations to carry out hazard identification or risk assessment procedures for plant, that person may carry out those procedures for a class of plant rather than for individual items of plant if-*
>
> *(a) all the plant in the class has similar functions and productive capacity; and*
>
> *(b) the procedures carried out for the class of plant do not result in any person being subject to a different risk than if the procedures were carried out for each individual item of plant.*

The Regulations impose duties on designers, manufacturers, importers, suppliers, employers and self-employed persons to carry out hazard identification and risk assessment in relation to plant and associated systems of work. Regulation 202 permits, in specific situations, a single hazard identification and risk assessment process to be carried out for a class of plant with similar functions and productive capacity.

Where multiple items of plant of the same design are used in circumstances (for example, systems of work and environment) which for all practical purposes are the same, a single hazard identification and risk assessment process in respect of one or a representative sample of items of plant in that class is sufficient, provided that the risk to a person is no different than if the processes were applied to each item of plant individually. This avoids the need to unnecessarily duplicate the process.

Example 1
A cannery processing fruit uses a production line that consists of 12 pressure cookers linked directly to the cannery plant performing the process of filling, labelling, and packaging the cans. The pressure cookers in the production line are of the same capacity and design. The employer determines that all twelve pressure cookers operate in the same environment and that operators perform standardised tasks and procedures in relation to them. Under the Regulations the employer is able to undertake a hazard identification and risk assessment on one of the pressure cookers and apply the hazards identified, risk assessment and risk control measures to the other eleven cookers.

Example 2
An employer has six power presses in a sheet metal factory. Each power press is to perform similar functions. The power presses are placed in a row. People may gain access to all sides of the two presses located at each end of the row. With the other four presses, people would only be able to gain access to the front part of the press.

Under the Regulations, the employer is able to undertake hazard identification and risk assessment for one of the end presses and apply the hazards identified, risk assessment and risk control measures to the other end press. Similarly the hazards identified, risk assessment and risk control measures for any one of the presses in the middle of the row may be used for the other three presses.

In choosing to carry out a generic process, the person with the duty to carry out this process must ensure that no person who may be affected by the plant or associated systems of work is subject to a different risk to their health or safety than if hazard identification and risk assessment were carried out for each individual item of plant. If a different risk would be posed to any person, a separate hazard identification and risk assessment process must be carried out for each relevant item of plant.

8. Relationship of the regulations to other hazard-specific regulations

The Regulations provide (regulation 203):

> *If any regulation made under the Act (other than these Regulations)which deals with a specific hazard imposes on any person in relation to plant a requirement which is inconsistent with or equivalent to a requirement imposed by these Regulations, the person is only required to comply with the first regulation.*

Regulation 203 recognises that a number of hazard-specific Regulations are in place and provides for other hazard-specific Regulations that may be developed in the future. To prevent overlap of regulatory duties, obligations and requirements under the **Occupational Health and Safety Act 1985**, regulation 203 establishes the precedence that should be given to hazard-specific Regulations.

If noise is identified as a hazard associated with plant, then in respect to that specific hazard and associated risk, the duties, obligations and requirements of the Occupational Health and Safety (Noise) Regulations 1992 prevail over any reasonably equivalent duty, obligation or requirement of the Occupational Health and Safety (Plant) Regulations 1995. That is, in relation to a noise hazard arising from plant, the Noise Regulations contain all the duties for employers, designers, manufacturers, importers and suppliers since the Noise Regulations prescribe duties for all of these individuals. The approved *Code of Practice for Noise* should be referred to for guidance in meeting the requirements of the Noise Regulations for the prevention, identification, assessment and control of risks arising from noise exposure in workplaces.

Similarly, in respect of manual handling hazards and associated risks arising from plant, the duties, obligations and requirements of the Occupational Health and Safety (Manual Handling) Regulations 1988 applying to employers, prevail over any related duties, obligations or requirements in the Occupational Health and Safety (Plant) Regulations. However, as the Manual Handling Regulations do not contain duties for designers, manufacturers, importers or suppliers, the duties prescribed in the Plant Regulations apply to these individuals in relation to manual handling hazards and associated risks. The approved codes of practice for Manual Handling should be referred to for guidance in meeting the requirements of the Manual Handling Regulations for the prevention, identification, assessment and control of risks arising from manual handling activity in workplaces.

9. Competency of people carrying out duties

Employers have a responsibility to ensure that people carrying out duties under the Regulations on their behalf have the appropriate competency to enable that person to correctly perform the tasks. The competency may be acquired through training, education or experience or through a combination of these.

The necessary training, education and experience will vary according to the type of plant and associated systems of work, and the complexity of the tasks to be undertaken.

10. Introduction

The design of an item of plant is critical to effective elimination or reduction of risk and therefore reduction of plant-related fatalities and injuries. An appropriate design process can avoid hazards and eliminate many of the risks from plant before it is introduced into the workplace. All phases of the life of plant, from design and use through to demolition and disposal, should be considered when designing plant. It is also important that designers produce adequate information about the plant and its proper use in the workplace and that this information is provided and disseminated. This is important to ensure that risks that cannot be eliminated in the plant at the design stage are understood and that appropriate practices are followed when the plant is used.

The Regulations require designers of plant for use at a workplace to ensure that hazard identification, risk assessment and control of risk associated with the design of plant is carried out. The hazard identification, risk assessment and risk control process is summarised in the flow chart at Figure 1.

11. Hazard Identification

11.1 Hazard Identification Duty

The Regulations provide (regulation 302):

A designer of plant must ensure that all hazards associated with the use of plant are identified during the design of the plant, having regard to the state of knowledge of the hazards.

Hazard means the potential to cause injury or illness. Examples of the potential harm that plant or associated system of work may cause to people at workplaces include:

- Injury due to hair, loose clothing, gloves, neckties, jewellery, cleaning brushes or rags, or materials tangling with moving parts of plant or materials in motion;
- Crushing by falling or moving objects or plant tipping or rolling over;
- Crushing due to people being thrown off and under plant;
- Crushing due to parts of a person's body being trapped between plant and any material or structure;
- Injury (cutting or piercing) due to a person striking a sharp object or being struck by sharp or flying objects;
- Shearing of parts of a person's body between two machine parts or between a machine part and a workpiece or between a machine part and a structure or object;
- Friction burns due to a person coming in contact with high speed rotating parts of plant or object, or rough surfaces of the plant or object;
- Injury due to a person coming in contact with high pressure fluid;
- Injury due to electricity shock or burn;
- Injury due to explosion;
- Injury due to slips, trips or falls;
- Injury due to insufficient consideration of ergonomic requirements; Note 5*
- Burns due to a person coming in to contact with high temperature objects or fire;
- Ill-health due to exposure to extreme temperature conditions;
- Injury or ill-health due to exposure to dust, vibration, noise Note 6 or radiation. Note 7

Note 5 (Regulation 303(4) defines 'ergonomic considerations' as "considerations relating to the application of knowledge about human function, capabilities and requirements as it applies to the design of plant and systems of work associated with the plant".)

Note 6 (Refer to section 8 of this code of practice for guidance on the regulatory controls applying to noise hazards associated with plant. The approved Code of Practice for Noise should be referred to for guidance on the prevention, identification, assessment and control of risks arising from noise exposure).

Note 7 (Refer to the Department of Health and Community Services which administers legislation on radiation.)

Designers are required to ensure all hazards associated with the use of plant are identified during the design of the plant. "Use" has a specific meaning in the Regulations – when used in relation to plant, "use" includes operate, maintain, service, repair, inspect and clean".

Thus, under the Regulations the designer is required to ensure that hazards associated with maintenance, service, repair, inspection and cleaning, as well as operation of the plant, are identified.

HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL PROCESS

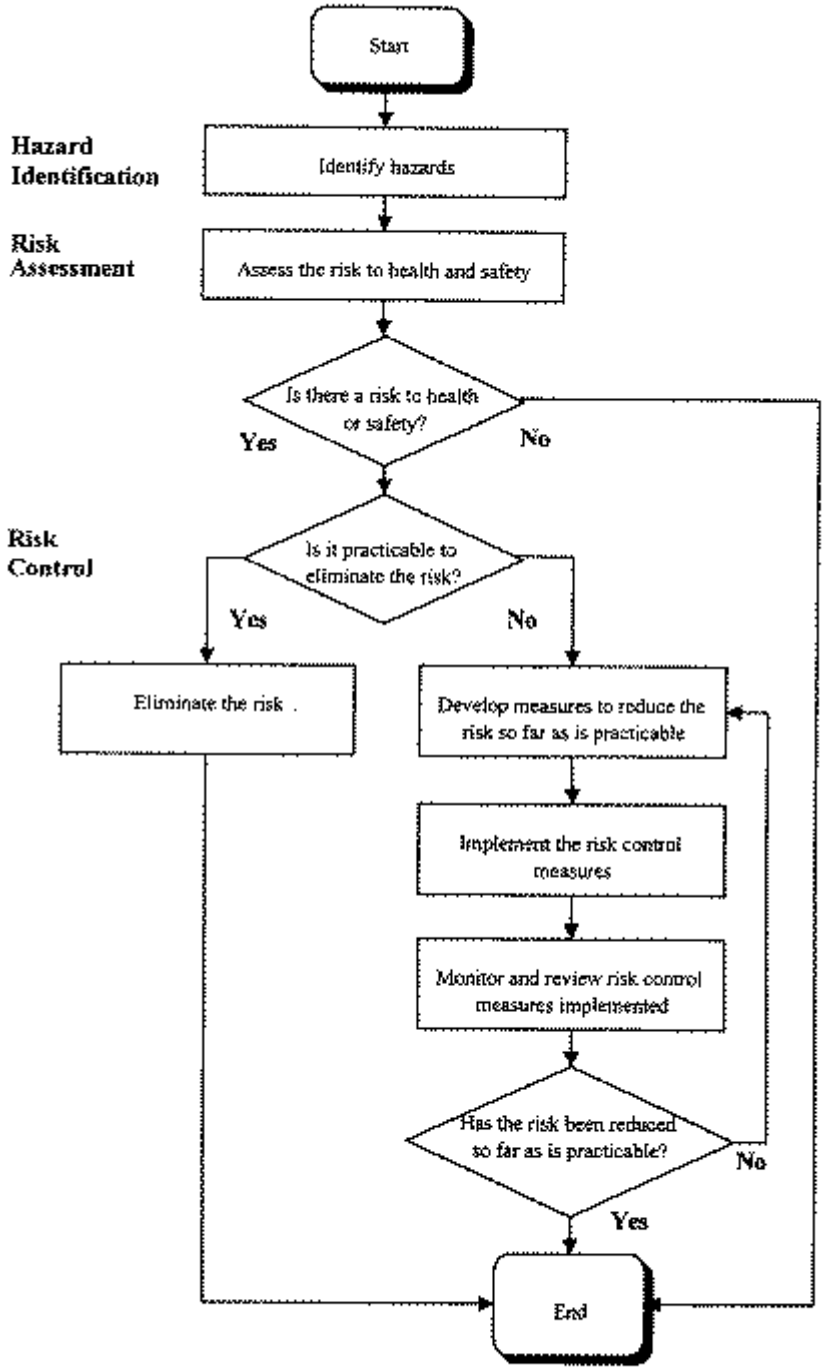


Figure 1: Flow chart

11.2 How to Identify Hazards.

'Hazard identification' is the process of identifying all situations or events that could give rise to the potential of injury or illness. Thus, it involves identifying all the sources arising from the use of the plant, that have the potential to cause injury or illness.

As an example, if the moving parts of an item of plant are identified as having a potential to cause injury through a person's clothing becoming entangled with the moving parts, then entanglement with the moving parts would need to be identified as a hazard associated with the use of the plant.

Appendix 3 outlines some of the hazards and sources of hazards that should be considered during hazard identification. Some or all of these may be relevant when undertaking hazard identification during the design of the plant, however, this is not intended to be an exhaustive list.

Designers should not limit themselves to situations that they have experienced. Rather they should try to anticipate all possible types of plant failure, systems failure, lack of consideration of ergonomic requirements and types of human error and how these could combine to create a situation that would cause harm to people.

Human error can be defined as any part of a set of human actions that exceeds a set limit of acceptability. Most errors are unintentional, unpremeditated actions that are inappropriate in the given situation. Some errors may be intentional. These occur when the person performs an action that is incorrect, but believes it to be correct or to be a better method of achieving the desired result. Thus, human error can also be defined as an inappropriate or missing action or response. (Deliberate behaviour, calculated to damage the system, is not considered to be human error.)

Missing or inappropriate actions or responses are more likely in work situations which place demands on people that are not compatible with their capabilities, experience and expectations. Such situations can occur when the design of plant and plant operating systems do not take account of ergonomic considerations.

The types of possible errors can be summarised as follows:

- error of omission (or missing response) - the person omits a specified action, a step in a sequence or a whole sequence; and
- error of commission (or inappropriate response) - the person does the task but does it incorrectly, for example, choosing the wrong action or object, doing it in the wrong sequence, taking too long or not long enough, or completing the particular action but not to the desired quality.

Appendix 4 lists some common human errors resulting from poor design through insufficient consideration of ergonomic requirements.

State of knowledge

Under the Regulations hazard identification is to be undertaken "having regard to the state of knowledge of the hazards". The phrase "state of knowledge" is taken from, and is one element of, the definition of "practicable" as set down in section 4 of the Act.

"State of knowledge" is to be interpreted objectively. It is not something which varies according to a duty-holder's own subjective or personal knowledge-base. It is an objective test of the general "state of knowledge" that a reasonable person in that position or situation is expected to have.

The state of knowledge in respect of hazards associated with the use of plant is a collective body of information sourced from experience and research in industry and government, and by professional bodies or specialist occupational health and safety practitioners.

Sources of information

There are a range of sources available that may assist the designer to ensure that the hazard identification process reflects the current state of knowledge on hazards which may arise. Examples include:

- discussions with other designers, manufacturers, suppliers or employers with similar types of plant;
- advice obtained from specialist professionals including engineers;
- available faults, incidents, injury and accident reports or data from employers, users and manufacturers of similar types of plant;
- available accident or incident information, hazard alerts and other relevant reports from Health and Safety Organisation, Victoria and counterparts in other States or overseas, Worksafe Australia, unions and employer associations, and professional bodies; and
- relevant reports or articles from occupational health and safety journals, technical references or data bases from Australia and overseas, where available in Australia.

12 Risk Assessment

12.1 Risk Assessment Duty

The Regulations provide (regulation 303):

(1) If a hazard is identified under regulation 302, a designer must ensure that an assessment is made to determine whether there is any risk associated with the hazard.

(2) Without limiting sub-regulation (1), the designer must ensure that the risk assessment takes into account -

(a) any risk factors associated with the use of the plant and, so far as is practicable, risk factors associated with the use of the plant which are specific to the workplace in which the plant is to be used; and

(b) the range of environmental and operational conditions in which the plant is intended to be used; and

(c) any ergonomic considerations in relation to people who may use the plant.

(3) If the design of plant is required to be notified in accordance with regulation 1001 and a risk assessment has been conducted under sub-regulation (1), the designer of that plant must ensure that-

(a) the method used to undertake the risk assessment required under this regulation; and

(b) the results of the risk assessment-

are recorded and retained, in a suitable state for examination for 10 years.

*(4) For the purposes of this Regulation '**ergonomic considerations**' means considerations relating to the application of knowledge about human function, capabilities and requirements as it applies to the design of plant and systems of work associated with the plant.*

12.2 How to Assess Risks.

"Risk assessment" is the process of determining whether there is any risk associated with each of the hazards identified, that is, whether there is any likelihood of injury or illness.

For each hazard identified, the designer should ensure the risk assessment involves consideration of any likelihood for people to be exposed to the hazard.

The assessment of whether there is any likelihood for people to be exposed to the hazard should involve a critical review of the adequacy of any risk control measures (if any) already incorporated into the design to eliminate the risk.

The Regulations require the designer to ensure that the risk assessment takes into account any risk factors associated with the use of the plant; the range of environmental and operational conditions in which the plant is intended to be used; and ergonomic considerations in relation to the people who may use the plant.

Use

Since "use" has a specific meaning in the Regulations when it is used in relation to plant, the designer is required to ensure that the risk assessment takes into account not only factors associated with the operation of the plant, but also factors associated with maintenance, service, repair, inspection and cleaning of the plant.

Ergonomic considerations in the design of plant

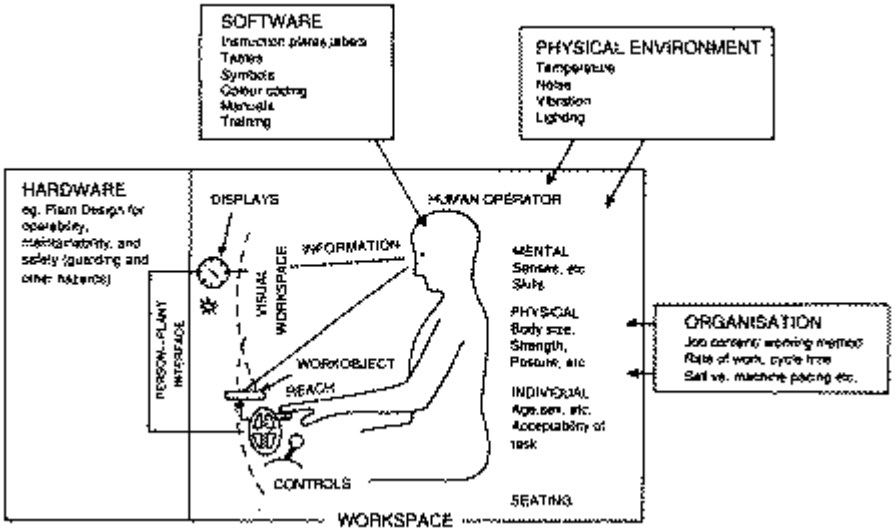
Most plant and associated systems of work involve some degree of human interaction. Ergonomics is concerned with the interaction between people, the plant and the other components of the system, and with the effects of these interactions on the performance of the system (see Figure 2).

A mismatch between human function, capabilities and requirements and the operational requirements for the plant will increase the risk to the operator and others in the vicinity of the plant. The application of ergonomics aims to maximise system performance while minimising the risks to people working with plant, as well as to others in the vicinity of the plant.

Ergonomics should be considered at every stage of the process of designing plant. All design decisions are likely to have some implication for operators or maintenance personnel. It is not sufficient to consider ergonomics in the final stage of developing operation procedures, when all major design decisions have been made.

Ergonomic factors are interrelated with design and performance factors. The risk assessment process that identifies and assesses ergonomic considerations is an integral part of the design process.

Fig 2 Ergonomics considerations in Plant design



* The above figure is derived from Fig. 1.2 in Clark & Corlett - *The Ergonomics of Workspaces and Machines. A Design Manual.* (1995).

Methods of risk assessment

A person carrying out a risk assessment should determine a method of assessment that is appropriate for the plant and the hazards identified. Methods used to assess risks may be identified through discussions with professionals such as engineers and also from other designers, manufacturers, suppliers or employers in the industry, or by referring to relevant published technical standards, technical references and journals or publications issued by Health and Safety Organisation Victoria. Such methods usually involve a combination of some of the following procedures:

- technical or scientific evaluation;
- analysis of past experience of the workplace and the relevant industry, including analysis of injury and near-miss data; and
- instructions or methods recommended by professionals (engineers, safety officers), designers, manufacturers, suppliers, importers, employers, employees or any other relevant parties.

Visual inspection, auditing or testing of plant similar to that being designed, may assist in the assessment of risks.

Examination of injury or incident data for the type of plant under design or for similar types of plant may assist in the determination of risks associated with identified hazards. However, the absence of an accident or incident history, a small number of accidents, or low severity of accidents cannot be taken as an automatic presumption of a low level of risk.

When assessing the risks associated with complex plant, a more systematic approach may be appropriate. A systematic approach may include quantitative analysis methods. For example, if plant is assessed by qualitative and semi-quantitative methods to result in a potentially catastrophic risk, this may need to be investigated further by the application of quantitative risk assessment.

12.3 Recording Risk Assessments.

The Regulations require the designer to record the risk assessment method used and the results of the assessment, if the design of the plant is required to be notified in accordance with regulation 1001. (The plant to which this notification requirement applies are listed in Item 1 of Schedule 2 of the Regulations.)

How the risk assessment is recorded depends on the types of hazards identified and the assessment method used. Whichever format chosen, the link between each hazard and the assessed risk should be clearly identified. The designer is required to retain the records in a suitable state for examination for 10 years.

Although the Regulations do not require the designer to record the risk assessment method and results for plant not requiring notification, it is suggested that this be done for all plant. This should assist compliance with regulation 308 which requires the designer to provide the manufacturer with information relating to the hazards and risks, identified and assessed in accordance with the Regulations, associated with use of the plant.

13 Risk Control

13.1 Risk Control Duty

The Regulations provide (regulation 304):

(1) A designer of plant must ensure that any risk associated with the use of the plant-

(a) is eliminated; or

(b) if it is not practicable to eliminate the risk, is reduced so far as is practicable by altering the design of the plant.

(2) A designer of plant must ensure that-

(a) the plant is designed so that the risk to the operators of the plant and people in the vicinity of the plant when the plant is used, is eliminated, or if it is not practicable to eliminate the risk, is reduced so far as is practicable; and

(b) if particular systems of work or the competency of operators are factors in the control of risk, they are specified in the information provided to the manufacturer under regulation 308; and

(c) if there is a likelihood of powered mobile plant colliding with pedestrians or other powered mobile plant, the design of the plant incorporates a warning device which will warn people who may be at risk from the movement of the plant.

(3) Nothing in this Part (except 301) limits the operation of this regulation.

13.2 Controlling Risk

"Risk control" is the process of determining and implementing measures to control risks. The measures of control should address any risk identified in the risk assessment process. (The designer should have regard to the published technical standards listed in Table 1 in section 13.3 and in the consolidated tables in Appendix 2 when determining measures to control risk.)

The final decision on adoption of control measures should be appropriate to the specific characteristics of the plant and the knowledge available to the designer about the intended operating environment.

The Regulations clearly establish a priority order for the types of measures to control risk. The principal duty of the designer is to eliminate risk associated with the plant. If it is not practicable to do this, the Regulations require the designer to take action to reduce the risk so far as is practicable.

"Practicable" is defined in the Act as meaning:

"*practicable having regard to–*
(a) the severity of the hazard or risk in question;
(b) the state of knowledge about that hazard or risk and any ways of removing or mitigating that hazard or risk;
(c) the availability and suitability of ways to remove or mitigate that hazard or risk; and
(d) the cost of removing or mitigating that hazard or risk."

In determining what measures are appropriate to ensure risk is controlled, each of the elements of practicable are required to be considered. This includes consideration of the severity of risks assessed. That is, consideration of the extent of the risk, including the seriousness of the potential injury or illness and the numbers of people who may be affected.

There are many ways for the designer to eliminate or reduce the risk to health and safety. Any action which removes the risk is the better control solution, provided it does not create another type of hazard and risk. When a control measure is selected, the designer should ensure that it does not create another risk or introduce new hazards. This could be done by carrying out a further hazard identification and risk assessment to evaluate the proposed design. The information gained should be compared to that obtained from the original hazard identification and risk assessment. If no single measure to control risk will achieve a satisfactory result, a combination of measures should be used.

For example, when designing a boiler the designer has identified the hazard of the boiler exploding due to over-pressure. The likelihood of this occurring in the absence of control measures would be high. While it is not practicable to eliminate the risk, the incorporation of a pressure release valve or other safety features reduces the risk associated with the hazard. However, if the pressure release valve or other safety features fail to operate, the risk of over-pressure and hence explosion of the boiler is again high. The safety valve reduces the risk but does not eliminate it.

Design to facilitate safe use

When designing plant to allow for safe use of that plant, factors the designer should take into consideration include:

- the maximum number of tasks an operator can be expected to safely perform at any one time, and complexity of those tasks;
- the layout of the workstation in which the plant may be used;
- the instrumentation for the plant, and the layout of the instrumentation. Instrumentation should provide the operator with clear, accurate information on how the plant is performing but not subject the operator to "information overload", which can cause error;
- the provision of devices, tools or controls appropriate to the pattern of work intended to be performed by the operator or other people using the plant;
- the provision of aids, guides, indicators, locks, interlocks, cover plates, guards, mounted instructions, signs, symbols and/or name plates, to facilitate correct actions and prevent operational errors;
- the need for quick recovery or maintaining the safety and integrity of the system in the event of operational error or plant failure;
- the need for ready access to the operator if assistance is required;
- the need to minimise the impairment of operator performance by eliminating or minimising the need for the operator to engage in physical or repetitive activity for inappropriate periods;
- the need to eliminate the risk of interference with, or inadvertent activation of, plant not in use.

Further guidance on the range of factors that should be considered when designing for the safe use of machinery is contained in AS 4024 *Safeguarding of machinery*. Other published technical standards listed in Table 1 in section 13.3 of this code also have applicable guidance on designing for the safe use of plant.

Ergonomic considerations

Technical references relating to ergonomic considerations can provide useful guidance on human functions, capabilities and requirements for designers of plant and plant operating systems.

It should not be presumed that those who use the plant will have a full or continuous understanding of those aspects of the plant operation that pose a risk to health or safety. Appropriate consideration of ergonomic design principles particularly in the development of appropriate information signals and displays, and controls, as well as the use of "fail to safety systems" can minimise risks posed by human error.

Human error, such as forgetting to do something after being distracted or making an inappropriate action after receiving confusing information, is foreseeable and should be minimised by appropriate design of both the plant and the operating system of which the operator's tasks are part. Appendix 4 provides some examples of specific design problems resulting in human error.

Hazard identification, risk assessment and risk control example
Appendix 5 provides an example of the application of hazard identification, risk assessment and risk control processes to the design of a bench grinder.

13.3 Using Published Technical Standards

When determining measures to control risk, designers should have regard to the published technical standards listed in Table 1 (and in the consolidated tables in Appendix 2). It is acknowledged that there may be a large range of published technical standards other than those listed in Table 1, that address a given design project. Designers may choose to consider these when determining measures to control risk.

The technical standards listed in Table 1 (and in the consolidated tables in Appendix 2) provide guidance for the design projects listed. *Note 8*

Note 8 (The reader should refer to "What is a Code of Practice?" and "Incorporation of Standards" at the front of this code of practice for an explanation of the significance of the technical standards listed in this code.)

For example, in regard to designing a forklift truck, AS 2359 provides guidance relevant to hazard identification, risk assessment and control for a designer. This includes guidance on: calibrating and testing the stability of a forklift truck to ensure the stability of the truck is sufficient to prevent overturning; testing methods to ensure the proposed braking system is appropriate to the truck's speed and loading capacity; selection of tyres and rims, having regard to maximum rated loads; testing for fatigue stress on the fork arms; guarding of dangerous and moving parts; appropriate design of controls including steering wheels, brake pedals and load control levers and advice on the design of forklifts which are required to operate in a potentially explosive or toxic atmosphere, dusty environments and uneven terrain.

Table 1: Published technical standards relating to design of plant			
Item No	**Plant Description**	**Code No.**	**Standard Title**
		AS 4024	Safeguarding of machinery
		AS 1219	Power presses - safety requirements
		AS 2939	Industrial robot systems - safe design and usage
		I/C 1508	Functional safety - Safety related systems
		AS 1431	Low voltage switchgear and control gear - control circuit devices and switching elements Part 1: general requirements
	Machinery - general	BS 6491	Electro-sensitive safety systems for industrial machines
		AS 1418	Cranes (including hoists and winches)
		AS 3860	Fixed guideway people movers
		ISO 2374	Lifting appliances - Range of maximum capacities for basic models
	All cranes including hoists and winches	BS 2573	Rules for the design of cranes
	All conveyors except moving walks	AS 1755	Conveyors - Design, construction, installation and operation - Safety requirements.
	Powered industrial trucks (which includes forklifts)	AS 2359	Powered industrial trucks
	Lifts	AS 1735	Lifts, escalators and moving walks - SAA Lift Code
		AS/NZS 1200	Pressure equipment
		AS 2593	Boilers - Unattended and limited attendance
		AS 3920	Assurance of product quality
		BS 5500	Specification for unfired fusion welded pressure vessels. - category 1. {for AS 1210 class 1H (h = 1)} category 2. {for AS 1210 class 2H (h = 1)}
		AS 2971	Serially produced pressure vessels
		ASME I	Power boilers
		ASME II	Materials
		ASME V	Non-destructive examination
		ASME VIII-1	Pressure vessels (Full NDE) {for AS 1210 class 1H (h = 1)}
	Pressure equipment other than gas cylinders and pressure piping	ASME IX	Welding and brazing qualifications
		AMBSC Code	Part 1 - Copper boilers
	Miniature boilers	AMBSC Code	Part 2 - Steel boilers
		AS 2030	SAA Gas Cylinders Code
	Gas cylinders	AS 3509	LP (liquefied petroleum) gas fuel vessels for automotive use
	Pressure piping	AS 4041	Pressure piping
		AS 1121	Guards for agricultural PTO drives

Table 1: Published technical standards relating to design of plant			
Item No	**Plant Description**	**Code No.**	**Standard Title**
		AS 1636	Agricultural wheeled tractors - Roll-over protective structures criteria and tests
		AS 2153	Guarding of agricultural tractors and machinery
		AS 2951	Part 3 Tractors
	Tractors	SAE J167	Overhead Protection for Agricultural Tractors - Test procedures and Performance requirements
		AS 2294	Earthmoving machinery - protective structures
		AS 2958	Earthmoving machinery - Safety
		ISO 6165	Earth-moving machinery - Basic types - Vocabulary
		ISO 6746-1	Earth-moving machinery - Definitions of dimensions and symbols - Part 1: Base machine
		ISO 6746-2	Earth-moving machinery - Definitions of dimensions and symbols - Part 2: Equipment
	Earthmoving machinery	ISO 7133	Earth-moving machinery - Tractor-scrapers - Terminology and commercial specifications
		AS 2211	Laser safety
		I/C 825	Safety of laser products.
	Lasers	EN 60825	Specification for radiation safety of laser products, equipment classification, requirements and user's guide.
		AS 1576	Scaffolding
		AS 1577	Scaffold planks
		AS 1892	Portable ladders
		AS 1892	Portable ladders
	Scaffolding Scaffolding general Scaffolding planks Trestle ladder scaffolding Ladder bracket scaffolding Scaffolds, general	AS 4576	Guidelines for scaffolding
	Temporary access equipment		
	Harnesses	AS 1891	Industrial safety belts and harnesses
		BS 3913	Specification for industrial safety nets
		EN 353	Personal protective equipment against falls from a height: Guided type fall arrestors
		EN 355	Personal protective equipment against falls from a height: Energy absorbers
		EN 360	Personal protective equipment against falls from a height: Retractable type fall arresters
	Industrial safety nets Fall arrest	EN 362	Personal protective equipment against falls from a height: Connectors
	Indirect and direct acting hand held explosive-powered tools	AS/NZS 1873	Power actuated (PA) hand held fastening tools
	Turbines	BS 5968	Methods of acceptance testing of industrial type

Table 1: Published technical standards relating to design of plant			
Item No	**Plant Description**	**Code No.**	**Standard Title**
	Industrial type		steam turbines
	For refinery services	API 612	Special purpose steam turbines for refinery services
	Amusement structures	AS 3533	Amusement rides and devices

Published technical standards should be viewed only as a starting point in the control of risks. It should not be assumed that a design that meets the standard is without risk. This is because the standard itself may not deal with all the matters relevant to hazard identification, risk assessment and risk control for the plant in question. Appropriate judgement needs to be exercised in such circumstances.

Designers, when designing plant to specifications in published technical standard(s) such as those listed in Table 1, must determine whether the technical standard(s) fully deals with the risk to health or safety identified in the risk assessment process. This should involve a systematic assessment of whether the technical standard(s) apply to the whole plant or only certain parts of the plant and an assessment of the adequacy of the technical standard(s) in controlling a particular type of risk, having regard to the state of knowledge.

If designing the plant in accordance with the technical standard(s) listed in Table 1, or any other published technical standard, does not eliminate the risk to health or safety, the designer is required to reduce the risk so far as is practicable by altering the design of the plant. If the redesign still does not adequately control the risk, the designer is required to specify the risk control measures that require implementation when the plant is used.

13.4 Record Keeping.

The Regulations provide (regulation 307):

(1) A designer of plant must keep a record of all published technical standards, including parts of a published technical standard, used to design the plant and make the record available for inspection by the

Minister or a design verifier.

(2) If a designer does not use published technical standards to design the plant, he or she must keep a record of the engineering principles used to design the plant and make the record available for inspection by the Minister or a design verifier.

(3) The designer must ensure that the records referred to in this regulation are kept and maintained in a suitable state for inspection for 10 years.

Designers are required, where applicable, to record the published technical standards and/or engineering principles being used to design the plant. To minimise the level of recording, the designer may identify all major assemblies that, when combined, form the whole plant. The designer could then record that the major assemblies identified form the complete plant, and that their constituent parts have been designed to the identified published technical standards or specific engineering principles.

The requirement of regulations 307(1) and (2) could be met by maintaining a record of the following information, as appropriate:

- unique identification of the plant being designed;
- identification of all the major assemblies, and where required, identification of all the items that have been designed to the published technical standard or specific engineering principles;
- title of the published technical standard(s) used;
- where the entire published technical standard is not used, identification of the clauses that are used, or alternatively identification of the clauses that are not used, whichever is the easier; and
- where engineering principles are used instead of published technical standards, an outline of the engineering principles used.

Records outlining engineering principles should contain sufficient information to establish that the engineering principles have adequately addressed the issues of strength, stability, durability and safety features required to ensure the safe operation of the plant under normal and foreseeable emergency conditions.

13.5 Use of Guarding as a Measure to Control Risk .

The Regulations provide (regulation 305):

(1) If a designer of plant uses guarding as a measure to control risk, the designer must ensure that guarding designed for that purpose will, so far

as is practicable, prevent access to the danger point or area of the plant.

(2) If a designer of plant uses guarding as a measure to control risk, the designer must ensure that-

(a) if access to the area of the plant requiring guarding is not necessary during operation, maintenance or cleaning of the plant, the guarding is a permanently fixed physical barrier; or

(b) if access to the area of the plant requiring guarding is necessary during operation, maintenance or cleaning of the plant, the guarding is an interlocked physical barrier which allows access to the area being guarded at times when that area does not present a risk and prevents access to that area at any other time; or

(c) if it is not practicable for the plant to use the type of guarding referred to in paragraph(a) or (b), the guarding is a physical barrier which can only be altered or removed by the use of tools; or

(d) if it is not practicable for the plant to use the type of guarding referred to in paragraphs (a), (b) or (c), the design includes a presence-sensing system that eliminates the risk arising from that area of the plant requiring guarding, while a person or any part of a person is in the area being guarded.

(3) If a designer of plant uses guarding as a measure to control risk the designer must ensure that the guarding is-

(a) designed to make by-passing or disabling of the guarding, whether deliberately or by accident, as difficult as is reasonably possible; and

(b) designed so as not to cause a risk in itself.

(4) If a designer of plant-

(a) uses guarding as a control measure; and

(b) the plant to be guarded contains moving parts and those parts may break or cause workpieces to be ejected from the plant-

the designer must ensure, so far as is practicable, that the guarding will control any risk from those ejected parts and workpieces.

(5) Nothing in this regulation prevents a designer of plant from providing guarding which allows convenient repair, servicing and maintenance of plant when the plant is not in normal operation.

Types of guards

Numerous types of guarding systems are available to guard dangerous parts of machinery to prevent access by any person or body part. The Regulations establish a priority order for the types of guarding systems. Where guarding is used as a measure to control risk, the designer is required to ensure that the guard designed for the plant is:

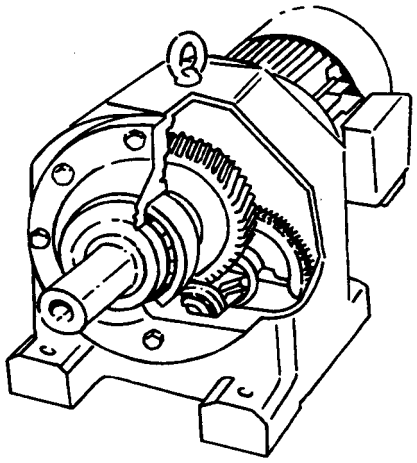
- a permanently fixed physical barrier if access to the area requiring guarding is not necessary during operation, maintenance or cleaning of the plant; or
- an interlocked physical barrier if access to the area requiring guarding is necessary during operation, maintenance or cleaning of the plant. (Note: this type of guarding system must only allow access to the guarded area when that area does not presents a risk).

If guarding is to be used and it is not practicable to use either a permanently fixed physical barrier or an interlocked physical barrier, the designer is required to ensure that the guarding is a physical barrier that can only be altered or removed by the use of a tool. The physical barrier (that is, fixed guard) should be fixed in position by means of fasteners or other suitable devices, that cannot be altered or detached without the aid of a tool or a key. If it is not practicable to use a physical barrier, the designer is required to include a presence sensing system in the design.

The following examples illustrate an application of each of the four types of guards.

Permanently fixed physical barrier - The risk associated with many hazards can be eliminated with a permanently fixed physical barrier. In Figure 3, the plant's power transmission is not required to be accessed during normal operation, maintenance or cleaning. It is therefore practicable to have the gear arrangements enclosed in a purpose designed gearbox housing to prevent access to moving gears. This has eliminated the risk associated with entanglement.

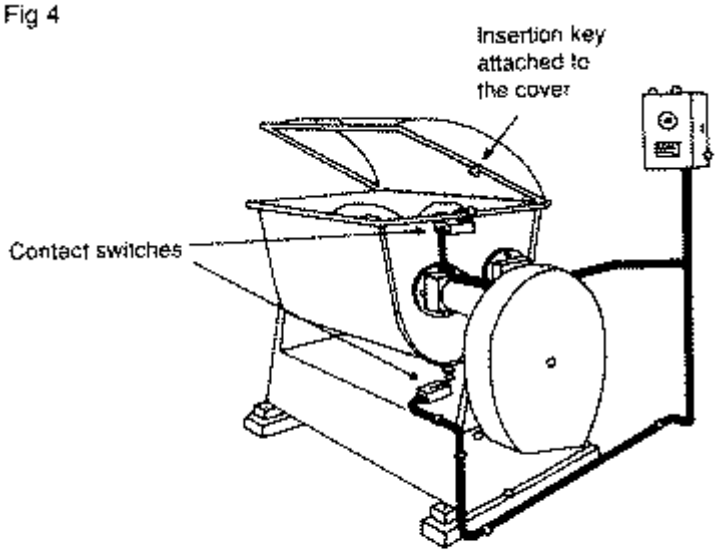
Fig 3
Cut – away view of a fixed physical barrier encasing the gear assembly and heavy duty electric motor



Interlocked physical barrier - An interlock guard is connected to the plant's operational controls so that the plant is prevented from operating until the guard is closed and either the guard remains locked closed until the risk from the hazard has passed or opening the guard causes the hazard to be eliminated before access is possible. In Figure 4, the hinged top guard on the dough mixer is provided with a positively operating insertion key which upon minimal movement, that is breaking contact when the lid is opened or removed, automatically cuts off the plant's power thereby allowing the dough blades to come to rest. In cases where the moving parts take a long period of time to come to rest, an

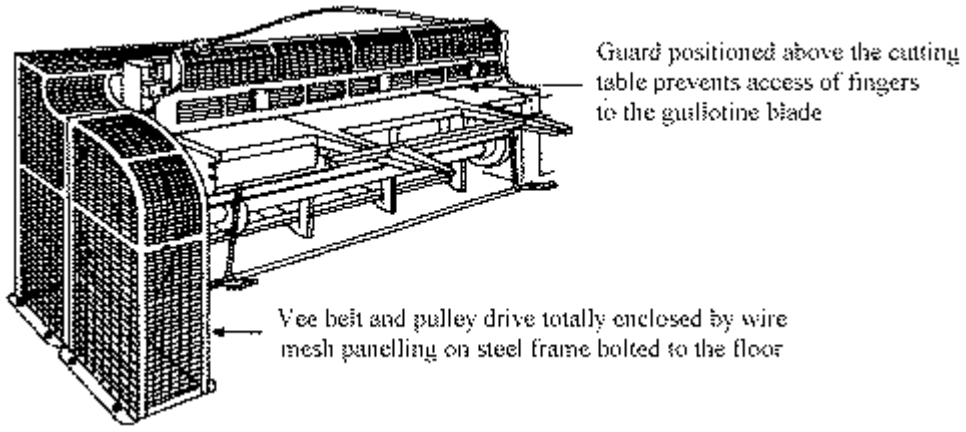
interlock locking arrangement preventing access is necessary to prevent access to the moving parts before they come to rest.

Fig 4



An electric interlock on this dough mixer prevents blade rotation if the cover is raised or the bowl is tilted

Physical barrier (or fixed guard) - The fixed guard by its design prevents access to the hazard associated with the moving parts of the plant. In Figure 5, the guillotine has a fixed guard secured to prevent access to the in-running nip points of the power transmission and the shear action of the guillotine blade.



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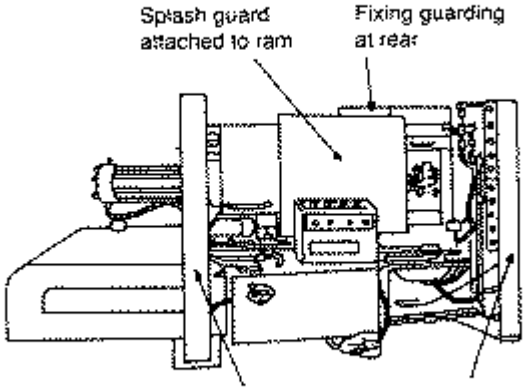
Presence sensing system - Presence sensing safeguarding systems are usually an unseen or light source barrier operating as a trip device. Upon detecting an intrusion of an object into the danger area, such as part of a person's body, the system shuts off power to the plant, and may, depending on the plant, brake the existing motion. In Figure 6, a bank of photo electric cells on plant used for die casting prevents the plant from operating while people are within the danger area.

Fig 6



Guard design

The mechanisms and controls forming part of a machine guard should be of a fail safe design. Guards should not in themselves create hazards. For example, the guarding should not weaken the structure of the plant, cause discomfort to the people using the plant or introduce new hazards such as pinch points, rough edges or sharp corners. Note: where some form of physical barrier is provided to prevent access to dangerous parts, the size and position of the barrier should take into account the range in height and build of people using the plant.

The design of the guard should be for a specific function, with design consideration being given, where appropriate, to: the placement, removal or ejection of work pieces; lubrication; inspection; adjustment; and repair of machine parts. Guarding should be designed for safe operation of the plant as well as to minimise interference to the plant.

The selection of a guard should take into consideration the environment in which it is to be used. Some examples of poor guard selection relative to the environment are: electrical charging of guards on high frequency welders; heating of guards in hot processes; and wire mesh guards on machines emitting splashes.

Physical barrier guarding should be constructed of material that is strong enough to resist normal wear and shock that may arise from failure of the parts or processes being guarded; and to withstand long use with a minimum of maintenance. If a guard is likely to be exposed to corrosion, corrosion-resistant materials or surface coatings should be used.

When an enclosure is used to prevent access to mechanical, chemical and electrical hazards, there may be an opportunity to control other risks. For example, risk associated with exposure to dust may be controlled by substituting a sheet metal guard for a mesh one.

Where there is a risk of jamming or blockage of moving parts, the designer should ensure that specific work procedures, devices and tools that will enable the plant to be cleared in a way that reduces the risk are documented.

If applicable, the designer should ensure that safe systems of work associated with the use and maintenance of the guarding and the maintenance of the components being guarded, are specified in the information provided to the manufacturer.

Examples of the use of guards as a measure to control risks associated with a bench grinder are provided in Appendix 5.

14. Providing information to the manufacturer

The Regulations provide (regulation 308):

A designer of plant must ensure, when the design of the plant is made available to the manufacturer, that the manufacturer of the plant is provided with information to enable the plant to be manufactured in accordance with the design specifications and, if applicable, with information relating to-

(a) the purpose for which the plant is designed; and

(b) the hazards and any risk, identified and assessed in accordance with this Part, associated with use of the plant; and

(c) testing or inspections to be carried out on the plant; and

(d) installation, commissioning, de-commissioning, use, transport, storage and, if the plant is capable of being dismantled, dismantling of the plant; and

(e) systems of work and competency of operators necessary for the safe use of plant; and

(f) emergency procedures (if any) required if there is a malfunction of the plant.

Purpose
When supplying information on the purpose for which the plant is designed, the information should be clear and precise. The information should contain all normal operational specifications and limitations.

As part of the documentation supplied to the manufacturer, if applicable, the designer is required to include details of the environment(s) for which the plant has been designed. Where appropriate, the designer should include a statement or warning on those circumstances where the use of the plant may result in an unsafe condition.

Hazards and risks
The designer is required to provide the manufacturer with information about hazards identified under regulation 302 and risks assessed under regulation 303, if applicable.

Other information
The Regulations also require the designer to provide the manufacturer with information on the following matters, if applicable:

- testing and inspection of plant;
- installation, commissioning, de-commissioning, operation, maintenance, cleaning, transport, storage and dismantling of plant;
- systems of work and competency of operators for safe use of plant; and
- emergency procedures (if any) associated with a malfunction of the plant.

. Such information provided should either be:

- the provisions relating to these matters that are contained, or referred to, in any relevant published technical standard used to design the plant, plus any further detail considered necessary by the designer; or
- alternative appropriate details where:
  - the standard used does not contain such information; or
  - a standard is available but not used in the design of the plant; or
  - the plant is not designed to a standard because there is no relevant standard available.

15. Hazard Identification, Risk Assessment and Risk Control

15.1 Manufacturers Duty to Control Risk

The Regulations provide (regulation 402)**:**

(2) *If the manufacturer of plant identifies a hazard and associated risk in relation to the construction and materials specified in the design of the plant and that hazard and risk have not been dealt with in the design, the manufacturer must-*

(a) advise the designer, in writing, of the hazard and associated risk as soon as is reasonably possible; or

(b) if it is not possible to advise the designer of the hazard and risk in accordance with paragraph (a), ensure that-

(i) the risk is eliminated; or

(ii) if it is not practicable to eliminate the risk, the risk is reduced so far as is practicable.

In determining whether there is a hazard and associated risk in relation to construction and materials specified in the design of the plant, the manufacturer should have regard to the published technical standards listed in Table 2. These standards also provide guidance on the inspection, testing and method of construction of plant. There may be published technical standards other than those listed in Table 2 that provide guidance on the materials used for the plant and the method of construction. The manufacturer may choose to consider these other published technical standards when identifying whether there is a hazard and associated risk in relation to the construction and materials specified in the design.

Where it is not possible for the manufacturer to advise the designer of an identified hazard and associated risk in relation to the construction and materials specified in the design, the manufacturer takes on the responsibility of the designer to ensure the risk is eliminated where practicable, or reduced so far as is practicable. *Note 9*
Note 9 (Where the manufacturer assumes the responsibilities of the designer under regulation 402, the manufacturer should have regard to the standards listed in Table l when determining measures to control risk)

Table 2: Published technical standards relating to the manufacture of the plant.			
Item No.	**Plant Description**	**Code No.**	**Standard Title**
		AS 4024	Safeguarding of machinery
		AS 1219	Power presses - safety requirements
		AS 2939	Industrial robot systems - safe design and usage
1.	**Machinery - general**	I/C 1508	Functional safety - Safety related systems
		AS 1418	Cranes (including hoists and winches)
		AS 3860	Fixed guideway people movers
2.	**All cranes including hoists and winches**	ISO 2374	Lifting appliances - Range of maximum capacities for
3.	**All conveyors except moving walks**	AS 1755	Conveyors- Design, construction, installation and operation - Safety requirements.
4.	**Powered industrial trucks (which includes forklifts)**	AS 2359	Powered industrial trucks
5.	**Lifts**	AS 1735	Lifts, escalators and moving walks - SAA Lift Code
		AS/NZS 1200	Pressure equipment
		AS 3920	Assurance of product quality
		BS 5500	Specification for unfired fusion welded pressure vessels - category l. {for AS 1210 class 1H (n = 1)} - category 2. {for AS 1210 class 2H (n = 1)}
		AS 2971	Serially produced pressure vessels
		ASME I	Power boilers
		ASME II	Materials
		ASME VIII-1	Pressure vessels (Full NDE) {for AS 1210 class 1H (n = 1))
	Pressure equipment other than gas cylinders and pressure piping	ASME IX	Welding and brazing qualifications
		AMBSC Code	Part I - Copper boilers
	Miniature boilers	AMBSC Code	Part 2 - Steel boilers
		AS 2030	SAA Gas Cylinders Code

Table 2: Published technical standards relating to the manufacture of the plant.			
Item No.	**Plant Description**	**Code No.**	**Standard Title**
	Gas Cylinders	AS 3509	LP (liquefied petroleum) gas fuel vessels for automotive use
6.	Pressure piping	AS 4041	Pressure piping
		AS 1121	Guards for Agricultural PTO drives
		AS 1636	Agricultural Wheeled Tractors-Roll over protective structures criteria and tests
7.	**Tractors**	SAE J167	Overhead protection for agricultural tractors-test procedures and performance requirements
		AS 2294	Earthmoving machinery protective structures
8.	**Earthmoving machinery**	AS 2958	Earthmoving machinery safety
		AS 2211	Laser safety
		I/C 825	Safety of laser productions
9.	**Lasers**	EN 60825	Specification for radiation safety of laser products, equipment classification, requirements and user's guide.
		Scaffolding	
	Scaffolding general	AS 1576	Scaffolding
	Scaffolding planks	AS 1577	Scaffold planks
	Trestle ladder scaffolding	AS 1892	Portable ladders
10.	Ladder bracket scaffolding	AS 1892	Portable ladders
		Temporary access equipment	
	Harnesses	AS 1891	Industrial safety belts and harnesses
		EN 353	Personal protective equipment against falls from height: guided type fall arrestors
		EN 355	Personal protective equipment against falls from height: energy absorbers
		EN 360	Personal protective equipment against falls from height: retractable type fall arrestors
11.	Fall arrest	EN 362	Personal protective equipment against falls from height: connectors
12.	**Indirect and direct acting hand held explosive-powered tools**	AS/NZS 1873	Power actuated (PA) hand held fastening tools
13.	**Amusement structures**	AS 3533	Amusement rides and devices

15.2 Manufacturer's Duty to Record Published Technical Standards Used in Manufacturing Plant
The Regulations provide (regulation 404):

(1) *A manufacturer of plant must keep a record of all published technical standards, including parts of a published technical standard, used to manufacture the plant and make the record available for inspection by the Minister.*

(2) *The manufacturer must ensure that the records referred to in this regulation are kept and maintained in a suitable state for inspection10 years.*

Manufacturers are required, where applicable, to record the published technical standards being used to manufacture the plant. To minimise the level of recording, the manufacturer may identify all major assemblies that, when combined, form the whole plant. The manufacturer could then record that the major assemblies identified form the complete plant, and that their constituent parts have been manufactured to the identified published technical standards.

The requirement of regulations 404(1) and (2) could be met by maintaining a record of the following information, as appropriate:

- unique identification of the plant being manufactured;
- identification of all the major assemblies, and where required, identification of all the items that have been manufactured to the published technical standard;
- title of the published technical standard(s) used; and
- where the entire published technical standard is not used, identification of the clauses that are used, or alternatively identification of the clauses that are not used, whichever is the easier.

15.3 Importers and Suppliers General Duties
The Regulations provide:

502. Importer's duties generally
(1) *Subject to sub-regulation (2), an importer of plant must ensure that the hazard identification, risk assessment and control of risk measures set out in Parts 3 and 4 have been carried out in relation to the design and manufacture of the plant before the plant leaves the control of the importer.*

(2) *If it is not practicable to comply with sub-regulation (1) the importer must ensure that the risk arising from use of the plant-*
(a) is eliminated; or
(b) if it is not practicable to eliminate the risk, is reduced so far as is practicable.

603. Supplier's duties generally
(1) A supplier of plant must ensure that the hazard identification, ask assessment and control of risk measures set out in Parts 3 and 4 or, in the case of imported plant, Part 5*, have been carried out in relation to the design and manufacture of the plant before the plant leaves the control of the supplier.*

(2) If it is not practicable to comply with sub-regulation (1), the supplier must ensure that the risk arising from use of the plant-

(a) is eliminated; or
(b) if it is not practicable to eliminate the risk, is reduced so far as is practicable.

(3) Sub-regulation (1) does not apply to plant, which the supplier intends for use for scrap material.

Importers and suppliers of plant have a responsibility under the Regulations to ensure that hazard identification, risk assessment, and risk control measures have been carried out before the plant leaves their control. The importer and supplier would normally ensure that this has been undertaken by receiving documentation from the designer via the manufacturer, or from the previous purchaser of the plant. (The supplier would obtain this information from the importer where the plant being supplied has been imported.) This information should confirm that appropriate hazard identification, risk assessment, and risk control measures were undertaken and as a consequence the designer has supplied documents associated with the safe operation of the plant, such as service manuals and operations manuals. A letter from the manufacturer or supplier confirming that hazard identification and risk assessment have been used in the development of the operation and maintenance manuals will meet the intent of the Regulations.

Where the importer or supplier of plant for use at the workplace are unable to establish that hazard identification and risk assessment have been undertaken, they have the responsibility of ensuring that the risk arising from the use of the plant is eliminated or reduced so far as is practicable.

The importer and supplier are not required to ensure hazard identification, risk assessment and risk control measures have been undertaken for stock ordered prior to the commencement of the Regulations.

16. Information Provision

The Regulations provide:

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405. Manufacturer's duty to provide information

A manufacturer of plant must ensure-

(a) so far as is practicable, that he or she obtains the information required to be provided to the manufacturer under regulation 308; and

(b) that a person to whom the manufacturer supplies the plant, is provided with the information provided to the manufacturer under regulations 308(a) to 308(f) when the plant is supplied by the manufacturer; and

(c) if the manufacturer acts in accordance with regulation 402(2)(b), that a person to whom the manufacturer supplies the plant is provided with the information, applicable to the plant, which is required to be provided by the designer under regulations 308(a) to 308(f).

503. Importer's duty to provide certain information to purchaser

(1) An importer of plant must-

(a) ensure that in respect of that plant, the person to whom the plant is supplied is provided with health and safety information provided to the importer by the designer or manufacturer when the plant is supplied; and

(b) so far as is practicable, ensure that he or she obtains the information from the designer or manufacturer which is required to be provided to the manufacturer under regulations 308(a) to 308(f); and

(c) if the importer acts in accordance with regulation 502(2), ensure that a person to whom the plant is supplied is provided with the information, applicable to the plant, which is required to provided by the designer under regulations 308(a) to 308(f).

(2) An importer of plant for use for scrap material, must, when supplying that plant to a person, advise the person in writing that the plant is intended for use as scrap material.

604. Supplier's duties to provide certain information to purchaser

(1) A supplier of plant, other than a supplier who supplies plant for hire or lease, must ensure-

(a) in the case of new plant-

(i) so far as is practicable, that he or she obtains the information required to be provided to the supplier under regulation 405 or 503 (as the case may be); and
(ii) that the person to whom the plant is supplied is provided with information provided to the supplier under regulation 405 or 503(as the case may be) when the plant is supplied; and

(b) in the case of used plant, the person to whom the plant is supplied is provided, at the time the plant is supplied, with-

(i) any information in the possession of the supplier relating to safe use of the plant; and
(ii) any records kept by the previous owner of the plant required under these Regulations, which is in the possession of the supplier.

(2) A supplier of plant for use for scrap material must, when supplying that plant to a person, advise the person in writing that the plant is intended for use as scrap material.

16.1 Type of Information to be Provided to the User

The Regulations require that a manufacturer, importer and supplier must ensure that health and safety information required to be supplied by the designer is provided to the person to whom the plant is supplied. This should include, where relevant, information on:

- hazards and risks;
- purpose of the plant;
- testing;
- inspection;
- installation;
- commissioning;
- operation;
- maintenance;
- cleaning;
- transport;
- storage;
- dismantling;
- systems of work;
- operator competency; and
- any emergency procedures relating to the plant.

The information may be provided in user manuals and manufacturers' instructions.

Health and safety information provided to the person to whom the plant is supplied (that is, the purchaser) should, wherever possible, be in plain English but maintain the accuracy and quality of the technical information. If health and safety information is not provided to an importer by the designer or manufacturer, the importer assumes the responsibilities for supplying the information normally supplied by the manufacturer. The importer is then required to provide the purchaser with relevant information obtained from the hazard identification, risk assessment and risk control of the plant required by regulation 502.

16.2 Used Plant

The supplier is required to provide the purchaser with whatever information relating to the safe use of the plant that is in the possession of the supplier. This should include information relating to commissioning, operation, maintenance and systems of work. This may include data sheets, test certificates, operations and service manuals, reports and a safety manual.

To comply with regulation 604(1)(b) a supplier who sells used plant should provide the health and safety information in his or her possession that would have been provided if the plant was new. If the supplier has additional information relating to safe use of the plant, for example, alerts, procedures, information from relevant industry associations or such sources, these should also be passed on to the purchaser.

The supplier should identify any components of the plant that are unserviceable. The components of the plant that are unserviceable may constitute a hazard in the operation of the plant. Where plant is identified as not fully serviceable, the supplier should inform the purchaser that the plant should not be used until the plant is fully serviceable.

17. Duties of a Supplier who Hires or Leases Plant

The general duties of a supplier under the Regulations apply to hirers and leasers of plant for use at a workplace (refer to section 15.3 of this code). In addition, for hirers and leasers of plant, the Regulations provide (regulation 605):

(2) A supplier of plant must ensure that between hirings and leasings, the plant is inspected and maintained to ensure the risk arising from the use of the plant is eliminated, or if it is not practicable to eliminate the risk, reduced so far as is practicable.

(3) A supplier of plant must ensure that inspections and maintenance carried out on the plant under sub-regulation (2) are recorded and the records are retained while the supplier has management or control of the plant.

(4) A supplier of plant must provide each person to whom the supplier hires or leases plant with any information on the safe use of the plant which is in the possession of the supplier.

The purpose of this regulation is to ensure that the risk to health or safety arising from hired or leased plant is eliminated or reduced so far as is practicable.

17.1 Inspection and Maintenance

In regulation 605(2), "between" means every time the plant is hired or leased, but does not include an extension to the hiring or leasing period for the same user (that is, hiree or lessee). The supplier may consider an extension to the period of contract as being an extended lease provided that appropriate mechanisms are put in place to ensure adequate inspection and maintenance is carried out during the lease.

To comply with this regulation, the supplier is required to ensure that any excessive wear or damage to the plant is identified and rectified. Proper regard should be given to the designer's or manufacturer's specifications for inspection and maintenance.

Measures to achieve compliance could include developing a regular risk assessment program so that any new or increased risk is identified. This could be done by a program of regular testing of the plant. The assessment should consider factors such as the amount of use of the plant and the operating and environmental conditions during the period.

Where plant is to be transferred between hirees or lessees without being returned to the supplier's depot, the supplier is required to ensure that the plant is inspected and maintained before transfer. For example, this may be done "on-site" without returning the plant to the depot.

Where the plant is hired or leased for an extended period of time, the supplier should make arrangements with the hiree or lessee to have the plant inspected and maintained, giving proper regard to the designer's or manufacturer's specifications for inspection and maintenance.

With plant that is hired or leased with an operator, the supplier may fulfil his or her duty under regulation 605 by preparing a comprehensive set of checks, and authorising the operator to carry out these checks between hirings and leasings. If this option is adopted, the supplier should ensure that the operator is competent to apply the checks and conduct, or arrange to have conducted, the maintenance identified by the checks.

The supplier is required to ensure that records are kept of inspections and maintenance carried out on the plant. The records should be maintained in a readable state and be readily available when needed. All information should, as a minimum, be available in English.

If agreement is reached that the hiree or lessee undertake the necessary inspections and maintenance, the supplier should ensure that either during the hire or lease of the plant or at the conclusion of the hire or lease, all outstanding records associated with inspections and maintenance of the plant are obtained from the hiree or lessee.

17.2 Information Provision

The information the supplier may reasonably be expected to have in most circumstances includes information provided by the designer, manufacturer, previous supplier, other persons who have hired the plant and statutory authorities. This may take the form of data sheets, operations manuals and maintenance manuals and should include any information about health and safety obtained at the time of hire or lease.

A previous hiree or lessee may identify a design feature or work practice associated with the plant that requires documentation not formerly supplied. In such cases the supplier should ensure that this documentation, if applicable, is supplied to all future persons hiring or leasing the plant.

Information subsequently obtained by the supplier and applicable to the plant, during the hire or lease of the plant should be passed through to the hiree or lessee as soon as practicable.

18. Consultation

18.1 Consultation Between Employers and Health and Safety Representatives

The Act places an obligation on the employer to consult with health and safety representatives in relation to plant. Section 31(2)(c) of the Act states that an employer shall:

"if practicable, consult the health and safety representative of a designated work group on all proposed changes to the workplace, the plant or substances used at the workplace or the conduct of work at the workplace that may affect health or safety of any member of the designated work group".

The Regulations provide (regulation 717):

If practicable, an employer must consult with a health and safety representative of a designated work group when undertaking hazard identification, risk assessment or control of risk processes under these Regulations which relate to plant or associated systems of work that may affect the health or safety of any member of the health and safety representative's designated work group.

The provisions of the Act and the Regulations combine to place an obligation on the employer to consult with a health and safety representative of a designated work group. In particular, consultation with the relevant health and safety representative must occur where the hazard identification, risk assessment or control of risk processes affect the health and safety representative's designated work group. The employer should consult with the health and safety representative when determining the approach and methods to be used.

A positive approach to prevention of workplace injury and disease arising from plant and systems of work associated with plant is enhanced by consultation. Employers who consult on health and safety issues and the implications of proposed changes at the planning stage, are more likely to gain relevant information to help reduce risks and avoid harmful consequences to employees' health and safety. Consultation is likely to be more effective when it involves provision of timely, accurate and relevant information.

Consultation should take place as early as possible when planning for the introduction of new or modified plant or systems of work associated with the use of plant, to allow for possible changes arising from the consultation to be incorporated. Consultative procedures should allow enough time for the health and safety representatives to consult with members of the designated working group and to discuss the issue with the employer.

It is suggested that hazard identification, assessment of risks and determination of measures to control risks associated with plant and associated systems of work be carried out by the employer in consultation with employees required to carry out the tasks, as well as with the health and safety representatives for the designated work groups. Employees are a valuable source of information in relation to hazards because of their day to day experience. It is also useful to consult with employees before particular control measures are introduced and when the effectiveness of implemented control measures are being reviewed.

Techniques for organising consultation

Effective consultation by the employer depends on communication - that is, understanding the people being consulted and providing them with adequate information in a format appropriate to their needs, to enable them to have informed views. The process used for consultation should consider the needs of non-English speaking background health and safety representatives and employees. Guidance on techniques for consultation in multilingual workplaces is provided in the *Code of Practice for Provision of Occupational Health and Safety Information in Languages other than English.*

Examples of consultation mechanisms may include direct discussion, toolbox meetings, quality circles, health and safety committee meetings, other forms of consultation existing in the workplace such as quality reports, hazard inspections, special working parties, or combinations of these.

18.2 Consultation Between Employers and Suppliers.

Consultation between employers and persons involved in the supply of plant may contribute to the elimination or reduction of risks associated with plant. Employers should use the regular contact that they have with their suppliers to discuss relevant health and safety issues associated with the plant. The supplier can then pass on information to designers and manufacturers.

19. Hazard Identification

19.1 Hazard Identification Duty

The Regulations provide (regulation 702):

(1) Subject to sub-regulation (2), an employer must ensure that all hazards associated with the installation, commissioning, erection and use of plant and the systems of work associated with that plant are identified, having regard to the state of knowledge of the hazards-

(a) before plant is used for the first time in a workplace; and

(b) before any alteration to the plant or any change in the way the plant is used or a system of work associated with the plant, including a change in the location of the plant; and

(c) before the plant is used for any other purpose than for which it was designed; and

(d) if new or additional information about hazards relating to the plant or its associated systems of work becomes available to the employer; and

(e) for all plant in the workplace at the date of commencement of these Regulations, as soon as practicable after that date.

(2) The employer's responsibilities under sub-regulation (1) only relate to the hazards associated with plant specifically applicable to the workplace where the plant is used or located.

Hazard means the potential to cause injury or illness. Examples of the potential harm, that plant or associated system of work may cause to people at workplaces include:

- Injury due to hair, loose clothing, gloves, neckties, jewellery, cleaning brushes or rags or materials tangling with moving parts of plant or materials in motion;
- Crushing by falling or moving objects or plant tipping or rolling over;
- Crushing due to people being thrown off and under plant;
- Crushing due to parts of a person's body being trapped between plant and any material or structure;
- Injury (cutting or piercing) due to a person striking a sharp object or being struck by sharp or flying objects;
- Friction burns due to a person coming in contact with high speed rotating parts of plant or object, or rough surfaces of the plant or object;
- Injury due to a person coming in contact with high pressure fluid;
- Injury due to electricity shock or burn;
- Injury due to explosion;
- Injury due to slips, trips or falls;
- Injury due to insufficient consideration of ergonomic requirements *Note 10, Note 11;*
- Burns due to a person coming in to contact with high temperature objects or fire;
- Ill-health due to exposure to extreme temperature conditions;
- Injury or ill-health due to exposure to dust, vibration, noise *Note 12* or radiation . *Note 13*

Note 10 (Regulation 303(4) defines 'ergonomic considerations' as "considerations relating to the application of knowledge about human function, capabilities and requirements as it applies to the design of plant and systems of work associated with the plant".

Note 11 (In the case of manual handling hazards, refer to section 8 of this code for guidance on the regulatory controls applying to these hazards. The approved codes of practice for Manual Handling should be referred to for guidance on the prevention, identification, assessment and control of risks arising from manual handling activity associated with plant.)

Note 12 (Refer to section 8 of this code of practice for guidance on the regulatory controls applying to noise hazards associated with plant. The approved Code of Practice for Noise should be referred to for guidance on the prevention, identification, assessment and control of risks arising from noise exposure.)

Note 13 (Refer to the Department of Health and Community Services which administers legislation on radiation.)

Amongst other things, regulation 702 requires the employer to ensure that all hazards associated with the use of plant are identified. "Use" has a specific meaning in the Regulations–

" 'Use' when used in relation to plant, includes operate, maintain, service, repair, inspect and clean".

Thus under the Regulations the employer is required to ensure that hazards associated with maintenance, service, repair, inspection and cleaning, as well as operation of the plant, are identified. (Note: hazards associated with the installation, commissioning and erection of plant are also required to be identified.)

19.2 How to Identify Hazards

"Hazard identification" is the process of identifying all situations or events that could give rise to the potential of injury or illness. Thus, it involves identifying all the sources that have a potential to cause injury or illness.

As an example, if there is a potential for the operator of a grinding machine to be cut by flying particles generated by the material being ground, then the flying particles would need to be identified as a source of hazard associated with the use of that plant.

Appendix 3 outlines some of the hazards and sources of hazards that should be considered during hazard identification. Some or all of these may be relevant when undertaking hazard identification of plant and systems of work associated with the plant at the workplace, however, this is not intended to be an exhaustive list.

Employers should not limit themselves to situations that they have experienced. Rather they should try to anticipate all possible types of plant failure, system failure, lack of consideration of ergonomic requirements and types of human errors and how these could combine to create a situation that could cause a risk to health or safety.

Human error can be defined as any part of a set of human actions that exceeds a set limit of acceptability. Most errors are unintentional, unpremeditated actions that are inappropriate in the given situation. Some errors may be intentional. These occur when the person performs an action that is incorrect, but believes it to be correct or to be a better method of achieving the desired result. Thus, human error can also be defined as an inappropriate or missing action or response. (Deliberate behaviour, calculated to damage the system, is not considered to be human error.)

Missing or inappropriate actions or responses are more likely in work situations which place demands on people that are not compatible with their capabilities, experience and expectations. Such situations can occur when the design of plant and plant operating systems do not take account of ergonomic considerations.

The types of possible errors can be summarised as follows:

- error of omission (or missing response) - the person omits a specified action, a step in a sequence or a whole sequence; and
- error of commission (or inappropriate response) - the person does the task but does it incorrectly, including, choosing the wrong action or object, doing it in the wrong sequence, taking too long or not long enough, or completing the particular action but not to the desired quality.

Appendix 4 lists some common human errors resulting from poor design through insufficient consideration of ergonomic requirements.

State of knowledge

Under the Regulations hazard identification is to be undertaken "having regard to the state of knowledge of the hazards". The phrase "state of knowledge" is taken from, and is one element of, the definition of "practicable" as set down in section 4 of the Act.

"State of knowledge" is to be interpreted objectively. It is not something which varies according to a duty-holder's own subjective or personal knowledge-base. It is an objective test of the general "state of knowledge" that a reasonable person in that position or situation is expected to have.

Sources of information
There are a range of sources that may assist the employer to ensure that the hazard identification process reflects the current state of knowledge on hazards that may be associated with the plant and the systems of work used in connection with the plant. Examples include:

- discussions with designers, manufacturers, suppliers or other employers with similar types of plant;
- available faults, incidents, injury and accident reports or data from other employers, users and manufacturers of similar types of plant;
- available accident or incident information, hazard alerts and other relevant reports from Health and Safety Organisation, Victoria and counterparts in other States or overseas, Worksafe Australia, unions and employer associations, and professional bodies; and
- relevant reports or articles from occupational health and safety journals, technical references or data bases from Australia and overseas, where available in Australia.

Carrying out hazard identification
Hazard identification must be carried out for all existing plant (that is, plant already in the workplace) as well as for plant introduced into the workplace after the Regulations are made.

Before plant is used for the first time
Where plant is introduced into the workplace after the Regulations are made, the employer is required to ensure that hazard identification is carried out before the plant is used the first time. The Regulations also require the employer to identify all hazards associated with the installation, commissioning and erection of the plant, as well as with the use of the plant.

The most cost effective way of implementing risk control measures associated with plant at a workplace is to identify the hazards associated with plant which is intended to be purchased for use at the workplace. Although hazard identification prior to purchase is not required by the Regulations, it would assist the employer to select for purchase the particular type and make of the plant that eliminates the risk to health or safety, or reduces the risk, so far as is practicable. This would avoid costly modifications to otherwise hazardous plant after the plant is already purchased for use at the workplace.

The employer should ensure that hazard identification of plant is undertaken by a person who has the knowledge and skills to enable him or her to effectively perform this task. The necessary attributes will vary according to the type of plant and associated systems of work, the hazards and the complexity of the identification and assessment process. In some workplaces, a team of people may need to be involved in hazard identification to ensure the right mix of training, experience and knowledge. When considering more complex plant, the team may also include specialist health and safety staff or outside technical experts. The employer should determine a method of hazard identification appropriate for the plant and associated systems of work, and the workplace.

Hazard identification should involve the examination of all relevant existing records to gather information on the type of situations or events that have led to injury or ill-health or near misses at the workplace where similar plant or associated systems of work are involved. Such records could include workers' compensation records, first aid records, reports of accidents and near misses and reports by employees or supervisors.

Plant already in use

For plant already in the workplace when the Regulations are made, the employer is required to carry out hazard identification as soon as practicable after the Regulations come into operation. A similar hazard identification process should be followed to that described above for plant to be used for the first time. In addition to examining existing records for the plant and similar types of plant, a physical inspection of the workplace should be conducted to observe the use of plant and associated systems of work. The observations made during the inspection would typically include:

- the types, number and location of plant in the workplace;
- the different systems of work associated with the plant in the workplace; and
- situations or events that may harm employees and others in the workplace.

A checklist could be developed for the physical inspection of the workplace. The complexity of the checklist should reflect the complexity of the plant and associated systems of work under review.

In some workplaces there may be a number of plant items that are similar or identical, with similar or identical systems of work. The inspection may focus on a representative sample of the plant instead of repeating the inspection for all plant. For further guidance on undertaking generic hazard identification and risk assessment processes refer to section 7 of this code.

Depending on the number and complexity of plant requiring inspection, it may be necessary to divide the inspection task into manageable lots. This will ensure that hazards are not overlooked. There are several ways of dividing the inspection tasks, such as by:

- different locations (for example, factory, grounds, warehouse, etc); or
- different categories of plant; or
- different functions or processes (for example, receiving, forming, finishing, etc).

Before alteration to the plant or change in the way plant is used

If the employer intends to alter the design of the plant or change the way the plant is used or change a system of work associated with the plant, the Regulations require the employer to carry out the hazard identification process again. All hazards introduced by the alteration or change would need to be identified and any risks associated with the identified hazards would need to be assessed before the altered plant is used. A similar process for hazard identification as described under the sub-heading "Before plant is used for the first time" may be used for this type of situation.

Plant used for any other purpose than for which it was designed

Designers of plant are required to carry out hazard identification, risk assessment and risk control for the plant which they design for use at workplaces. Designers are also required, if applicable, to provide health and safety information relating, amongst other things, to the purpose for which the plant is designed and proper use of the plant. The designer's recommendations on purpose and proper use of the plant should be followed.

If the employer intends to use an item for any purpose other than for which it was designed, the Regulations require the employer to carry out a hazard identification to identify hazards associated with the proposed usage. For example, if an item of plant that is designed to cut plastic is intended to be used to cut metal, all hazards associated with that intended usage must be identified before commencement.

Where new or additional information about hazards becomes available

After hazard identification, risk assessment and risk control have been carried out for a piece of plant and associated systems of work used in the workplace, it is necessary to carry out the hazard identification process again if new or additional information about hazards to health or safety relating to the plant or associated systems of work becomes available to the employer.

20. Risk Assessment

20.1 Risk Assessment Duty

The Regulations provide (regulation 703):

(1) If a hazard is identified under regulation 702, an employer must ensure that an assessment is made to determine whether there is any risk associated with the hazard.

(2) The employer must ensure that the assessment takes into account-

(a) the systems of work associated with the use of the plant; and

(b) the layout of, and physical conditions in the workplace where the plant is to be used; and

(c) the capability, skill and experience of the person ordinarily using the plant; and

(d) any reasonably foreseeable abnormal operating conditions for the plant.

(3) If the plant is required to be registered in accordance with regulation 1007, the employer must ensure that the method used to undertake the risk assessment and the results of that assessment are recorded and retained while the assessment is relevant to the plant.

20.2 How to Assess Risks

"Risk assessment" is the process of determining whether there is any risk associated with each of the hazards identified, that is, whether there is any likelihood of injury or illness.

For each hazard identified, the designer should ensure the risk assessment involves consideration of any likelihood for people to be exposed to the hazard. The assessment of whether there is any likelihood for people to be exposed to the hazard should involve a critical review of the adequacy of any risk control measures (if any) already implemented to eliminate the risk.

For plant already in use in the workplace, the assessment of risks associated with each of the identified hazards should be done by taking into consideration the built-in design safety features of the plant and the systems of work already instituted to control risk to health or safety. To assist this process, the person or team responsible for risk assessment should prepare a list of the existing risk control measures for each of the hazards identified and make a judgement on the effectiveness of these controls. To assist in determining if there are any risks associated with identified hazards, the person or team should consult with employees in the area where the hazard is located, particularly the plant operators and people who carry out inspection, maintenance and repair of the plant.

The Regulations require the employer to ensure that the assessment takes account of:

- the systems of work associated with the use of the plant;
- the layout of, and physical conditions in the workplace where the plant is to be used;
- the capability, skill and experience of the person ordinarily using the plant; and
- reasonably foreseeable abnormal operating conditions for the plant.

It should be noted that as "use" has a specific meaning in the Regulations when it is used in relation to plant, the employer is required to ensure that the risk assessment takes into account not only factors associated with the operation of the plant, but also factors associated with maintenance, service, repair, inspection and cleaning of the plant. For example, risk assessment would need to take account of the capabilities, skills and experience of people carrying out these activities as well as employees operating the plant.

Methods of risk assessment

A person carrying out a risk assessment should determine a method of assessment appropriate for the plant, the hazards identified and the workplace. Methods used to assess risks may be identified through discussions with designers,

manufacturers, suppliers or other employers in the industry, or by referring to relevant published technical standards, technical references and journals or publications issued by Health and Safety Organisation, Victoria. Such methods usually involve a combination of some of the following procedures:

- visual inspection of the plant and its associated environment;
- auditing;
- testing;
- technical or scientific evaluation;
- analysis of injury and near-miss data; and
- instructions or methods recommended by designers, manufacturers, suppliers, importers, employees, other employers or any other relevant parties.

Examination of injury or incident data for similar types of plant may assist in the determination of risks associated with identified hazards. However, the absence of an accident or incident history, a small number of accidents, or low severity of accidents cannot be taken as an automatic presumption of a low level of risk.

When assessing the risks associated with complex plant, a more systematic approach may be appropriate. A systematic approach may include quantitative analysis methods. For example, if plant is assessed to result in a potentially catastrophic risk by qualitative and semi-quantitative methods, this may need to be investigated further by the application of quantitative risk assessment.

20.3 Recording Risk Assessments

The Regulations require the employer to record the risk assessment method used and the results of the assessment if the plant is required to be registered in accordance with regulation 1007. (The plant required to be registered under the Regulations are listed in Item 2 of Schedule 2 of the Regulations.)

A record of the risk assessment should assist the employer with the identification of appropriate risk control measures. It should also assist any subsequent risk assessments that may be necessary because of changes to the plant or associated systems of work. If during the risk assessment, potential changes to the plant or associated systems of work are identified, it would be useful to note these in order to facilitate future hazard identification and risk assessment inspections on hazards introduced via the plant changes.

How the risk assessment is recorded will depend on the types of hazards identified and the assessment method used. Whichever format chosen, the link between each hazard and the assessed risk should be clearly identified.

21. Risk Control

21.1 Risk Control Duty

The Regulations provide (regulation 704):

(1) An employer must ensure that any risk associated with plant and associated systems of work, including installation, erection, commissioning and use of plant-

(a) is eliminated; or

(b) if it is not practicable to eliminate the risk, is reduced so far as is practicable.

(2) When an employer is determining measures to control risk, the employer must not depend solely on the use of administrative controls or personal protective equipment to control the risk unless the employer has established that-

(i) substitution of the plant with plant which has a lower level of risk; or

(ii) the use of engineering controls; or

(iii) isolation of the plant from people-

are not practicable measures to control risk.

(3) Nothing in this Part (except regulation 701) limits the operation of this regulation.

21.2 Controlling Risk

"Risk control" is the process of determining and implementing appropriate measures to control risks assessed. Under the Regulations the primary duty of the employer in relation to risk control is to eliminate, where practicable, any risk associated with plant and associated systems of work [regulation 704(1)(a)]. It is only if elimination of risk is shown not to be practicable in a given circumstance, that the employer must ensure the risk is reduced so far as is practicable [regulation 704(1)(b)].

"Practicable" is defined in the Act as meaning:

"*practicable having regard to–*

(a) the severity of the hazard or risk in question;
(b) the state of knowledge about that hazard or risk and any ways of removing or mitigating that hazard or risk;
(c) the availability and suitability of ways to remove or mitigate that hazard or risk; and
(d) the cost of removing or mitigating that hazard or risk."

In determining what measures are appropriate to ensure risk is controlled, each of the elements of practicable are required to be considered. This includes consideration of the severity of risks assessed. That is, consideration of the extent of the risk, including the seriousness of the potential injury or illness and the numbers of people who may be affected.

During the process of finding ways to reduce risk so far as practicable, in order to achieve compliance with regulation 704(1)(b) or any other risk reduction provision in Part 7 of the Regulations, a means of eliminating the risk may be identified. In such an event, the employer must implement the elimination measure where it is practicable.

Under the Regulations it is necessary that the measures of control address any risk identified in the risk assessment process. The employer should have regard to the published technical standards listed in Table 3 in section 21.4 of this code when determining measures to control risk. The final decision on adoption of control measures must be appropriate to the unique characteristics of the plant and the environment in which the plant is used.

21.3 Categorisation of Risk Control Measures

The Regulations clearly establish a priority order for the types of measures to be used to control risks. The following categorisation of risk control measures is consistent with the Regulations and will assist employers to comply with the Regulations.

Elimination

The best way to eliminate the risk is to remove the hazardous plant (or hazardous parts of the plant) or discontinue the process involving the hazardous plant. Where it is decided to discontinue use of a hazardous plant, the plant should be disabled.

Many hazards can be addressed prior to the introduction of plant into the workplace, that is, at the planning and purchasing stages. For example, the adoption of purchasing policies that take account of health and safety when buying plant for the workplace can often eliminate risks. Consideration should be given at the outset to purchasing plant or parts of the plant that eliminate the risk.

Substitution

If elimination is not practicable, consider substituting the hazardous parts of the plant with a safer part.

Engineering controls
Engineering controls involve the use of measures to change the physical characteristics of the plant. These can take the form of:

- design modification - modifying the design of a piece of plant means a fundamental change to the way the plant works or its operating characteristics. If the design is modified, the process of hazard identification and risk assessment should be repeated. (Note: the duties relating to designers come into effect if this approach is taken - refer to Part 2 of this code);
- installation of guarding to prevent workers getting clothing or body parts caught by a piece of plant, or prevent workpieces being expelled from the plant and striking people; and
- measures such as enclosures, local exhaust ventilation or automation.

Isolation
Isolation of the plant can be achieved, for example, by constructing a booth from which the plant can be operated remotely, or placing the plant behind a separating wall.

Administrative controls
Administrative controls involve the use of systems of work to control the risk - for example, installing a "lock–out" system to ensure that plant is isolated from its power source while maintenance or cleaning work is being done, or arranging work programs so the amount of time spent near hazardous machinery is minimised.

Personal protective equipment
Personal protective equipment (PPE) can be used as a short-term control measure until a "higher order" control has been provided. PPE can also be used to supplement other measures used to control risk. When it is required, the employer should ensure that PPE is provided and that it fits employees correctly, and that it is maintained.

Combining control measures
The Regulations provide that exclusive reliance on administrative controls and personal protective equipment must only occur where other measures have not been practicable. If health and safety risks are to be addressed only by these measures, efforts to eliminate or reduce the risks using other measures should continue.

When determining the preferred risk control measure, consideration should be given to the time needed for implementation and whether it is necessary to withdraw the plant from use or implement an interim risk control measure, while the preferred risk control measure is being prepared. For example, if an entanglement risk is assessed as requiring control, it may take some time to modify the plant to incorporate the necessary guards or safeguarding system. Alternative measures, such as barricades and safe systems of work should be implemented immediately until the modifications are complete.

In practice, risk elimination or reduction will probably be achieved by a combination of controls and should always include a specification and implementation of systems of work.

Risk control example
In a workplace, to ensure that servicing is carried out and that the plant is properly lubricated, maintenance personnel are regularly required to obtain access underneath mobile plant such as industrial lift trucks. The hazard identified is plant falling off vehicle jacks and hoists, causing severe injury to the person underneath.

To control the risk, the following options in order of priority, could be considered:

Elimination. - Can the job be done without requiring the plant to be raised? That is, is it practicable for the employer to install an in-ground service pit?

Substitution - If the plant still requires raising to gain access underneath, can the job be done without raising the plant on jacks or hoists? Can the plant be raised by a safer means such as, on screw-type jacks, temporary props, or driven onto elevating ramps?

Engineering controls - Can the designer re-design the plant so that all oil drainage and greasing points are located without the necessity of raising the plant? The risk control measures to do this may be the re-routing of all oil drainage bungs to the outside lower edge of the plant, and the installation of grease piping to allow greasing to be carried out on an external bank of grease points. Alternatively, for those areas requiring regular greasing, can these components be replaced with sealed units that do not require re-greasing?

Isolation - Can the job be done without the requirement for the employee to enter under the plant? For example, can modifications be made to the grease guns and the implement used to drain the oil so that servicing can be carried out from the side? Note: while there may still be a requirement to raise the plant to allow sighting of the grease and oil drainage points, with modified equipment such as long nosed grease guns, the risk of injury to the employee is substantially reduced should the plant fall.

Administrative controls - Where the above considerations are not practicable and employees are still required to gain access under the vehicle, proper instruction and training on the safe methods of elevating and temporarily securing the raised plant should be carried out. This administrative control should also incorporate regular monitoring to ensure that the safety requirements identified in the training are being followed. Another administrative control would be the use of new grades of grease and oil to increase the period between services, thereby reducing the employee's exposure to the hazard. (Note: as different grease and oil may introduce different operational characteristics into the plant, the operational parameters of the plant as designed should be reviewed.)

Personal protective equipment - In this example personal protective equipment is not applicable due to the high crushing forces generated if the hazard occurs.

Hazard identification, risk assessment and control example
Appendix 6 provides an example of the application of the hazard identification, risk assessment and risk control process to powered mobile plant.

21.4 Using Published Technical Standards for Guidance on Risk Control

Employers should have regard to the published technical standards listed in Table 3 below (and in the consolidated tables in Appendix 2) when determining measures to control risk *Note 14*. There may be published technical standards other than those listed in Table 3 that are relevant to the use of the plant in question and employers may choose to consider these when determining risk control measures.

Published technical standards should be used as a starting point to help control risks. It should not be assumed that by following the standards, the risk is eliminated or reduced, so far as is practicable. This is because the standard itself may not deal with all the matters relevant to risk control for the plant in question. Appropriate judgement needs to be exercised in such circumstances.

Table 3: Published technical standards relating to control of risks associated with plant use

Note 14(The reader should refer to "What is a Code of Practice?" and "Incorporation of Standards" at the front of this code of practice for an explanation of the significance of the technical standards listed in this code.)

Item No.	Plant Description	Code No.	Standard Title
		AS 4024	Safeguarding of machinery
		AS 1219	Power presses - safety requirements
		AS 2939	Industrial robot systems - safe design and usage
		I/C 1508	Functional safety - Safety related systems
		AS 1431	Low voltage switchgear and control gear - control circuit devices and switching elements Part 1: general requirements.
1.	**Machinery - general**	BS 6491	Electro-sensitive safety systems for industrial machines
		AS 2550	Cranes - Safe use
2.	**All cranes including hoists and winches**	AS 3860	Fixed guideway people movers
3.	**All conveyors except moving walks**	AS 1755	Conveyors- Design, construction, installation and operation - Safety requirements.
4.	**Powered industrial trucks (which includes forklifts)**	AS 2359	Powered industrial trucks
5.	**Lifts**	AS 1735	Lifts, escalators and moving walks - SAA Lift Code
		AS/NZS 1200	Pressure equipment
		AS 2593	Boilers - Unattended and limited attendance
		AS 3788	Boilers and pressure vessels - In-service inspection
	Pressure equipment other than gas cylinders	AS 3873	Boilers and pressure vessels - Operation and maintenance

	and pressure piping		
6.	Gas cylinders	AS 2337	Gas cylinders test stations
7.	**Earthmoving machinery**	AS 2958	Earthmoving machinery - Safety
		AS 2211	Laser safety
		AS 2397	Safe use of lasers in the building and construction industry
		I/C 825	Safety of laser products
8.	**Lasers**	EN 60825	Specification for radiation safety of laser products, equipment classification, requirements and user's guide
9.	**Scaffolding** Scaffolds, general	AS 4576	Guidelines for scaffolding
	Temporary access equipment		
	Harnesses	AS 2626	Safety belts and harnesses - selection, use and maintenance
	Industrial safety nets	AS 4576	Guidelines for scaffolding
10.	Work boxes - crane lifted	AS 2550	Cranes - Safe use Part 1 - General requirements
11.	**Indirect and direct acting hand held explosive-powered tools**	AS/NZS 1873	Power actuated (PA) hand held fastening tools
12.	**Amusement structures**	AS 3533	Amusement rides and devices

21.5 Guarding as a Measure to Control Risk

The Regulations provide (regulation 705):

(1) If an employer uses guarding as a measure to control risk in relation to plant, the employer must ensure that guarding designed for that purpose will, so far as is practicable, prevent access to the danger point or area of the plant.

(2) If an employer uses guarding as a measure to control risk, the employer must ensure that-

(a) if access to the area of the plant requiring guarding is not necessary during operation, maintenance or cleaning of the plant, the guarding is a permanently fixed physical barrier; or

(b) if access to the area of the plant requiring guarding is necessary during operation, maintenance or cleaning of the plant, the guarding is an interlocked physical barrier which allows access to the area being guarded at times when that area does not present a risk and prevents access to that area at any other time; or

(c) if it is not practicable for the plant to use the type of guarding referred to in paragraph (a) or (b), the guarding is a physical barrier which can only be altered or removed by the use of tools; or

(d) if it is not practicable for the plant to use the type of guarding referred to in paragraph (a), (b) or (c) a presence sensing system is used that eliminates the risk arising from that area of the plant requiring guarding, while a person or any part of a person is in the area being guarded.

(3) If an employer uses guarding as a measure to control risk in relation to plant the employer must ensure that the guarding-

(a) makes by-passing or disabling of the guarding, whether deliberately or by accident, as difficult as is reasonably possible; and

(b) does not cause a risk in itself.

(4) If an employer-

(a) uses guarding as a control measure; and

(b) the plant to be guarded contains moving parts and those parts may break or cause workpieces to be ejected from the plant-

the employer must ensure, so far as is practicable, that the guarding will control any risk from those ejected parts and workpieces.

(5) Nothing in this regulation prevents an employer from providing guarding which allows convenient repair, servicing and maintenance of plant when the plant is not in normal operation.

Numerous types of guarding systems are available to guard dangerous parts of machinery to prevent access by any person or body part. If guarding is used as a control measure, the employer is required to ensure that any guard designed for the plant will, so far as is practicable, prevent access to the danger point or area of the plant. The Regulations establish a priority order for the types of guarding systems. As the employer moves down the guarding hierarchy, the employer should consider what other risk control measures may be needed to be used in conjunction with the guarding to prevent access to the danger points or areas of the plant, so far as is practicable.

Guarding hierarchy

Permanently fixed physical barrier

If access to the area of the plant requiring guarding is not necessary during operation, maintenance or cleaning of the plant, the employer is required to ensure the guarding used is a permanently fixed physical barrier. A permanently fixed physical barrier provides the highest level of protection against hazards. Examples of fixed guards of this type would be the casing enclosing the plant's electric motor and the cast steel casing enclosing the gearing or power transmission. Permanently fixed physical barriers are normally used where there is no requirement to access the components being guarded. They cannot be removed without also making the plant inoperable.

Interlocked physical barrier

If access to the area of the plant requiring guarding is necessary during operation, maintenance or cleaning of the plant, the employer is required to ensure that guarding used is an interlocked physical barrier which allows access to the area being guarded at times when that area does not present a risk and prevents access to that area at any other time.

An interlock guard is one that is moveable or has a moveable part. The movement of the guard interacts with either the danger parts of the plant or the control system of the plant to prevent motion of the danger parts of the plant while the guard is open. Interlock guards having a wide application in most industries and are frequently encountered on plant involved in production.

Interlock guards may be mechanically interlocked directly with the operating mechanism. This type of interlock guard provides a positive mechanical interlock. In the example of a brake press, the press is unable to operate the stroke unless the interlock guard is in position preventing access to the danger area.

Interlock guards may also interface with the plant's control system where there is no direct mechanical interlock available. In the example of the brake press, the presence of an interlock guard which interfaces with the plant's control system, would prevent the press action commencing while the guard was not in position to prevent access to the press area.

Interlock guards due to their moving parts may require frequent maintenance and can require modifications to the control systems. Where guards are power operated, the employer should consider any hazards introduced by the powered movement of the guard.

Physical barrier

If guarding is to be used and it is not practicable to use a permanently fixed barrier or an interlocked physical barrier, the employer is required to ensure that the guarding is a physical barrier which can only be altered or removed by the use of a tool.

A physical barrier is normally a fixed guard which has no moving parts and offers protection only if it is in its correct position. Fixed guards may be fixed enclosing guards or fixed distance guards.

A fixed enclosing guard prevents access to a particular part of a machine by enclosure. For example, the bolted guard over the inspection port of a gear transmission, or wire mesh guard bolted over belt pulleys.

A fixed distance guard does not completely enclose a hazard but reduces the possibility of access to any dangerous part or area by its size and ability to keep all parts of the operator at a distance from the hazard. For example, a fixed distance guard for a brake press would allow the operator to introduce the material to be pressed while preventing the operator's fingers from encroaching into the immediate press area. A fixed distance guard can therefore provide protection against accidental access to moving parts and trapping spaces. The openings are wide enough only to feed material to the press. The guard is adjusted to the minimum gap to prevent access to trapping space.

A fixed guard is best used for repetitious dedicated work such as punching and shallow folding of material. Where there are a variety of guards and dies required for a variety of applications, the fitting of a fixed guard may not be practicable.

Although fixed guards offer the next highest level of protection from an interlocked physical barrier, they may not be practicable due to production access requirements or maintenance access requirements. Fixed guards may not be suitable in guarding all areas of the plant during production as they may be visually restrictive and cause inefficiencies. Due to the requirement to use tools or keys to fix and remove the guards, the frequent changing of fixed guards may result in an unacceptable level of production inefficiency. Fixed guards may be heavy and present a hazard if they need to be regularly removed and replaced by another type of guard.

If guarding is to be used and it is not practicable to use a physical barrier, a presence sensing system must be used.

Presence sensing systems

Where other types of guards are not practicable, the next level of protection is afforded by guards such as presence sensing or proximity sensing guards.

Presence sensing or proximity sensing guards are protective devices that have a proximity reaction. A switching command is initiated by the variation of optical electromagnetic, electrostatic or other fields. These include electro-optic action (light barriers, light curtains, light screens) and ultrasonic and protective devices with a capacitive or inductive action.

A presence sensing device is part of an overall presence sensing safeguarding system. This system comprises a combination of the presence sensing device and the plant's control elements (which include the primary control elements - any clutch, braking system or other arrangements) whereby the dangerous parts of a machine are brought to a safe state when the sensing field is interrupted.

These types of guards are very flexible as they allow a wide range of applications. They are able to be used for repetitive and dedicated applications and all facets of plant production.

Presence and proximity sensing devices require high levels of integrity and reliability of the guard and the machine. Generally, specialist skills are required to verify the integrity of the guarding system.

Published technical standards providing further guidance

Further guidance on the systems of guarding available to either eliminate or reduce the risk associated with a hazard is contained in AS 4024 *Safeguarding of machinery Part 1: General principles* and AS 1219 *Power presses - Safety requirements.*

Example: Guarding on a bench grinder
For the bench grinder example described in Appendix 5, the guards provided on the bench grinder to protect the operator from unintentionally coming in contact with the revolving grinding wheel should be sufficient to prevent access while at the same time allowing the workpiece to be ground. The opening to allow access to the wheel should therefore be as small as practicable.

Rather than have a hinged clip assembly, the guards used to prevent contact with the grinding wheel should be screwed or bolted into place to make them difficult to by-pass. This prevents inadvertent removal of the guards, as an implement such as a screwdriver or spanner would be required to remove them. Removal is required for regular cleaning and replacement of the grinding wheel. The design also allows regular maintenance of the guards to be carried out at the time of replacement of the grinding wheels.

The guards should be designed and maintained so that disintegration of the grinding wheel does not cause the guard to disintegrate into flying fragments, thereby creating a risk to safety itself. Regular checking of the guards should be carried out to ensure that abrasive particles from the grinding wheel have not worn the guard down to such an extent that this can occur.

21.6 Installation, Erection and Commissioning

The Regulations provide (regulation 707):

An employer must ensure that-

(a) plant is installed or erected to provide sufficient clear working area around the plant to allow the plant to be used in a manner which eliminates the risk associated with the activity, or if it is not practicable to eliminate the risk, reduces the risk so far as is practicable; and

(b) so far as is practicable, the layout of plant in the workplace does not affect access and egress to and from the workplace to the extent that it presents a risk; and

(c) the plant is not brought into operation unless the commissioning process (if any) has established, so far as is practicable, that it is safe to bring the plant into operation; and

(d) the installation, erection and commissioning processes include inspections which will ensure that the risk associated with these activities are monitored.

Methods to eliminate or reduce the risk to health or safety during installation, erection and commissioning include:

- barricades and guarding to prevent easy access to the site;
- warning signs to highlight dangers;
- walkways, ladders and scaffolds for access by people involved in the above activities. (Guidance on appropriate walkways, ladders and scaffolds is contained in the published technical standards listed in item 10 of Table 1);
- positioning of plant on the site to allow adequate clear space around the plant for people requiring access;
- a workplace layout that provides safe access to, and egress from the plant; and
- interim safeguarding during testing and start-up where final means of safeguarding are not in place.

Such methods should take into consideration the information provided by the designer via the manufacturer, importer and/or supplier.

Plant location
When considering the location of plant, the employer should ensure that access and egress to areas of the plant that require cleaning and maintenance does not constitute a risk to health or safety. The employer should also ensure that, during any maintenance or cleaning of the plant, other operational plant in the vicinity does not present a risk to health or safety.

21.7 Plant in Use

The Regulations provide (regulation 708):

(1) An employer must ensure that-

(a) plant is maintained-

(i) so as to eliminate the risk associated with the use of the plant; or

(ii) if it is not practicable to eliminate the risk, so as to reduce the risk so far as is practicable; and

(b) plant is inspected to the extent necessary to ensure that the risk associated with the use of the plant is monitored; and

(c) so far as is practicable, measures are provided to prevent-

(i) alterations to the plant which have not been permitted by the employer; or

(ii) interference with the plant.

(2) In respect of plant required to be registered under regulation 1007, an employer must ensure, so far as is practicable, that records of inspections and maintenance carried out on the plant are kept while the employer has management or control of the plant.

General
The Regulations require the employer to ensure that inspections are carried out to monitor risks to health or safety.

The employer should ensure that where safety features or warning devices are incorporated into plant they are used as intended, and maintained and tested.

The employer should ensure that persons do not work between the fixed and traversing parts of the plant where there is a risk to health or safety.

Access and egress
When considering the system of work associated with the use of plant, the employer should also consider the access and egress requirements of the plant operator:

- while the plant operator is at his or her workstation during normal operation of the plant; and
- during any other conditions (including emergencies) that the plant has been designed for or that the employer envisages may occur.

Maintenance, inspection, cleaning
Plant should be maintained, inspected and cleaned according to the recommendations of the designer and manufacturer. Further guidance on inspection and maintenance of various types of plant is given in the published technical standards listed in Table 3

The employer should ensure the necessary facilities and systems of work are provided and maintained for employees maintaining, inspecting or cleaning plant, so as to eliminate risks to health or safety, or if it is not practicable to eliminate the risks, reduce the risks so far as is practicable. Where practicable, the system of work should involve stopping the plant before maintenance, cleaning or repairs are commenced and the use of lockout or isolation devices and permit-to-work systems.

Where it is not practicable to carry out cleaning or maintenance with the plant stopped, alternative means of preventing inadvertent operation should be implemented. The employer should consider the use of the following methods:

- fitting operational controls which permit controlled movement of the plant; and
- initiating safe systems of work.

Damaged plant

Where the employer is assessing the function and condition of plant that is impaired or damaged and presents an immediate risk to health and safety, the plant should be withdrawn from use until the risk is controlled or the plant repaired.

For damaged plant, the employer should ensure that an assessment of the damage is carried out. The assessment should identify the nature of the damage, whether the damage can be repaired, and what repairs are necessary. The repair, inspection and any necessary testing of the plant should be carried out while ensuring that the plant remains within its design limits.

Alteration

Where plant is to be altered, the employer should ensure that the design of the alteration has undergone a hazard identification and risk assessment. When the plant is altered, it should be inspected and tested having regard to the design specifications for the alteration. This should occur before the plant is returned to service.

The person undertaking an assessment of damaged plant or assessment for the purpose of altering plant should be specifically competent to undertake these tasks, and should take into consideration the information from the designer and manufacturer and any relevant published technical standards.

Dismantling

Where plant is to be dismantled, the employer should ensure that any relevant information provided by the designer and manufacturer is given to the person who is to dismantle the plant. Where plant that is to be disposed of contains materials presenting a risk to health or safety, the employer should ensure that the person disposing of the plant has been provided with all the relevant information about the plant and the materials it contains. Any other training, information and instruction should also be provided so that the disposal can be carried out in a manner that eliminates or reduces the risk to the health and safety of the person disposing of the material, and any other person. The employer should ensure that the person is competent in the disposal of such plant.

Plant at the end of its service life may require dismantling due to the potential of fatigue, corrosion or abrasion causing the plant to become unstable and thereby creating a hazard of collapse. Because of this alteration to the plant's physical characteristics, the method of erection, if known, is frequently not able to be carried out in reverse order during the dismantling process. Therefore, before dismantling plant the employer should consider the areas of high fatigue, corrosion, abrasion and other known hazards, to aid identification of structural weaknesses and assist development of safe dismantling procedures.

As an example, water tube boilers slung from overhead supports at the end of their service life will have been subject to repairs and replacement of the water tubes. They will exhibit corrosion or pitting in the boiler with a possible significant deterioration of the boiler's structural strength. The person dismantling a boiler in this condition should take into consideration the mechanism for supporting the boiler during dismantling, to ensure that no inadvertent collapse occurs due to weakened sections being subjected to a excessive stress loading

21.8 Plant Not in Use

The Regulations provide (regulation 709):

An employer must ensure that when plant is not in use it is left in a state which does not create a risk, so far as is practicable, for any person.

Plant that has been taken off-line would constitute plant not in use. For example, an automatic robot on a welding line may be taken off-line due to a design modification no longer requiring the use of the robot for the particular product. The robot is therefore still fully functional but is no longer in use. As the robot is able to be powered up and become operational, the employer should ensure that the plant is not left in a state that presents a risk to health or safety. This may be done by isolating the work station from the power supply, employing log-out/tag-out systems and providing physical stops to prevent movement in the event of accidental powering of the plant.

Powered mobile plant may present a risk to health or safety if measures are not taken to prevent the plant moving of its own accord (for example, rolling down a sloping surface), or to prevent unauthorised operation. For example, an industrial lift truck at the end of, or during a shift, is plant that is frequently not in use and unattended for short periods of time. The employer should ensure that the operator of the truck is fully conversant with the safety procedures required when leaving the truck unattended. This would include ensuring that the truck has been parked on a firm, level surface with the handbrake applied, the motor switched off and the key removed.

21.9 Powered Mobile Plant

The Regulations provide (regulation 711):

(1) An employer must ensure that the likelihood of powered mobile plant overturning or of a falling object coming into contact with the operator of the plant or the operator being ejected from the plant is eliminated, or if it is not practicable to eliminate the likelihood, reduced so far as is practicable.

(2) If a risk assessment identifies a likelihood of-

(a) a powered mobile plant overturning; or

(b) objects falling on the operator; or

(c) an operator being ejected from the plant-

an employer must ensure that, so far as is practicable, an appropriate combination of operator protective devices are provided, maintained and used to reduce, as far as is practicable the risk to the operator.

(3) An employer must ensure that the risk of powered mobile plant colliding with pedestrians or other powered mobile plant is eliminated, or if it is not practicable to eliminate the risk, reduced so far as is practicable.

(4) Without limiting sub-regulation (3), if there is a likelihood of powered mobile plant colliding with pedestrians or other powered mobile plant, the employer must ensure that the plant has a warning device which will warn people who may be at risk from the movement of the plant.

(5) An employer must ensure, so far as is practicable, that no person, other than the operator, rides on powered mobile plant unless the person is afforded a level of protection from exposure to a risk which is equivalent to that provided to the operator.

For guidance on compliance with this regulation refer to the risk control measures outlined for the powered mobile plant example presented in Appendix 6.

AS 2294 *Earth-moving machinery - Protective Structures*; and AS 1636 *Agricultural wheeled tractors - Roll-over protective structures - Criteria and tests* provide guidance on methods and standards for the selection and testing of protective structures where plant may overturn or be struck by a falling object.

21.10 Electrical Plant and Plant Exposed to Electrical Hazards

The Regulations provide (regulation 712):

An employer must ensure that -

(a) plant is not used if the plant or the conditions under which it is to be used give rise to a risk due to the presence of electricity; and

(b) if maintenance, cleaning or repair of electrically powered plant is being carried out-

(i) the plant is disconnected from the electricity supply; or

(ii) if it is not practicable to disconnect the plant from the electricity supply, appropriate measures are provided to avoid inadvertent energising of the plant; and

(c) excavations using plant near underground power lines are carried out in such a way as to ensure the risk to people associated with the operation-

(i) is eliminated; or

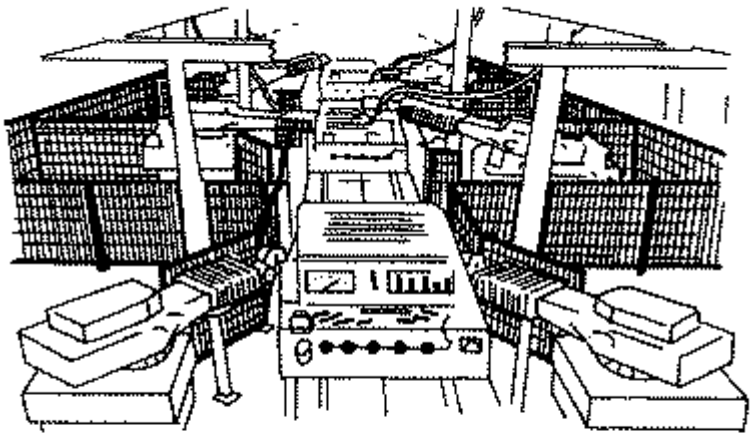
(ii) if it is not practicable to eliminate the risk, reduced so far as is practicable; and

(d) plant is operated near overhead electrical power lines in such a way as to ensure the risk to people associated with the operation-

(i) is eliminated; or

(ii) if it is not practicable to eliminate the risk, reduced so far as is practicable.

Fig 7



Automatic robot welding on an electronics line. The power being an integral part of the production line is unable to be disconnected from the robots. Therefore each robot is surrounded with a safety fence consisting of fixed and interlocked access guards which isolates the power upon intrusion into this area

Risk control example for regulation 712(b)
Some measures that may be appropriate to achieve compliance with regulation 712(b) are outlined below using an automatic robot production line as an example.

It may not be possible to disconnect the power supply of an automatic robot on a welding production line where the power source is an integral part of the production line (see Figure 7 below). Where the plant is required to be isolated from the production line to allow maintenance or repairs to be undertaken, the employer should ensure that appropriate measures are put in place to avoid unintentional energising of the plant. Appropriate measures may include:

- isolating the plant from the power supply source, by operation of interlocked guards when entering the safeguarded space;
- employing log-out/tag-out systems of work to ensure that persons do not inadvertently energise the plant; and
- providing physical stops such as a stand for the arm of the robot that locks it in position, or physically stops the base of the robot from slewing, or by placing physical blocks to the potential entrapment points in the event that the robot does move.

21.11 Plant Used to Lift or Suspend Loads Including People and Materials
The Regulations provide (regulation 713):

(1) This regulation does not apply to plant used in connection with -

(a) professional stunt activities; or

(b) theatrical or acrobatic performances.

(2) In respect of plant that is used to lift or suspend people, equipment or materials an employer must ensure that-

(a) subject to sub-regulation (3), the plant is specifically designed to lift or suspend those loads; and

(b) all lifting or suspending is carried out-

(i) with lifting attachments that are appropriate to the load to be lifted or suspended; and

(ii) within the safe working limits of the plant; and

(c) subject to sub-regulation (4), so far as is practicable, no loads are suspended over, or travel over a person; and

(d) loads are lifted or suspended in a way which ensures that the load remains under control during the activity; and

(e) so far as is practicable, no load is lifted simultaneously by more than one piece of plant.

(3) If it is not practicable to use plant to lift or suspend loads that is specifically designed for the purpose, the employer must ensure that-

(a) the plant used to lift or suspend the load does not cause a greater risk than if specifically designed plant was to be used; and

(b) if the plant is lifting or suspending people-

(i) the people are lifted or suspended in a work box which is securely attached to the plant; and

(ii) the people in the work box substantially remain within the confines of the work box while they are being lifted or suspended; and

(iii) if there is a likelihood of a person falling from a height, a safety harness is provided and worn by the person in order to prevent, so far as is practicable, injury to the person as a result of the fall; and

(iv) means are provided by which the people being lifted or suspended can have safe egress from the plant in the event of a failure in the normal operation of the plant.

(4) Sub-regulation (2)(c) does not apply to plant which is an amusement structure.

Risk control example for regulations 713 (2) and 713(3)(b)(iv)
The Regulations require that plant used to lift or suspend people, equipment or materials is specifically designed to lift or suspend those loads. Where it is not practicable to use plant specifically designed for the purpose, the Regulations require the employer to ensure the plant used does not cause a risk to health or safety any greater than if specifically designed plant was to be used.

As an example, an employer may require a person to be suspended from a crane in a workbox to allow a visual inspection of the inside of a chimney or cooling tower. Due to access limits the crane boom may need to be fully extended and include a fly jib. The employer should ensure that appropriate safe working limits for the crane and fly jib are applied when suspending persons from a crane. So far as is practicable the employer should ensure the crane has been designed to enable the safe suspension of people in a workbox. The design should include such features as the ability to safely retrieve the workbox in the event of power failure and should also ensure the safety of the persons in the workbox in the event of primary brake failure.

Where the item of plant is not designed to lift or suspend the people, the employer is required to ensure that there is available, a means that will allow egress from the workbox in the event of a power failure of the crane. The employer should ensure that an auxiliary power supply for the crane is readily available. This would normally be an auxiliary hydraulic pump able to be connected to the crane's hydraulic system. The pump should be capable of sustaining the load and other functions associated with the safe retrieval of the persons in the workbox. Where this not practicable, a second crane should be on stand-by to provide for safe egress of the people in the workbox.

The employer should also ensure that the operator is properly trained and instructed in the use of the auxiliary power unit and the circumstances under which it must be used.

Further guidance on methods and standards on the selection of workboxes for the purposes of lifting or suspending people is provided in AS 2550 *Cranes Mobile, tower and derrick - Selection and operation.*

21.12 Industrial Lift Trucks

The Regulations provide (regulation 714):

An employer must ensure that an industrial lift truck is-

(a) equipped with lifting attachments that are appropriate to the load to be lifted or moved; and

(b) used in a manner that ensures that the risk to the operator of the truck which arises from systems of work and the environment in which the trucks are used is eliminated, or if it is not practicable to eliminate the risk, reduced so far as is practicable.

Risk control example for regulation 714(a)

The employer is required to ensure that industrial lift trucks are equipped with lifting attachments that are appropriate to the load to be lifted or moved. For example, to gain the maximum usage of a storage area, an employer in a paper mill wants to stack rolls of paper end on and five high. In this case, instead of the standard types, the industrial lift truck should have a swivelling roll clamp lifting attachment designed for the size of the roll of paper intended to be lifted. The employer should ensure that the capacity of the industrial lift truck is sufficient for the roll to be lifted with the attachment. This information would normally be obtained from the designer via the manufacturer and supplier. Systems of work taking into account not only the normal hazards associated with industrial lift truck operation but also other hazards introduced by the attachment and the paper rolls should be developed by the employer.

21.13 Scaffolds

The Regulations provide (regulation 715):

An employer must ensure, in relation to scaffolds, that -

(a) no work, other than the work of erecting or dismantling the scaffold, is carried out from a scaffold unless the scaffold, or the relevant part or portion of the scaffold, is complete; and

(b) the scaffold is secure and capable of supporting the work to be carried out on the scaffold; and

(c) on becoming aware that the scaffold or its supporting structure is in an unsafe condition, appropriate repairs, alterations or additions are carried out before the relevant part or portion of the scaffold is used; and

(d) if a scaffold is left unattended, people who would not ordinarily be using the scaffold are prevented, so far as is practicable, from gaining access to the scaffold.

Scaffolding or plant that is specifically designed to raise or lower people should be provided for the use of any person engaged on any work that cannot be done safely from the ground or other supporting surface of solid construction.

The employer should ensure the scaffold selected is only used for purposes that it is designed. (Where a scaffold is to be used for a purpose for which it was not designed, the employer is required under the Regulations to carry out a hazard identification process in relation to the intended usage. If a hazard is identified the associated risk must be assessed.)

Light duty prefabricated aluminium scaffolds should not be selected for use as access towers or for stacking heavy materials (such as bricks) on, without additional design considerations. These types of loading are specialised and severe, and may exceed the generalised light duty loading intended by the designers.

Employers should be aware that scaffolds that are erected to be secure and capable of supporting the work to be carried out may not stay in that condition. A scaffold that was secure when erected may, as a result of interference, become a risk to health and safety. Workers periodically remove components of scaffolding to facilitate work. For example, window fitters and glazers often need to remove ties and do so without appreciating the likely effect on the scaffold. A health or safety risk may arise from this action, so the employer should regularly monitor scaffolds to reduce and quickly rectify such interference. As another example, prefabricated mobile scaffolds inside buildings are often height adjusted to suit varying ceiling protrusions. Occasionally, components (for example, braces, toe-boards and access ladders) are removed and the scaffold no longer conforms to the designer's, manufacturer's or supplier's specifications.

As part of the measures to prevent interference with scaffolds, the employer should ensure that training of employees required to work on scaffolds covers the importance of:

- not removing ties, rakers or other stabilising devices;
- not weakening or overloading the supporting structure of a scaffold; and
- not removing or interfering with any identification attached to the scaffold.

Scaffolds left standing for long periods may become unsafe and require repair before being used again. For example, scaffolds left standing for long periods can obstruct subsequent work to be performed by other trades people. These people may then cause interference to the scaffold to facilitate their work, thereby causing the scaffold to become unsafe for further use.

The employer should ensure that scaffolds left standing and unused for long periods are inspected prior to being used again, to determine whether they are in a safe condition for use.

When a scaffold is left unattended, there is a greater chance of unauthorised access to the scaffold. That is, the unattended scaffold is more easily accessed by members of the public, or by other employees not required or intended to have access. The employer is required to prevent, so far as is practicable, such access.

The employer should consider the placement of hoarding around scaffolds on street pavements to prevent members of the public gaining access to the scaffold. The employer should also consider, as part of the method of controlling unauthorised access to the scaffold, implementing work practices requiring the bottom most access ladder to be removed from the scaffold when its use is not required.

Where erection of a scaffold is incomplete, the employer should ensure that employees (other than those involved in the erection of the scaffold) are prevented from gaining access to it. Such measures could include:

- the posting of signs at all obvious entry and exit points to warn that the scaffold is incomplete; and
- the removal of the bottom most access ladder.

Further guidance on safety aspects of scaffolding is provided in *AS/NZS 4576 - Guidance for Scaffolding*

22. Training, Information and Instruction of Employees

22.1 Duties of Employers

Section 21(2)(e) of the Act requires an employer *"to provide such information, instruction, training and supervision to employees as are necessary to enable the employees to perform their work in a manner that is safe and without risks to health"*.

The Regulations provide (regulation 716):

(1) If a hazard related to plant and its associated systems of work is identified and assessed to be a risk, under regulation 703, an employer must ensure that -

(a) employees likely to be exposed to the risk, and anyone supervising the employees, are trained and provided with information and instruction in-

(i) the nature of the hazard associated with the plant and systems of work associated with the plant, and the processes used for hazard identification, risk assessment and control of risk; and

(ii) the need for, and proper use and maintenance of, measures to control risk; and

(iii) the safety procedures associated with the use of the plant at the workplace; and

(iv) the use, fit, testing and storage of personal protective equipment, if personal protective equipment forms part of the measures to control risk; and

(b) people involved in-

(i) commissioning and installing plant; and

(ii) testing of plant; and

(iii) de-commissioning, dismantling and disposal of plant; and

(iv) inspection and maintenance-

are provided with information, which is available to the employer, on how the activities referred to in paragraphs (i), (ii), (iii) and (iv) can be carried out in such a way as to ensure the risk to them while carrying out those activities is eliminated, or if it is not practicable to eliminate the risk, reduced so far as is practicable.

(2) In respect of lifts, the duties of an employer under sub-regulation (1)(a) do not apply to employees who travel in a lift, other than employees who carry out work on the lift.

22.2 Purpose of Training

If a hazard related to plant and its associated systems of work is identified and assessed to be a risk to health or safety, the Regulations require training for employees likely to be exposed to the risk and also for anyone supervising the employees. The purpose of training is to provide employees and their supervisors with the skills and knowledge necessary to effectively follow the safety procedures and use the control measures implemented for their protection. It should also give them an appreciation of the hazards associated with the plant.

The amount of detail and extent of training required will depend on the nature of the hazard(s) and risk(s) associated with the plant or systems of work and the complexity of the work procedures and control measures required to eliminate or reduce the risk. In this regard, the risk assessment process specified in the Regulations provides important guidance when developing training programs.

22.3 Outcomes of Training.

The Regulations provide that where an employee is likely to be exposed to risk, the employer must ensure that the employee and anyone supervising the employee has received appropriate training. The outcomes of the training are not mandated in the Regulations but should include the employee having the ability to demonstrate competency in the safe use of the plant in the workplace.

Where training is required in accordance with regulation 716(1), the employer should ensure that the outcomes of training for employees and anyone supervising the employees include the ability to demonstrate an understanding of:

- the nature and location of hazards associated with plant in the workplace;
- the reasons for, and nature of, the control measures that are in use or are planned. (Training should address the need for, and proper use and maintenance of, measures to control risk as this assists in ensuring employee commitment to these measures);
- the specific control measures which are necessary in relation to each employee's own job (as appropriate, this should include instructions in the correct use of engineering controls, safe work practices and recognition of factors likely to impair plant user performance);
- the processes of hazard identification, risk assessment and risk control;
- the arrangements for reporting circumstances likely to cause hazards;
- when and how to use appropriate personal protective equipment, including proper care and the arrangements for maintenance, cleaning and replacement, distribution and checking procedures for when donning equipment; and

emergency procedures relating to the use of the plant in the workplace.

22.4 Training Methods.

When developing and providing training programs the employer should consider any special needs the employees being trained may have. Special needs may relate to specific skills, work experience, gender, physical disability (including injury), intellectual disability, ethnicity and first language, literacy and age. These special needs should be taken into account in the structure, content and delivery of the training. This may take the form of oral or highly graphic training methods, or use of a language other than English. The employer should refer to the *Code of Practice for Provision of Occupational Health and Safety Information in Languages other than English* for guidance on training in multilingual workplaces.

The employer should evaluate the training to ensure that the content of the training is clearly understood by the employees.

22.5 Review of Training

To ensure that training remains effective, when changes occur in the workplace which may affect the health or safety of employees, the employer should review training to identify further training needs and provide this training. Such changes include:

- a change in the nature of hazards and associated risk due to alterations to, or the introduction of, new plant; and
- changes in the layout of the workplace, work practices or control measures which relate to the plant.

22.6 Training for Certificated Plant Users and Operators

The employer should refer to the Occupational Health and Safety (Certification of Plant Users and Operators) Regulations 1994 to identify which plant is required to be operated by a person who holds a certificate of competency. The employer should ensure that the certificated employee and person providing supervision to that employee, has undergone training appropriate to the specific plant and work practices at the workplace.

Note: the demonstrated competencies sufficient to obtain a certificate of competency may or may not be considered by the employer as satisfying the requirements of the job. Employers need to consider the individual work environment and work practices when identifying the nature of the hazards associated with the plant and systems of work to determine the extent of any additional training needed. For example, the employer could identify those persons who have had experience limited to a small range of plant, or who have not been required to operate the plant for an extended period of time and will therefore require additional training.

22.7 Competency-based Training for Non-certificated Operators

The following sources of information may be useful when developing training to provide employees with the knowledge and skills to use plant that does not require a certificated operator:

- information provided by the designer, manufacturer, importer or supplier about the competency of operators necessary for the safe use of the plant;
- national occupational health and safety competency standards developed by the National Occupational Health and Safety Commission; and
- national industry competency standards.

As an example, where the employer requires employees to operate earthmoving equipment (or other loadshifting equipment such as cableways and flying foxes), he or she may use the core training elements of the *National Guidelines for Occupational Health and Safety Competency Standards for the Operation of Loadshifting Equipment and Other Types of Specified Equipment* and the associated Instruments of Assessment as a starting point when determining the training required for specific work practices and how to assess operator competency. The National Guidelines document also covers competency standards that can be used as the basis for determining basic requirements for the operation of certain types of cranes and refrigeration plant.

22.8 Provision of Information to Persons Commissioning, Testing and Inspecting the Plant

Information on the commissioning, installation, testing, inspection, maintenance, de-commissioning, dismantling and disposal of plant may be obtained from designers, manufacturers, suppliers, statutory authorities, and the published technical standards contained in Table 3. Other information that employers may be expected to have available would include information on the particular site, environment and use that applies to the plant. This information should be made readily available to persons involved in the above work processes.

23 Design Verifiers

Under the Regulations, certain plant (listed in Item 1 of Schedule 2 of the Regulations), must not be used at a workplace unless notification of the design of the plant has been given to the Minister (regulation 1001). The notification must include a design verification statement (regulation 1002(4)(a)).

The Regulations provide (regulation 1003):

(1) The person who gives notification of a plant design must ensure that the design verification statement was made by a design verifier who did not participate in the design that is the subject of the statement.

(2) A person who has participated in the design of particular plant, must not knowingly act as a design verifier for that plant.

The designer verifier should have acquired through academic qualifications or design experience, the knowledge and skills to independently verify the tasks performed by the designer. There may be more than one design verifier for the plant being verified. A design verifier may be employed by the same company that carried out the design project.

The design verifier may have developed another design which is part of the same design project, provided that he or she has not been involved in that part of the design for which he or she is the design verifier.

In cases where plant is made up of a number of different assemblies that have been designed by different designers, the Regulations require the person giving notification of plant design to ensure that each assembly design has been verified by a design verifier who has not been involved in the design of that particular assembly. A person in designing one assembly may act as the design verifier of another assembly of the same plant.

Even though assemblies of the plant may have been designed by several designers, one design verifier may verify the designs for all the assemblies of the plant, providing he or she has not been involved in the design of any of these assemblies.

A design verifier may provide advice to a designer on elements of the design requiring further measures to control risk to health or safety and subsequently act as a design verifier for the revised design.

Appendix 1 Definitions of Types of Plant and Other Related Terms

.The Occupational Health and Safety (Plant) Regulations 1995 set down the following definitions for different types of plant and other technical terms referred to in the Regulations. Note: examples shown in brackets are not set down in the Regulations but are provided in this code for guidance.

'**Abseiling Equipment**' means equipment used to manually lower or raise a person in a harness or seat, supported by one or more fibre ropes and includes the equipment used to anchor or haul the rope or ropes while abseiling.

'**Amusement structure**' means powered equipment operated for hire or reward which provides entertainment or amusement through movement of the equipment, or part of the equipment, or when passengers travel on, around or along the equipment. (Examples include Ferris wheels, merry-go-rounds, coin in the slot amusement rides.)

'**Boiler**' means a boiler as defined in AS/NZS 1200 Boilers and Pressure Vessels with a hazard level A, B, C or D as determined by AS 3920 Part 1, Pressure Equipment Manufacture - Assurance of Product Quality.

'**Boom type elevating work platform**' means a telescoping device, hinged device, or articulated device or combination of those devices used to support, elevate and position personnel, equipment or materials by means of a platform, but does not include an industrial lift truck.

'**Bridge crane**' means a crane comprising a bridge beam or beams mounted at each end, to end carriages, capable of travelling along elevated runways and having one or more hoisting mechanisms.

'**Building maintenance equipment**' means a suspended platform, including a building maintenance unit or a swing stage, which incorporates permanently installed overhead supports to provide access to the faces of a building for maintenance, but does not include a suspended scaffold.

'**Building maintenance unit**' means a power operated appliance with a suspended platform, permanently installed or intended to be permanently installed on a building and specifically designed to provide access to the facade of the building, for persons working from the platform.

'**Concrete placing unit (truck-mounted with boom)**' means plant used to place concrete by way of pumping concrete through a pipeline attached to or forming part of a boom and capable of travelling over a supporting surface without the need for fixed runways.

'**Conveyor**' means equipment, by which loads are raised, lowered or transported or capable of being raised, lowered, 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 similar means; or
(c) a rotating screw; or
(d) a vibration or walking beam; or
(e) a powered roller conveyor where the rolls are driven by an endless belt, rope, or chain or other similar means.

'**Crane**' means an appliance intended for raising or lowering a load and moving it horizontally, but does not include - an industrial lift truck, earthmoving machinery, an amusement structure, a tractor, an industrial robot, a conveyor, building maintenance equipment, a suspended scaffold or a lift.

'**Earthmoving machinery**' means plant used to excavate, load, transport, compact or spread earth, overburden, rubble, spoil, aggregate or similar material, but does not include a tractor or industrial lift truck or a vehicle designed to be used primarily as a means of transport on public roads. (Examples include bulldozers, excavators, front-end loaders, backhoes, scrapers, dredgers, draglines and face shovels.)

'**Explosive powered tool**' means an implement used to drive fasteners including nails, bolts and screws against, into or through material by means of explosive charges, and includes every attachment to and accessory of such an implement but does not include a firearm within the meaning of the **Firearms Act 1958.**

'**Gantry crane**' means a crane which–
(a) consists of a bridge beam or beams, which are supported at one or both ends by legs mounted to end carriages; and
(b) is capable of travelling along runways; and
(c) has one or more hoisting mechanisms.

'**Gas cylinder**' means a rigid vessel not exceeding 3000 litres water capacity and without openings or integral attachments on the shell other than at the ends, designed for the storage and transport of gas under pressure and to which, AS 2030 - Gas Cylinders applies.

'**Hoist**' means an appliance intended for raising or lowering a load or people, and includes a mast climbing work platform, personnel and materials hoist, scaffolding hoist and serial hoist but does not include a lift or building maintenance equipment.

'**Individual fall arrest system**' means equipment incorporating a harness which is used or intended to be used to arrest the fall of a person wearing the harness.

'**Industrial lift truck**' means a powered appliance comprising a mast with an elevating carriage to which a pair of fork arms or other load holding attachment is attached and includes–
(a) a truck on which the operator is raised with the attachment for order-picking; and
(b) a truck where the frame and lift unit straddle, raise, lower, move or stack the load–
but does not include a crane or earthmoving machinery.

'**Industrial robot**' mans a mechanical manipulator, capable of handling materials, tools or devices through programmed motions which are usually intended to be carried out repetitively.

'**Laser**' means plant that produces a beam of electromagnetic radiation in the wavelength range from 100 nanometres to 1 millimetre and used for cutting, alignment, scanning or measurement, but does not include plant which produces light beams at these wavelengths for the primary purpose of illumination.

'**Lift**' means permanent plant or plant intended to be permanently installed in or attached to a building or structure in which people, goods or materials may be raised or lowered within a car or cage, or on a platform and the movement of which is restricted by a guide or guides and includes an escalator, moving walk and stairway lift.

'**Mast climbing work platform**' means plant with a working platform used to support and elevate personnel, equipment and materials by means of a drive system which moves along an extendable mast but does not include a lift or building maintenance equipment.

'**Mobile crane**' means a crane capable of travelling over a supporting surface without the need for fixed runways.

'**Operator protective devices**' include roll-over protective structures, falling object protective structures, operator restraining devices and seat belts.

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'**Powered mobile plant**' means plant which is provided with some form of self propulsion which is ordinarily under the direct control o an operator.

'**Prefabricated scaffolding**' means an integrated system of prefabricated components manufactured in such a way that the possibl geometry of assembled scaffolds is pre-determined by the designer.

'**Pressure equipment**' means boilers, pressure vessels and pressure piping.

'**Pressure piping**' means pressure piping as defined in AS/NZS 1200 Boilers and Pressure Vessels with a hazard level A, B, C or D a determined by AS 3920 Part 1, Pressure Equipment Manufacture - Assurance of Product Quality but does not include pressure pipin which is regulated under–

(a) the **Gas Industry Act 1994**; or
(b) the **Petroleum Act 1958**; or
(c) the **Petroleum (Submerged Lands) Act 1982**; or
(d) the **Pipelines Act 1967**; or
(e) the **Water Industry Act 1994**; or
(f) any other Act (other than the **Occupational Health and Safety Act 1985**) which imposes statutory controls over pressure pipin comparable to those listed in paragraphs (a) to (e).

'**Pressure vessel**' means a pressure vessel as defined in AS/NZS 1200 Boilers and Pressure Vessels and AS 2030 Gas Cylinders with a hazard level A, B, C or D as determined by AS 3920 Part 1, Pressure Equipment Manufacture - Assurance of Product Quality and includes a fired heater and a gas cylinder, but does not include a boiler or pressure piping.

'**Scaffold**' means a temporary structure specifically erected to support access or working platforms. (Examples include prefabricate scaffolds, swing stages, tube and coupler scaffolds, trestle scaffolds, bracket scaffolds and ladder bracket scaffolds).

'**Suspended scaffold**' means a scaffold incorporating a suspended platform which is capable of being raised or lowered when in use.

'**Temporary access equipment**' means abseiling equipment, a work box, an industrial safety net, or an individual fall arrest system.
'**Tower crane**' means a boom or jib crane mounted on a tower structure.

'**Tractor**' means a powered vehicle, primarily designed to haul and provide power for agricultural or horticultural machinery o implements, by way of a power take-off rotating shaft or other mechanical means, but does not include earthmoving machinery or passenger vehicle.

'**Turbine**' means a rotary motor or engine driven by a flow of water, steam or gas primarily intended for the production of electricity (Examples include hydroelectric, steam and gas turbines.)

'**Vehicle hoist**' means a hoist which is permanently installed or intended to be permanently installed in a workplace to elevate a vehicl to allow work to be carried out on the vehicle.

'**Work box**' means a personnel carrying device, designed to be suspended from a crane, to provide a working area for persons elevate by and working from the box.

'**Workpiece**' means material, off-cut or scrap (in any form) on which an item of plant is doing work, or material, off-cut or scrap (in an form) produced by an item of plant but does not include a load being lifted or moved by the plant.

Appendix 2 Published Technical Standards Referenced in this Code

The following tables list published technical standards that are referenced in this code of practice as providing guidance on the design, manufacture or use of certain classes or types of plant. Each table relates to a class or type of plant and lists the titles of the applicable published technical standards (together with their code numbers). It also indicates whether the guidance provided in the technical standard is applicable to the design, manufacture and/or the use of the plant.

1. Machinery

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
Machinery - general	AS 4024	Safeguarding of machinery	✓	✓	✓
	AS 1219	Power presses - Safety requirements	✓	✓	✓
	AS 2939	Industrial robot systems - safe design and usage	✓	✓	✓
	I/C 1508	Functional safety - Safety related systems	✓	✓	✓
	AS 1431	Low voltage switchgear and control gear - control circuit devices and switching elements Part 1: General requirements.	✓	☒	✓
	BS 6491	Electro-sensitive safety systems for industrial machines	✓	☒	✓

2. Plant designed to lift or move people or materials (other than ships, boats, aircraft or vehicles designed to be used primarily as a means of transport on a public road or rail)

Cranes:

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
	AS 1418	Cranes (including hoists and winches)	✓	✓	☒
	AS 2550	Cranes - Safe use	☒	☒	✓
	AS 3860	Fixed guideway people movers	✓	✓	✓
	ISO 2374	Lifting appliances - Range of maximum capacities for basic models	✓	✓	
All cranes including hoists and winches	BS 2573	Rules for the design of cranes	✓	☒	☒

Conveyors:

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
All conveyors except moving walks	AS 1755	Convenyors - Design, construction, installation and operation - Safety requirements.	✓	✓	✓

Industrial Trucks (including forklifts):

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
Powered industrial trucks (including forklift trucks)	AS 2359	Powered industrial trucks	✓	✓	✓

Lifts:

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
Lifts	AS 1735	Lifts, escalators and moving walks - SAA Lift Code	✓	✓	✓

3. Pressure Equipment

Plant Description	Code	Standard Title	Design	Manufacture	Use

	Number				
	AS/NZS 1200	Pressure equipment	✓	✓	✓
	AS 2593	Boilers - Unattended and limited attendance	✓	☒	✓
	AS 3788	Boiler and pressure vessels - In-service inspection	☒	☒	✓
	AS 3873	Boiler and pressure vessels - Operation and maintenance	☒	☒	✓
	AS 3920	Assurance of product quality	✓	✓	☒
	BS 5500	Specification for unfired fusion welded pressure vessels. - category 1. {for AS 1210 class 1H (h = 1) category 2. {for AS 1210 class 2H (h = 1)	✓	✓	☒
	AS 2971	Serially produced pressure vessels	✓	✓	☒
	ASME I	Power boilers	✓	✓	☒
	ASME II	Materials	✓	✓	☒
	ASME V	Non-destructive examination	✓		☒
	ASME VIII-1	Pressure vessels (Full NDE) {for AS 1210 class 1H (h = 1)	✓	✓	☒
Pressure equipment other than gas cylinders and pressure piping	ASME IX	Welding and brazing qualifications	✓	✓	☒
	AMBSC Code	Part 1 - Copper boilers	✓	✓	☒
Miniature boilers	AMBSC Code	Part 2 - Steel boilers	✓	✓	☒
	AS 2030	SAA Gas Cylinders Code	✓	✓	☒
	AS 2337	Gas cylinder test stations			✓
Gas cylinders	AS 3509	LP (liquefied petroleum) gas fuel vessels for automotive use	✓	✓	☒
Pressure piping	AS 4041	Pressure piping	✓	✓	☒

4. Tractors

Plant Description	**Code Number**	**Standard Title**	**Design**	**Manufacture**	**Use**
	AS 1121	Guards for agricultural PTO drives	✓	✓	☒
	AS 1636	Agricultural wheeled tractors - Roll-over protective structures criteria and tests	✓	✓	☒
	AS 2153	Guarding of agricultural tractors and machinery	✓	✓	☒
	AS 2951	Part 3 Tractors	✓	✓	☒
Tractors	SAE J167	Overhead protection for agricultural tractors - Test procedures and performance requirements	✓	✓	☒

5. Earthmoving machinery

Plant Description	**Code Number**	**Standard Title**	**Design**	**Manufacture**	**Use**
	AS 2294	Earthmoving machinery - protective structures	✓	✓	☒
	AS 2958	Earthmoving machinery - Safety	✓	✓	✓
	ISO 6165	Earth-moving machinery - Basic types - Vocabulary	✓	☒	☒

	ISO 6746-1	Earth-moving machinery - Definitions of dimensions and symbols - Part 1: Base machine	✓	☒	☒
	ISO 6746-2	Earth-moving machinery - Definitions of dimensions and symbols - Part 2: Equipment	✓	☒	☒
Earthmoving machinery	ISO 7133	Earth-moving machinery - Tractor-scrapers - Terminology and commercial specifications	✓	☒☒	☒

6. Lasers

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
	AS 2211	Laser safety	✓	✓	✓
	AS 2397	Safe use of lasers in the building and construction industry	☒	☒	✓
	I/C 825	Safety of laser products.	✓	✓	✓
Lasers	EN 60825	Specification for radiation safety of laser products, equipment classification, requirements and user's guide	✓	✓	✓

7. Scaffolds

Plant Description	Code number	Standard Title	Design	Manufacture	Use
Scaffolding, general	AS 1576	Scaffolding	✓	✓	☒
Scaffolding planks	AS 1577	Scaffold planks	✓	✓	☒
Trestle ladder scaffolding	AS 1892	Portable ladders	✓	✓	☒
Ladder bracket scaffolding	AS 1892	Portable ladders	✓	✓	☒
Scaffolds, general	AS 4576	Guidelines for scaffolding	✓	☒	✓

8. Temporary access equipment

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
	AS 1891	Industrial safety belts and harnesses	✓	✓	
Harnesses	AS 2626	Safety belts and harnesses - selection, use and maintenance	☒	☒	✓
	BS 3913	Specification for industrial safety nets	✓	☒	
Industrial safety nets	AS 4576	Guidelines for scaffolding	☒	☒	✓
Work boxes - crane lifted	AS 2550	Cranes - Safe use Part 1 - General requirements	☒	☒	✓
	EN 353	Personal protective equipment against falls from a height: Guided type fall arresters	✓	✓	☒
	EN 355	Personal protective equipment against falls from a height. Energy absorbers	✓	✓	☒
	EN 360	Personal protective equipment against falls from a height. Retractable type fall arresters	✓	✓	☒
Fall arrest	EN 362	Personal protective equipment against falls from a height. Connectors	✓	✓	☒

9. Explosive-powered tools

Plant Description	Code Number	Standard Title	Design	Manufacture	Use
Indirect and direct acting hand held explosive-powered tools	AS/NZS 1873	Power actuated (PA) hand held fastening tools	✓	✓	✓

10. Turbines

Plant Description	Code	Standard Title	Design	Manufacture	Use

	Number				
Industrial type	BS 5968	Methods of acceptance testing of industrial type steam turbines	✓	☒	☒
For refinery services	API 612	Special purpose steam turbines for refinery services	✓	☒	☒

11. Amusement structures

Plant Description	**Code Number**	**Standard Title**	**Design**	**Manufacture**	**Use**
Amusement structures	AS 3533	Amusement rides and devices	✓	✓	✓

Key:

AS	=	Australian Standard
API	=	American Petroleum Institute
ASME	=	American Society of Mechanical Engineers
AS/NZS	=	Australian Standard/New Zealand Standard
BS	=	British Standard
EN	=	Europaische Norm (or European Standard)
I/C	=	International Electrochemical Commission
ISO	=	International Organisation for Standardisation
SAE	=	Society of Automotive Engineers

Appendix 3 Examples of Sources of Hazards

The list of hazards and sources of hazards is broad but not exhaustive and is provided here for guidance only.

POSSIBLE HAZARDS

Entanglement, crushing, trapping, cutting, stabbing, puncturing, shearing, abrasion, tearing, stretching, burning, electrocution, irradiation, asphyxiation and suffocation.

SOURCES OF HAZARD

Plant

- Generation of hazardous conditions, due to pressurised content, electricity, radiation friction, vibration, fire, explosion, temperature, moisture, vapour, gases, dust, ice, hot or cold parts.
- Failure of the plant resulting in the loss of contents, loss of load, unintended ejection of workpieces, explosion, fragmentation or collapse of parts.
- Insufficient or unsuitable control systems including guarding.
- Lack of stability or insufficient support resulting in roll-over or collapse of plant.
- Unsuitable material type or strength used for the plant resulting in plant failure.
- Unsuitable accessories or accessories in unsatisfactory condition.
- Task not appropriate for the type or capacity of the plant.
- Insufficient ergonomic considerations for operator use, including:
    - insufficient consideration of the suitability of the plant for operators from the full range of height, build, strength in a normal working population;
    - lack of visual or acoustic signals and warning devices indicating abnormal conditions and providing feedback on actions taken during operation;
    - inadequate precision and logic in the operating instructions;
    - excessive complexity of emergency procedures;
    - unsuitable location and design of critical controls and displays of information;
    - potential for inadvertent movement or operation of the plant;
    - lack of visibility for the operator;
    - potential for human error arising from lack of compatibility of displays and controls;
    - lack of account for population stereotypes or expectation of how control operating direction relates to the action resulting from that control;
    - potential for error due to complexity of the operator's tasks or due to overload of signals and information to be processed by the operator;
    - lack of consideration for maintenance and servicing activities;
    - presence of noise, vibration or other hazard causing discomfort, distraction, errors and missed signals and alarms;
    - inadequate lighting;
    - lack of provision for appropriate posture of the operator as required by the task.

Systems of Work

- Inadequate communication systems.
- Absence of systems for foreseeable abnormal situations and fluctuation of operating conditions.
- Insufficient work procedures and instruction provided by the designer and/or supplier.
- Inadequate job and task design.
- Inadequate or insufficient plant layout.
- Excessive rate of work such as pacing.
- Inadequate shift arrangements.
- Insufficient competency of people using the plant.
- Inappropriate clothing or jewellery.
- Objects falling from plant due to inappropriate systems of work.

Environment

- Absence of personal protective equipment or use of inappropriate personal protective equipment.
- Unsuitable terrain for the plant causing instability and resulting in roll-over, fall through or impact.
- Environmental conditions causing the plant to fail.
- Inappropriate location in the workplace and the impact on workplace design and layout.
- Insufficient access and egress during normal, maintenance and emergency conditions.
- Insufficient control relative to the presence of other people in the vicinity of the plant.

Appendix 4 Design Sources of Human Error

The following table lists some human errors that may be associated with the use of plant and the possible causes due to poor design of the plant or systems of work associated with the plant.

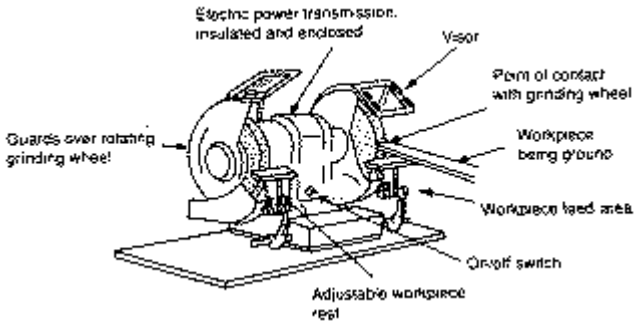
Common human errors	Possible causes due to poor design
Inadvertent activation of plant.	Lack of interlocks or time lockouts. Lack of warning sign against activating equipment under specified damaging conditions. Several critical displays of information are too similar or too close together.
Errors of judgement, particularly during periods of stress or high job demand.	Job requires operator to make hurried judgements at critical times, without programmed back-up measures.
Critical components installed incorrectly.	Design and instructions are ambiguous on installation of components. Lack of asymmetrical configurations or guides on connectors or equipment.
Inappropriate use or delay in use of controls.	Critical controls are too close, similar in design, awkwardly located. Readout instrument blocked by arm making adjustment. Labels on controls are confusing. Information is too small to see from operator's position.
Inadvertent activation of controls.	Controls easy to activate by brushing past or too close to other controls. Controls can be easily activated accidentally. Lack of guards over critical controls.
Critical instruments and displays not read or information misunderstood because of clutter.	Critical instruments or displays not in most prominent area. Design of many displays similar.
Failure to notice critical signal.	Lack of suitable auditory and visual warning to attract operator's attention to information.
Plant operation results in unexpected direction or response.	Activation direction of controls conflicts with population norms or expectancies.
Lack of understanding of procedures.	Instructions are difficult to understand.
Following prescribed procedures results in error or incident.	Written prescribed procedures not checked for accurate operation.
Lack of correct or timely actions.	Available information incomplete, incorrect or not available in time. Response time of system or plant too slow for making next appropriate action. Lack of automatic corrective devices on system with fast fluctuations.
Exceeding prescribed limitations on load or speed.	Lack of governors and other parameter limiters. Lack of warnings on exceeding parameters.

Appendix 5 Application of Hazard Identification and Risk Assessment and Control to the Design of a Bench Grinder

The following is provided as an example only and is not meant to be an exhaustive account of all possible hazards, risks and control measures for bench grinders and their related work processes.

Introduction

Bench grinders may be found in many work places. While it is likely that most of them are located in metal and manufacturing industries, it is common for grinders to be used in other industries. For example, farmers may use them for sharpening tools and implements. The designer should take into consideration the wide range of workplaces, both large and small, where grinders are likely to be used.



A designer when designing a bench grinder should consider all the stages of the bench grinder's life. While the following is not an exhaustive list, these stages include:

design
use which includes:
- operation
- maintenance
- cleaning
- adjustment
- inspection
- repair

alteration
decommissioning
storage
dismantling
demolition/disposal.

For each likely stage in the life of the bench grinder, the designer should consider what are the likely hazards, the risks associated with these hazards, and the risk control measures that can be applied. This information should be passed on to the manufacturer.

Hazard Identification

To assist in the identification of hazards arising from the operation of grinders, the designer should obtain relevant published technical standards and any other available information on grinders. Guidance relative to the design of bench grinders is contained in AS 1788.1 *Abrasive wheels Part 1 Design, construction and safeguarding*, and *Part 2 Selection, care and use* and the designer may choose to consider this when identifying hazards. (Such sources may also assist in the assessment of the risks associated with identified hazards).

When considering the uses that the bench grinder is required to undertake, the designer should also consider all reasonably foreseeable misuse. Foreseeable misuse can include:

- use of the bench grinder for a purpose that it was not designed, such as grinding glass or ceramics rather than metal;
- selection of grinding wheels inappropriate for the range of metals likely to be ground;
- incorrect behaviour due to not following set procedures.

An example of misuse would be someone attempting to stop the abrasive wheel by hand after it has been switched off but is still running down.

When designing a bench grinder, some hazards that the designer should consider include:

1. Entanglement
   The movement of the abrasive wheel may cause injury by entanglement, friction or abrasion, if any part of the operator's body, clothing etc, comes into contact with the wheel. This may lead to parts of the body being drawn in, and trapped between, parts of the grinder and any material being ground, or the wheel and other parts of the grinder. Injury may also be caused by contact or entanglement with any material in motion, such as workpieces that may move on the wheel.

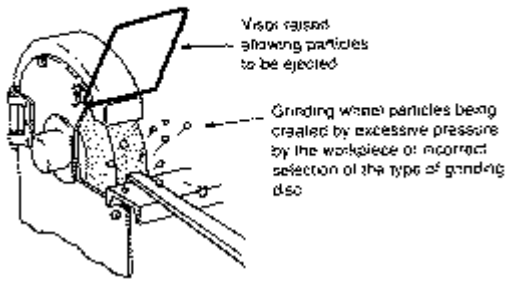
   Parts of the operator's body may be drawn in between rotating and fixed parts of a bench grinder, such as between the grinding wheel and an incorrectly adjusted workpiece rest. Exposed power transmission components such as belts may result in pinch and nip point hazards. High-speed rotating shafts present an entanglement hazard.

2. Friction and abrasion hazards
   Friction and abrasion hazards may be present at the periphery of a grinding wheel. If any part of the operator's body comes into contact with the rotating abrasive wheel, the operator is likely to suffer serious friction burns and abrasions.

3. Sparks generated from the material being ground
   Hot sparks may be present during the grinding process, and enter into the operator's eyes and burn other parts of the body. They may also present a hazard to others in the operating area and be potential ignition sources for fires.

4. Flying particles generated by the grinding process, either from the wheel or the workpiece being ground
   When grinding occurs, it creates air-borne particles of abrasive and metal that may enter the operator's eyes, or other parts of his or her body (see Figure A2). These particles may also present a risk to other people in the area.

Fig A2



5. Disintegration/material coming loose from the grinding disc or wheel
   If used inappropriately, an abrasive wheel may start to disintegrate at high speed. Failure of the bench grinder can result in the ejection of pieces from the grinding wheel and may result in the disintegration of the grinding wheel. The resultant projectiles have the potential to cause serious injury to the operator and other people in the vicinity.

6. Workpieces being ejected from the grinding wheel
   When using bench grinders, if the workpiece rest is not properly adjusted, the workpiece may become jammed between the grinding wheel and the rest, leading to disintegration and ejection of the workpiece at high speed. The operator and other people in the vicinity may be struck if workpieces are ejected from the bench grinder.

7. Run down
   Hazards may arise as a result of the time it takes the grinding wheel to come to rest after being stopped. Attempts to stop the wheel by hand or accidental contact with the wheel while running down may result in injury.

8. Out of balance operation
A hazard may arise if a dual wheel grinder is operated with only one wheel, if it is not designed to do so. This may cause excessive loading on the grinder's bearings eventually causing them to seize.

9. Stability of the grinder during normal operation
Bench grinders are designed to be bolted to a bench to prevent overturning during start up and grinding operations. If this is not done, unexpected or excessive movement of the grinder may occur during accidental jamming of the workpiece. This may lead to entanglement and abrasion hazards.

10. Electrocution/shocks/burns
An electrical hazard may arise in many ways, including:

- damage to the grinder while in operation causing the grinder to become "live";
- repair of the grinder without isolating it from the power source; and
- incorrect installation of, or alterations to, the grinder or its power supply.

11. Airborne dust, particles etc
The presence in the air of ground particles from the abrasive wheel itself and from the workpiece being ground may be a hazard to the operator and other people in the vicinity if the particles enter their breathing zone.

12. Vibration
The vibration from continued holding of metal workpieces against a surface rotating at high speed can cause physical harm such as "white finger" in the operator.

13. Height, layout etc of bench
Hazards may arise from not applying ergonomic design principles to the bench that the grinder is to be fixed to. The designer should consider the fatigue, discomfort and psychological stress of the operator and the means of reducing these, so far as is practicable, under the intended conditions of use.

Note: while the designer of the bench grinder is not responsible for the design or layout of the workplace, he or she has a responsibility to provide information on the systems of work necessary for safe use of the plant. This could include information on such things as recommended bench heights, bench layouts, access and security.

In designing for safe use of the bench grinder, the designer should also consider the following factors that could give rise to hazards:

14. Access to the on/off switch
Operating controls are often simple push button devices that can be accidentally operated. Conversely more complex controls may create a hazard by making it difficult to stop the grinder quickly. Poorly-located or designed operating controls may create a hazard. Simple push button devices can sometimes be operated accidentally due to their design or location. More complex controls that are not designed in line with operator expectations or ergonomic principles may confuse or delay the operator and make it difficult to stop the grinder quickly.

Poorly-located controls may increase the risk of entanglement. For example, the risk of entanglement would be increased if the operator needed to lean across the working grinder to activate the off switch.

15. Access
Hazards may arise from a bench grinder installed in an area that makes it difficult to access and operate, or in an area where it is too easy for unauthorised people to gain access.

16. Repair, inspection and cleaning
Hazards may arise from improper and neglected repairs, inspections and cleaning. They may also arise from these activities if insufficient or incorrect information is supplied. For example, a failure to warn of electrical danger while the cover is removed for repair.

Risk Assessment
For each hazard identified, the designer has a duty to ensure that an assessment is made of risks associated with the hazard. This involves assessing whether there is any likelihood of injury or illness. The risk assessment should involve consideration of any likelihood for people to be exposed to the hazards. The assessment should, where possible, be based on documented evidence and knowledge. The risk assessment should result, for each identified hazard, in an understanding of risks that require control.

For example, flying particles generated by the grinding wheel have been identified as something that could give rise to injury or illness. Consideration of accident records for other grinders reveals that there is a likelihood that the operator and others in the vicinity of the grinder will be injured or suffer from ill-health as a result of flying particles generated when the grinder is in use. The designer is therefore required under the Regulations to identify that a measure is needed to control the risk.

Risk Control
The designer is required to ensure that any risk associated with the use of the bench grinder is eliminated where practicable, or reduced so far as is practicable. Thus, in determining the control measures to be incorporated into the design of the grinder, consideration is required to be given to what is practicable. This involves consideration of each of the four elements of practicable as defined in the Act (refer to section 13.2 of this code). AS 1788.1 *Abrasive Wheels Part 1 Design, construction and safeguarding* provides guidance relevant to the design of a bench grinder and the designer may choose to consider this when determining risk control measures. The designer should have regard to AS 4024 *Safeguarding of machinery* when determining safeguarding measures.

There are a number of risk control measures that the designer may implement to address the hazards and associated risks. These control measures include those that are incorporated into the design (that is, engineering measures, including guards) and those that will be recommended in information provided to the manufacturer for passing on to the purchaser. The latter relate to work practices and other administrative controls that the user should implement. Some of the controls are illustrated in Figure A1 above, other examples are provided below.

<u>Engineering</u>
Risk control measures that may come under this category include designing the bench grinder:

- to eliminate entanglement hazards such as exposed rotating shafts or other exposed moving parts;
- to have a correctly fitted and adjustable workpiece rest;
- to eliminate, or reduce so far as is practicable, the risk of parts of the operator's (or any other person's) body coming into contact with the abrasive wheel, for example, by providing suitable guards and locating controls within safe access of the operator;
- to direct any sparks created in the grinding process away from the operator and other people in the vicinity. For example, the grinder may be designed so that sparks are normally directed down to the floor;
- so that if the grinding wheel starts to disintegrate, the grinder and guards are robust enough not to break apart and increase the risks to the operator. The design of the grinder may also include provision for ensuring that the parts of a disintegrating wheel do not fly out and hit the operator;
- to have controls to prevent accidental or inadvertent starting;
- so that it will not operate if it is unstable;
- so that it may be worked safely with only one of its dual wheels, or so that it will not start or run with only one wheel operational;
- so that in the case of the grinder being damaged, it does not become an electrical hazard; and
- to have wiring designed with consideration to appropriate published technical standards.

Guarding

Risk control measures that may come under this category include incorporating guards to:

- prevent any part of the operator's body or clothing etc, from coming into contact with moving parts;
- expose the minimum amount of the abrasive wheel as practicable to reduce the risk of the operator (or other people) coming into contact with the rotating abrasive wheel;
- prevent sparks or flying particles hitting the operator, in particular the operator's eyes or face. This may be achieved by using a combination of guards including the steel guard over the abrasive wheel and a drop down clear bench grinder visor (see Figure A2 above);
- withstand the force of a disintegrating grinding wheel. If the grinding wheel disintegrates or becomes loose on the spindle, the guard(s) should, so far as is practicable, contain the wheel or its parts to prevent injury;
- protect against work pieces being ejected from the bench grinder; and
- protect against electrical hazards, in both normal operation and as a result of damage.

Information

The information the designer may provide regarding control of risk includes information relating to:

- safe operation of the bench grinder, including any operations for which the grinder may be expected to be used, but is not designed for;
- hazards and risks;
- safety features of the bench grinder;
- need for specific guards or other safety features for particular operations;
- need for personal protective equipment such as goggles and gloves when operating the grinder;
- installation information such as the correct method of securing the bench grinder against movement or instability;
- necessary testing or inspection, maintenance and cleaning to ensure, so far as is practicable, the continued safe operation of the bench grinder;
- procedures considered necessary to carry out repairs, testing and inspection, maintenance and cleaning to ensure, so far as is practicable, the safety of people undertaking these tasks;
- training, qualifications and/or experience necessary for people operating the bench grinder or carrying out inspection or testing, maintenance, cleaning or repair;
- electrical hazards that may arise from damage to the bench grinder or while repairing, inspecting, maintaining or cleaning the grinder;
- ergonomic considerations relating to the use, placement and access to the bench grinder.

Note: if particular systems of work or the competency of operators are factors in the control of risk, the designer is required to specify these in the information provided to the manufacturer.

Appendix 6 Application of Hazard Identification and Risk Assessment and Control to a Powered Mobile Plant Used in the Workplace

The following is provided as an example only of the application of hazard identification, risk assessment and risk control to powered mobile plant. This is not meant to be an exhaustive account of all possible hazards and associated risks and control measures for powered mobile plant used in the workplace.

Introduction
A company uses powered mobile plant to transport loads around the workplace. On occasions it is necessary for personnel to accompany the powered mobile plant to record load movements.

Hazard Identification
The employer has a duty to ensure all hazards associated with the use of the powered mobile plant and the systems of work associated with them are identified. The employer consults with the health and safety representatives of the operators, personnel associated with the powered mobile plant (who may be maintenance and/or administrative personnel and other employees in the area) to identify hazards that arise from the use of the powered mobile plant in the workplace. The employer also consults with these health and safety representatives when assessing the risks associated with the hazards identified. Hazard identification of powered mobile plant may include a forklift in a warehouse, factory or storage yard, a front end loader or excavator at a work-site, or a mobile crane at a construction site.

Hazards and sources of hazards identified include:

- Powered mobile plant falling into excavations or maintenance pits, falling off ramps or rolling down embankments resulting in the operator being ejected from the cabin.
- Collisions between powered mobile plant and between powered mobile plant and structures or objects in the area, such as buildings, storage tanks or trees.
- Personnel being hit by powered mobile plant.
- Personnel accompanying the operator on the powered mobile plant falling off or unsafely disembarking from the powered mobile plant he or she has hitched a ride on.
- Loads being carried by the powered mobile plant falling off, hitting doorways, buildings or structures, or falling back onto the powered mobile plant's cabin area and striking the operator or passenger.
- Unattended and incorrectly parked powered mobile plant.

Risk Assessment
All of these identified hazards were assessed to be a risk because of their likelihood for injury or illness.

Risk Control
Having identified the hazards and assessed the risks, the employer in consultation with the relevant health an safety representatives identified a number of measures for controlling the risks associated with the operation of powered mobile plant in the employer's workplace. The risk control measures were developed in accordance with the requirements for control prescribed in the Regulations, in particular regulations 704 and 711.

1. **Powered mobile plant falling into excavations or maintenance pits, falling off ramps or rolling down embankments resulting in the operator being ejected from the cabin.**

   Risk control measures identified to comply with regulations 711(1) and 711(2) included:

   - removal of maintenance pits, levelling the powered mobile plant's operating area by filling in excavations and hollows, installing adequate rails along ramps, and barriers along embankments;
   - if it was not practicable to remove the maintenance pits, filling in the excavations, or where the hazard of rolling down an embankment cannot be removed, clearly marking the edges and directing mobile plant traffic away from the pits, excavations and embankments. Approach to these hazards should then only be with the aid of a spotter to accurately direct the plant;
   - fitting of seat belts to the powered mobile plant, and to ensure their use, where practicable linking them to the mobile plant's ignition to prevent the mobile plant starting with the seat belt undone.

2. **Collisions between powered mobile plant and between powered mobile plant and structures or objects in the area, such as buildings, storage tanks or trees.**

   Risk control measures identified to comply with regulation 711(3) included:

   - speed limits clearly marked and enforced on all traffic;
   - traffic control measures introduced to ensure traffic separation into clearly marked lanes;
   - loading and unloading areas barricaded off from the travelling lanes;
   - all powered mobile plant fitted with reversing beepers and flashing lights;
   - powered mobile plant equipped with headlights for night work;
   - warning horns fitted to all powered mobile plant.

3. **Personnel being hit by powered mobile plant.**

   Risk control measures identified to comply with regulation 711(3) included:

   - separating pedestrians from the powered mobile plant operating area by barricading pedestrian walkways and requiring the mobile plant operators, their passengers and other operators to remain in their cabins or within specified safety zones;
   - modifying powered mobile plant operators' seats to better enable them to travel in reverse when their forward view is restricted;
   - fitting all powered mobile plant with reversing beepers and flashing lights. (Note: the fitting of these warning devices will meet the employers duty under regulation 711(4));
   - fitting improved mirrors on the powered mobile plant to enable a clearer and greater area of viewing;
   - supplying personnel walking in designated pedestrian areas or standing in safety zones with brightly coloured reflective vests, which they are required to wear.

4. Personnel accompanying the operator on the powered mobile plant falling off or unsafely disembarking from the powered mobile plant he or she has hitched a ride on.

Risk control measures identified to comply with regulation 711(5) included:

- changes to procedures to remove the requirement of personnel travelling with the powered mobile plant to record load movements;
- development of test procedures which removes the requirement of maintenance personnel travelling with the powered mobile plant to assess the effectiveness of maintenance undertaken;
- if these changes were not practicable, fitting of a passenger seat within the operator's cabin. This seat should be within the over head protection structure and be fitted with a seat belt. The seat should be in a position that does not affect the operator's view of the work area but still enables the operator to be aware of the passenger's movement - that is, when the passenger is getting on or off the powered mobile plant;
- measures to ensure that personnel get on or off the powered mobile plant only at designated points.

5. Loads being carried by the powered mobile plant falling off, hitting doorways, buildings or structures, or falling back onto the powered mobile plant's cabin area and striking the operator or passenger.

Risk control measures identified to comply with regulations 711(1) and 711(2)(b) included:

- improvements to the falling object protection structure (overhead guard) to prevent any loads falling onto the operator. Note: if the employer modifies the design of the overhead guard then he or she takes on the responsibility of the designer for the modification and must undertake hazard identification, risk assessment and risk control as a designer;
- changes to procedures to ensure that:
  - loads to be lifted are secure and not liable to fall off or out of the plant's carrying implement;
  - no loads are carried that are higher than any back support structure which would render the load liable to rolling back into the operator's cabin area.

6. Unattended and incorrectly parked powered mobile plant.

Risk control measures identified to comply with regulation 709 included:

- warning device fitted to provide an audible and visible warning if the operator does not apply the parking brake;
- warning device fitted to provide an audible and visible warning if the operator leaves the cabin without first shutting off the plant's power;
- clearly marked areas where powered mobile plant is to be parked.

All the risk control measures identified were assessed for practicability. Where the risk control measure require alterations to be made to the powered mobile plant (for example changes to the falling object protective structures and the fitting of seat belts, passenger seats and motor governors) the designer or manufacturer should be consulted before the alteration is made, to ensure that the proposed alterations do not affect the safety of the powered mobile plant.

Where a risk control measure was adopted a timetable was established to review its effectiveness and to ensure its maintenance.

REFERENCES RELATING TO ERGONOMIC CONSIDERATIONSREFERENCES RELATING TO ERGONOMIC CONSIDERATIONS

The references listed below are not incorporated into this code of practice. They are included here to provide an indication of sources of further reading.

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ACKNOWLEDGMENT
The following text is acknowledged gratefully as the source of Figure 2 in section 12.2 of this code.

Clark, T.S., & Corlett, E.N. (1995) *The Ergonomics of Workspaces and Machines. A Design Manual*. London: Taylor & Francis.