

Australian Standard™

## Wood processing machinery—Safety

### Part 2: Finishing machinery— Common requirements



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Australian Woodworking Industry Suppliers Association  
Construction, Forestry, Mining and Energy Union  
Department for Administrative and Information Services South Australia  
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Australian Standard™

## Wood processing machinery—Safety

### Part 2: Finishing machinery— Common requirements

Originated as AS CZ10—1960.  
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## PREFACE

This Standard was prepared by the Standards Australia Committee SF-007, Guarding of Woodworking Machinery, as a revision (in part) of AS 1473—1991, *Guarding and safe use of woodworking machinery*.

This Standard is one of a series dealing with the safety of woodworking machinery.

During its work, the Committee considered a number of draft Standards emanating from the European Community and agreed to base this Standard upon those drafts. It is believed that by maintaining consistency with the European Community drafts, the costs to purchasers of new machinery will be minimized since there will be minimal differences between the finished Standards in both Europe and Australia.

This Standard has been written in a hierarchical manner with this Part of the Standard dealing with those aspects of finishing machines which are common to all types of machine. This leaves the unique requirements for a particular type of machine, for example circular saws or moulding machines, to be covered in a Part of the Standard dealing with that class of machine.

It is intended that the most commonly encountered machines will be covered by subsequent Parts to this Standard. However, there will inevitably be some machines which will not be included in a Standard. In these cases, the general principles in this Part should be followed.

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

## CONTENTS

|                                                                       | <i>Page</i> |
|-----------------------------------------------------------------------|-------------|
| <b>SECTION 1 SCOPE AND GENERAL</b>                                    |             |
| 1.1 SCOPE.....                                                        | 5           |
| 1.2 OBJECTIVE.....                                                    | 5           |
| 1.3 REFERENCED DOCUMENTS.....                                         | 5           |
| 1.4 DEFINITIONS.....                                                  | 6           |
| 1.5 CONSULTATION.....                                                 | 14          |
| 1.6 NEW TECHNOLOGY .....                                              | 14          |
| <b>SECTION 2 RISK ASSESSMENT</b>                                      |             |
| 2.1 GENERAL.....                                                      | 15          |
| 2.2 RISK ASSESSMENT.....                                              | 15          |
| 2.3 DOCUMENTATION.....                                                | 17          |
| <b>SECTION 3 PLANT LAYOUT AND MACHINE INSTALLATION</b>                |             |
| 3.1 FOUNDATIONS .....                                                 | 18          |
| 3.2 WORK PLACES AND MEANS OF ACCESS .....                             | 18          |
| 3.3 MACHINE LAYOUT AND WORKING AREA .....                             | 18          |
| 3.4 LIGHTING .....                                                    | 18          |
| 3.5 ELECTRICAL .....                                                  | 18          |
| 3.6 NOISE .....                                                       | 18          |
| <b>SECTION 4 PLANT SAFETY, WORK SYSTEMS AND RISK CONTROL MEASURES</b> |             |
| 4.1 MACHINE GUARDING—GENERAL CONSIDERATIONS .....                     | 19          |
| 4.2 CONTROLS .....                                                    | 19          |
| 4.3 CONTROL DEVICES .....                                             | 20          |
| 4.4 PROTECTION AGAINST MECHANICAL HAZARDS .....                       | 23          |
| 4.5 PROTECTION AGAINST NON-MECHANICAL HAZARDS.....                    | 45          |
| 4.6 ELECTRICITY.....                                                  | 56          |
| 4.7 ERGONOMICS AND HANDLING .....                                     | 56          |
| 4.8 MAINTENANCE .....                                                 | 56          |
| 4.9 SIGNALS AND WARNING DEVICES .....                                 | 56          |
| 4.10 INFORMATION FOR USE.....                                         | 57          |
| 4.11 ACCOMPANYING DOCUMENTATION .....                                 | 57          |
| 4.12 BRAKING SYSTEMS.....                                             | 59          |
| <b>SECTION 5 SAFE OPERATION AND OPERATOR TRAINING</b>                 |             |
| 5.1 GENERAL.....                                                      | 61          |
| 5.2 TRAINING AND SUPERVISION .....                                    | 61          |
| 5.3 MODEL INSTRUCTIONS.....                                           | 61          |
| 5.4 EDUCATION AND TRAINING .....                                      | 62          |
| <b>SECTION 6 MAINTENANCE AND INSPECTION</b>                           |             |
| 6.1 GENERAL.....                                                      | 63          |
| 6.2 MAINTENANCE REQUIREMENTS—ROUTINE.....                             | 63          |
| 6.3 MAINTENANCE REQUIREMENTS—PERIODIC.....                            | 64          |
| 6.4 INSPECTION PROGRAM.....                                           | 64          |
| 6.5 REPAIRS AND ALTERATIONS.....                                      | 65          |
| 6.6 UNSERVICEABLE MACHINES.....                                       | 65          |
| 6.7 DISCONNECTION OF POWER.....                                       | 65          |

## APPENDICES

|   |                                                                                    |    |
|---|------------------------------------------------------------------------------------|----|
| A | LIST OF HAZARDS .....                                                              | 66 |
| B | REQUIREMENTS FOR TOOL BRAKING .....                                                | 69 |
| C | EXAMPLES OF METHODS OF NOISE REDUCTION .....                                       | 73 |
| D | MODEL INSTRUCTIONS FOR THE SAFE OPERATION OF WOODWORKING<br>MACHINES—GENERAL.....  | 76 |
| E | MODEL INSTRUCTIONS FOR THE SAFE OPERATION OF SPECIFIC<br>WOODWORKING MACHINES..... | 78 |

STANDARDS AUSTRALIA

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**Australian Standard**

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**Wood processing machinery—Safety**

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Part 2: Finishing machinery—Common requirements

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SECTION 1 SCOPE AND GENERAL

### 1.1 SCOPE

This Standard specifies requirements for the design, manufacture, guarding and use of wood processing machinery (plant) for the processing of sawn, gauged and machined materials used in the manufacture of components for joinery, furniture, second fixings and the like.

The Standard does not apply to machinery used for the primary milling of saw logs into sawn green timber products which are dealt with in AS 1473.1, or seasoning and treatment processes, nor does it apply to chainsaws, harvesting machinery and portable hand-held tools.

### 1.2 OBJECTIVE

The objective of this Standard is to provide designers, manufacturers, suppliers and users of wood processing machinery with the means of minimizing the risks to the health and safety of persons working with or near wood processing machines.

### 1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

#### AS

- |        |                                                                                        |
|--------|----------------------------------------------------------------------------------------|
| 1470   | Health and safety at work—Principles and practices                                     |
| 1473   | Wood processing machinery—Safety                                                       |
| 1473.1 | Part 1: Primary timber milling machinery                                               |
| 1543   | Electrical equipment of industrial machines                                            |
| 1657   | Fixed platforms, walkways, stairways and ladders—Design, construction and installation |
| 1755   | Conveyors—Design, construction, installation and operation—Safety requirements         |
| 1939   | Degrees of protection provided by enclosures for electrical equipment (IP Code)        |
| 4024   | Safeguarding of machinery                                                              |
| 4024.1 | Part 1: General principles                                                             |

#### AS/NZS

- |          |                                            |
|----------|--------------------------------------------|
| 1269     | Occupational noise management (series)     |
| 1337     | Eye protectors for industrial applications |
| 1680     | Interior lighting                          |
| 1680.2.4 | Part 2.4: Industrial tasks and processes   |

## AS/NZS

- 2161 Occupational protective gloves
- 2161.3 Part 3: Protection against mechanical risks
- 2210 Occupational protective footwear
- 2210.1 Part 1: Guide to selection, care and use.
- 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)
- 61241 Electrical apparatus for use in the presence of combustible dust
- 61241.3 Part 3: Classification of areas where combustible dusts are or may be present

## ISO

- 7960 Airborne noise emitted by machine tools—Operating conditions for wood-working machines

## NOHSC (Worksafe Australia)

- 1001 National Standard for manual handling
- 1003 Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment
- 2005 National code of practice for manual handling
- 3008 Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment

**1.4 DEFINITIONS**

For the purpose of this Standard the following definitions apply.

**1.4.1 Anti kickback device**

A device which either reduces the possibility of kickback or arrests the motion of the workpiece.

**1.4.2 Combined machine**

A machine incorporating two or more elements such as a surface planer, circular saw, vertical spindle moulder, thicknesser, bandsaw or a mortiser and is designed and constructed in such a way as to enable each element to be used separately, where the workpiece is primarily fed by hand and manually removed between each operation.

**1.4.3 Complex installation**

Machines in combination, i.e. single purpose machines linked by transfer equipment to form a production unit.

**1.4.4 Cutting against the feed and climb cutting**

Two different cutting actions which are determined by the relative direction of the tool blade to the workpiece. (See Figure 1.1.)

**1.4.5 Cutting area of the tool**

That area of the tool involved in the cutting process. (See Figure 1.2.)

**1.4.6 Danger zone**

Any zone within or around machinery in which any person is subject to a risk to health or safety.

**1.4.7 Demountable power feed unit**

Feed mechanism which is designed so that it can be moved from the working position.

#### **1.4.8 Ejection**

The unexpected movement of the workpiece, tool, or parts of them from the machine during processing.

#### **1.4.9 Exposed person**

Any person wholly or partially in a danger zone.

#### **1.4.10 Hand feed**

The manual holding and/or manual guiding of the workpiece or of a machine element incorporating a tool. Hand feed includes the use of a hand-operated carriage on which the workpiece is placed manually or clamped. (See Figure 1.3.)

#### **1.4.11 Integrated feed**

A feed mechanism for the workpiece or tool which is integrated with the machine and where the workpiece or machine element with incorporated tool are held and controlled mechanically during the machining operation. (See Figure 1.4.)

#### **1.4.12 Kickback**

The unexpected movement of the workpiece or parts of it opposite to the direction of feed during processing.

#### **1.4.13 Loading the machine**

The manual or automatic placing of the workpiece onto a carriage, magazine, lift, hopper, moveable bed, conveyor or the presentation of the workpiece to an integrated feed device.

#### **1.4.14 Machine operator**

The person or persons given the task of installing, operating, (including feeding and tailing out), troubleshooting, adjusting, (setting), maintaining and cleaning, repairing and/or transporting machines.

#### **1.4.15 Machining centre**

A computerized numerical control (CNC) machine with integrated feed capable of carrying out several processes (e.g. routing, boring, sanding, shaping, edge banding etc.) and on which tools can be changed, or the machine set or the process carried out under CNC control.

#### **1.4.16 Multi-station machine**

A machine comprising several processes where the workpiece, once loaded, moves by an integrated feed mechanism through and from one process to the next e.g. four-side planing and moulding machine, or double-end tenoning machine.

#### **1.4.17 Non-cutting area of the tool**

That area of the tool where the tool is not involved in the cutting process. (See Figure 1.2.)

#### **1.4.18 Safety appliance**

An additional device which is not an integral part of the machine but which assists the operator in the safe feeding of the workpiece. (See Figure 4.16.)

#### **1.4.19 Shall**

Indicates that a statement is mandatory.

#### **1.4.20 Should**

Indicates a recommendation.

#### **1.4.21 Similar material**

Materials with physical and technological characteristics similar to those of wood, such as cork, wood based materials as chipboard, fibreboard, plywood, and for which the process of machining and chip or particle removal is similar, e.g. rubber, plastic and other stiff material.

#### **1.4.22 Speed range**

Speed within which the tool spindle or tool is designed to operate.

#### **1.4.23 Stationary machine**

A machine designed to be located on or fixed to the floor or other parts of the structure of the premises and to be stationary during use.

#### **1.4.24 Transportable machine**

A machine which is located on the floor, stationary during use and equipped with a device, normally wheels, which allows it to be moved between locations.

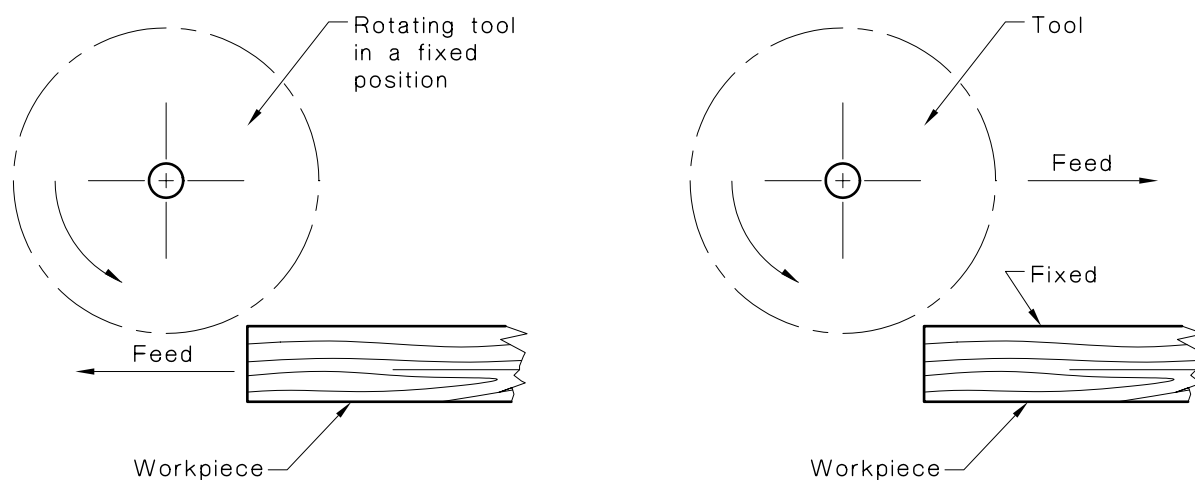
#### **1.4.25 Tools**

All individual tools and tool sets for the mechanical removal of chips e.g. circular saw blades, bandsaw blades, chain cutters, knives, boring tools, detachable cutters, solid cutters. Tools also include devices for forming and shaping or chipless cutting.

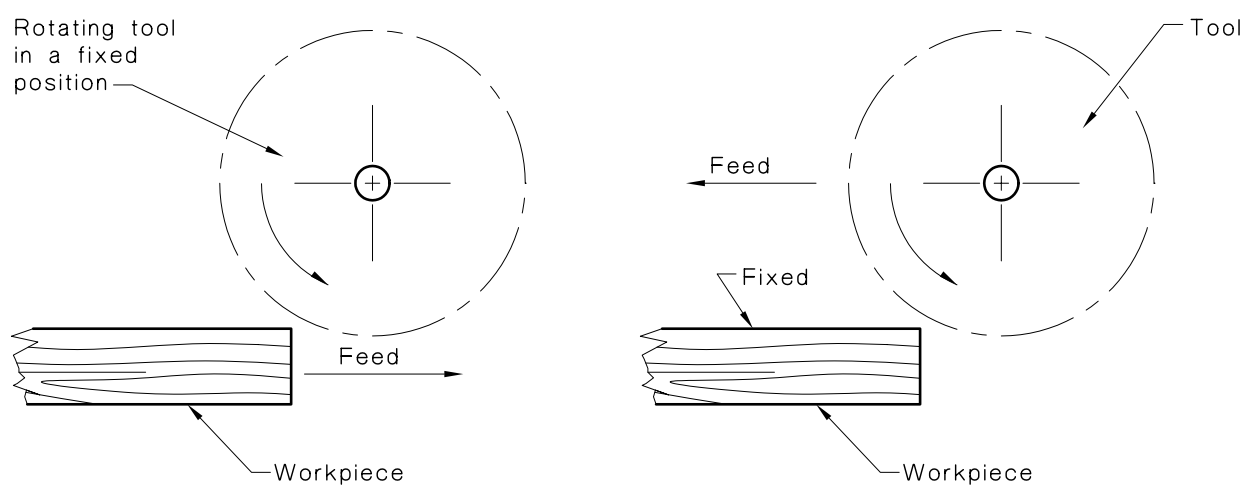
#### **1.4.26 Wood processing machine**

A machine or a combination of machines designed to cut and saw wood and similar materials, by chip removal, or chipless cutting, sanding and forming, laminating (including gluing and edging) or joining of wood and similar materials.

It includes equipment for the noise and dust control, which is integral with the machine, associated auxiliary equipment, e.g. power feed units, reversing units, magazines and hoppers, clamping devices, and conveying and lifting equipment.

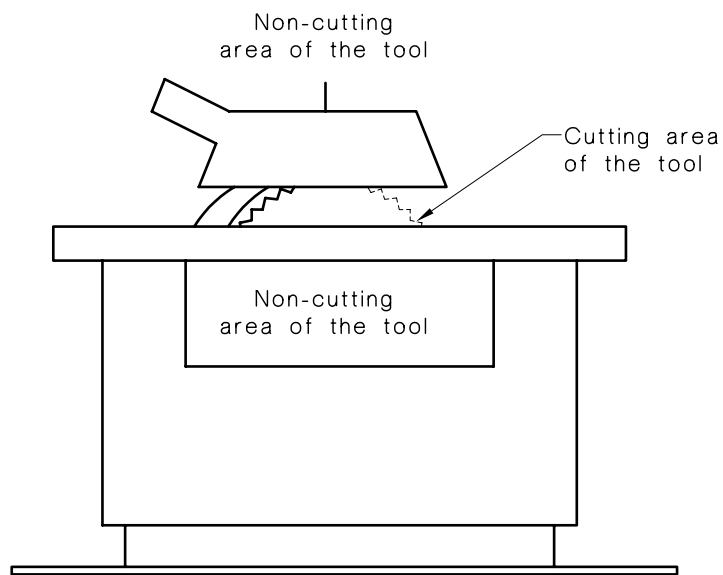


(a) Cutting against the feed

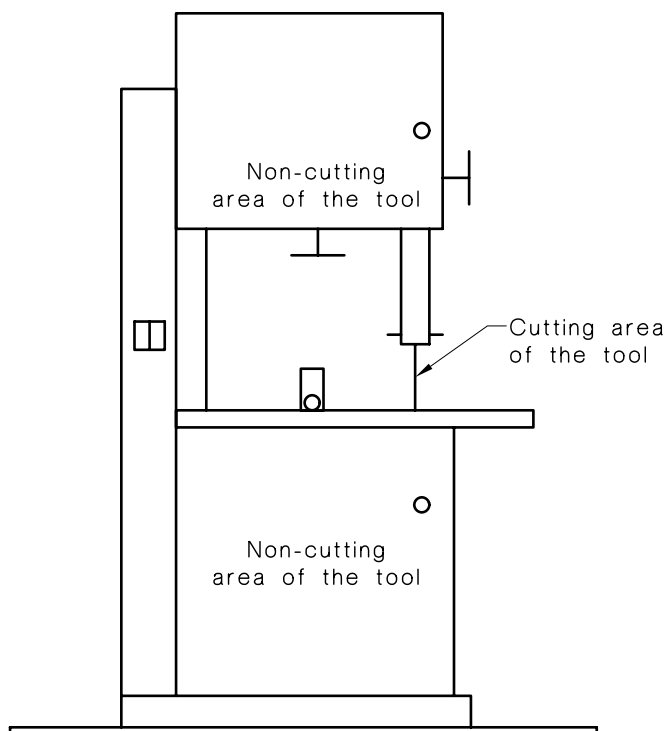


(b) Climb cutting

FIGURE 1.1 CUTTING ACTIONS

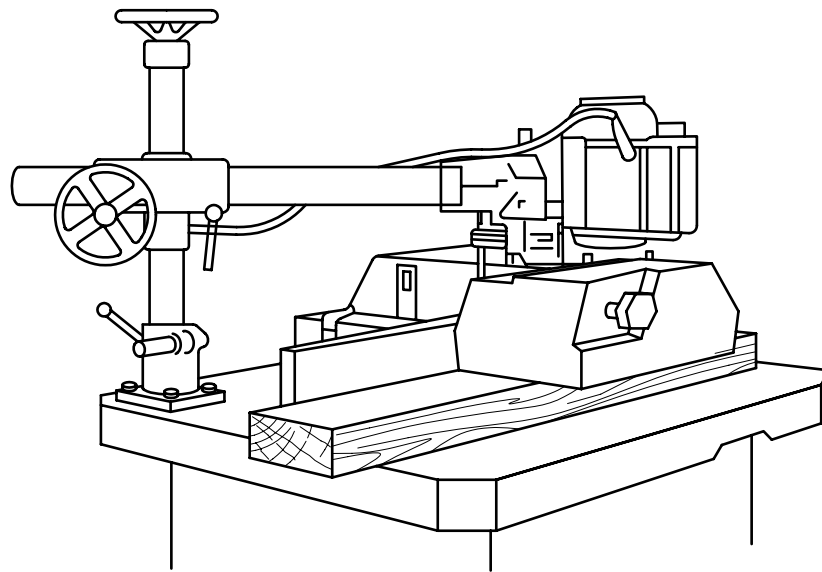


(a) Circular saw

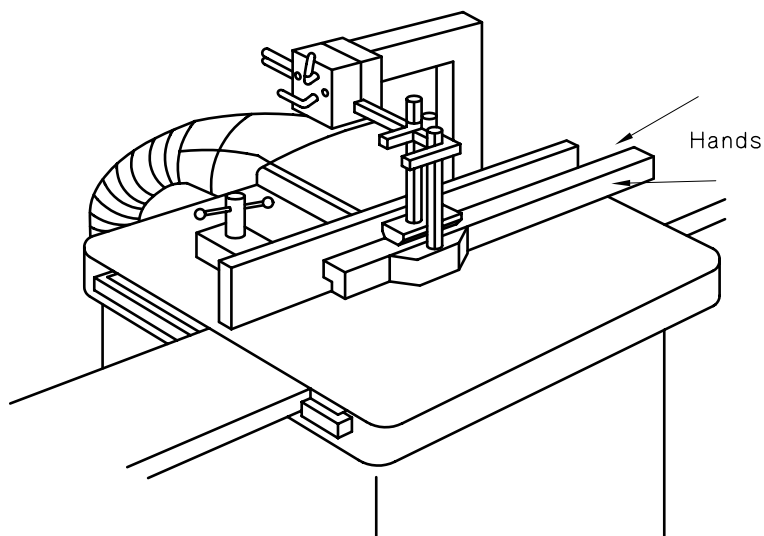


(b) Bandsaw

FIGURE 1.2 CUTTING/NON CUTTING AREA OF THE TOOL

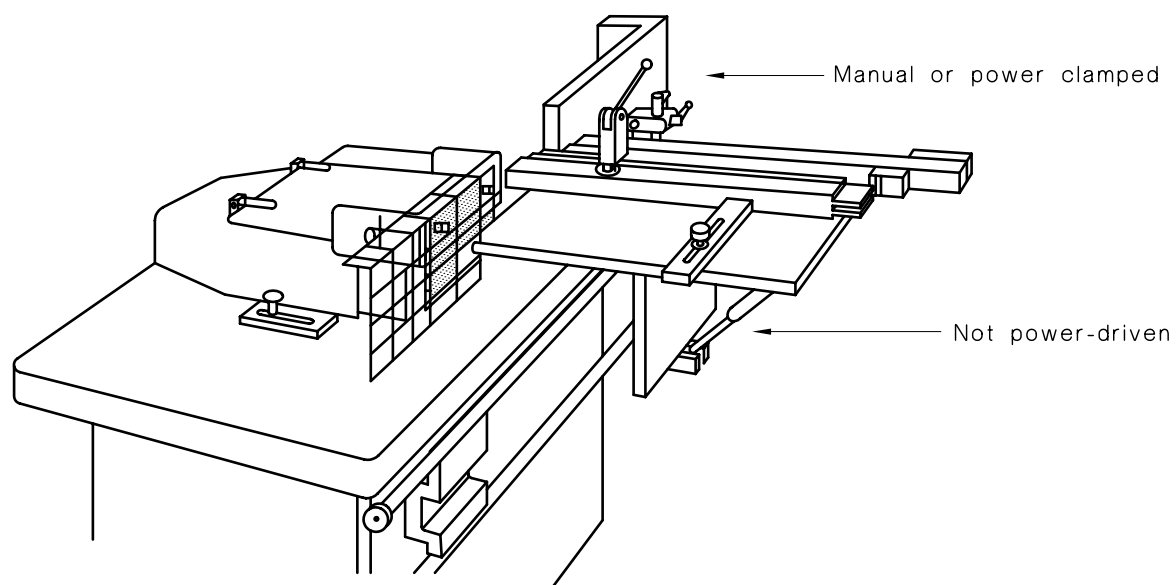


(a) Power feeder



(b) Manually held and fed

FIGURE 1.3 (in part) HAND FEEDING



(c) Mechanical clamping, manually fed

FIGURE 1.3 (in part) HAND FEEDING

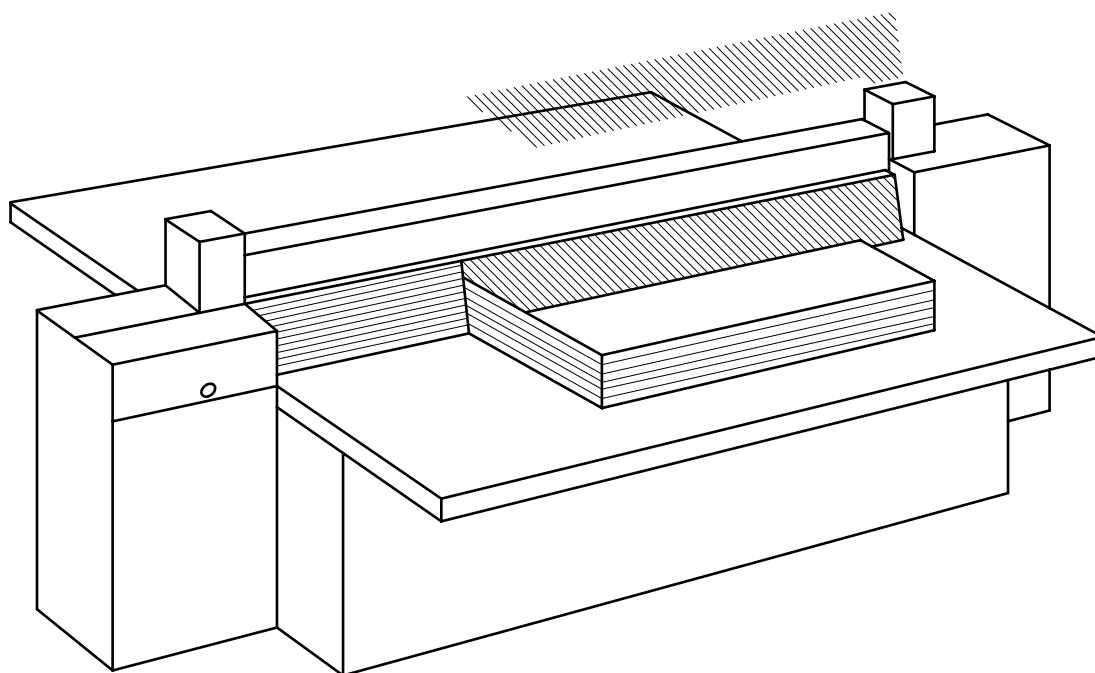
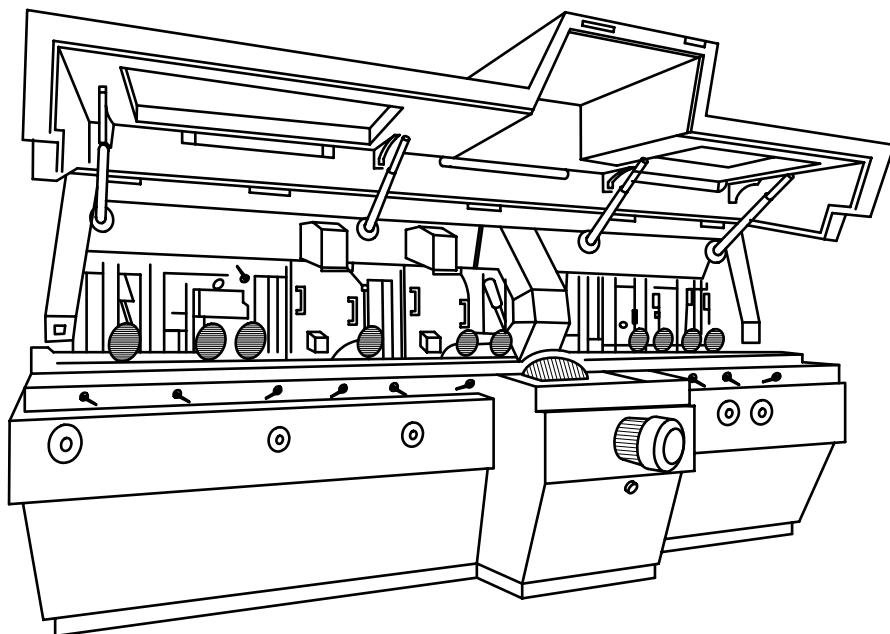


FIGURE 1.4 INTEGRATED FEED

## 1.5 CONSULTATION

When planning any process which involves changes to or relocation of existing machinery, or the provision of new machinery, every effort should be made at the design phase to consult with all personnel who will use or maintain it.

Designers should visit the site where the machinery will be used to consult with the personnel. The manufacturer should consult the designer when any faults are detected or changes made at any phase in the life of the machine.

In this way, foreseeable safety related issues can be addressed at the outset, which will lead to a safer and more productive workplace.

Guidance in evaluating, assessing and selecting the most appropriate design and operational methods is given in AS 4024.1.

## 1.6 NEW TECHNOLOGY

Caution should be used when attempting to apply new technology to an existing machine since additional dangers may be created. An assessment of the machine should be made to evaluate the applicability of the technology to the machine.

An example of the dangers which may be created when attempting to modify a machine, is fitting a braking system to a circular saw and throwing the blade from the arbor because of reverse torque.

## SECTION 2 RISK ASSESSMENT

### 2.1 GENERAL

This Section describes the procedure known as risk assessment by which the knowledge and experience of the design, use, incidents, accidents and harm related to machinery is brought together in order to assess the risks during the life of the machinery (see also AS 4024.1).

This Standard is not intended to provide a detailed account of methods for analysing hazards and estimating risks as this is dealt with elsewhere (e.g. textbooks and other reference documents).

### 2.2 RISK ASSESSMENT

Risk assessment is a series of logical steps to enable the examination, in a systematic way, of the hazards associated with machinery. Risk assessment is followed, whenever necessary, by risk reduction as described in AS 4024.1. When this process is repeated it provides the process for minimizing hazards and implementing safety measures according to the state of the art. A list of hazards and the measures required to counter them are set out in Appendix A.

Risk assessment includes (see Figure 2.1) the following:

- (a) *Risk analysis* Risk analysis consists of—
  - (i) determination of the design limits of the machinery;
  - (ii) hazard identification; and
  - (iii) risk estimation.
- (b) *Risk evaluation* Risk analysis provides the information required for the risk evaluation, which in turn allows judgements to be made on the safety of machinery.

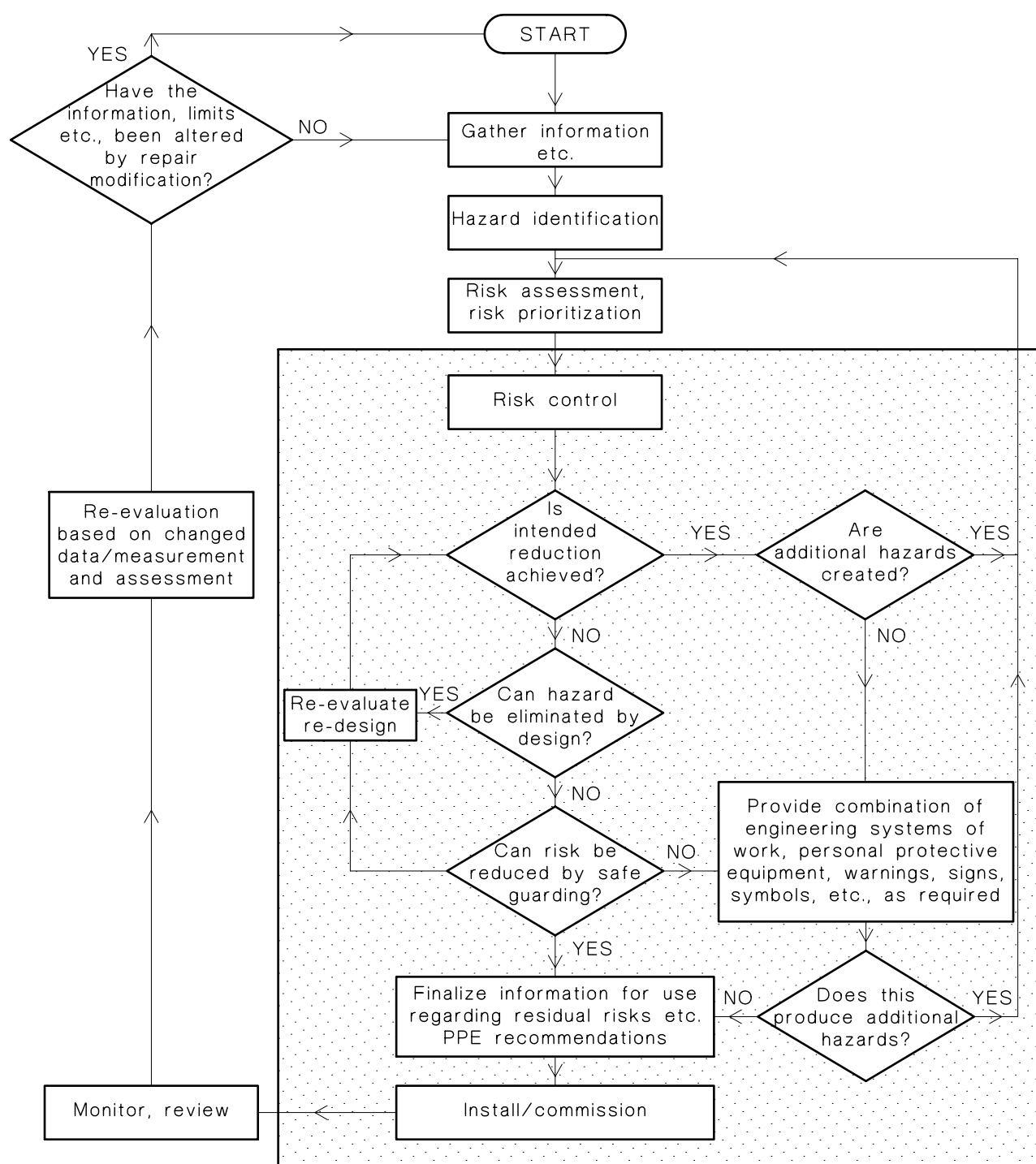
Risk assessment relies on judgemental decisions. These decisions shall be supported by qualitative methods, complemented as far as possible by quantitative methods. Quantitative methods are particularly appropriate when the foreseeable severity and extent of harm are high.

Quantitative methods are useful to assess alternative safety measures and to determine which gives better protection.

NOTE: The application of quantitative methods is restricted by the amount of useful data which are available. Therefore, in many applications only qualitative risk assessment will be possible.

The risk assessment procedure shall be conducted in such a manner that it is possible to document—

- (i) the intended use of the machinery for which the assessment has been made, (e.g. specifications or limits);
- (ii) the hazards, hazardous situations and hazardous events identified;
- (iii) pertinent information used (e.g. accident histories and experience gained from risk reduction applied to similar machines);
- (iv) the objectives to be achieved by the risk control measures;
- (v) the safety measures implemented to eliminate identified hazards or reduce risks; and
- (vi) the residual risk to the individual hazards by specifying any relevant assumptions that have been made (loads and safety factors).



NOTE: Risk reduction and selection of appropriate risk control measures are not part of the risk assessment process.

FIGURE 2.1 THE ITERATIVE PROCESS TO ACHIEVE SAFETY

### 2.3 DOCUMENTATION

Documenting the risk assessment is a means of describing the hazards identified and the risk control measures implemented. The documentation should contain information on—

- (a) the information on which the risk assessment was based;
- (b) the machinery for which the assessment has been made (specifications or limits);
- (c) any relevant assumptions which have been made, such as loads, strengths, or safety factors;
- (d) the hazard identified;
- (e) the hazardous situations identified;
- (f) the hazardous events considered in the assessment;
- (g) the data used and the sources;
- (h) any uncertainty associated with the data used and the impact on the risk assessment;
- (i) the objectives to be achieved by the risk control method;
- (j) any requirements implemented (e.g. Standards or other specifications used);
- (k) the information regarding residual risks; and
- (l) the results of the final risk evaluation.

## SECTION 3 PLANT LAYOUT AND MACHINE INSTALLATION

### 3.1 FOUNDATIONS

Machines should be fixed or located on a substantial foundation, floor or other support so that they are stable and secure.

### 3.2 WORK PLACES AND MEANS OF ACCESS

Work places and means of access should generally be in accordance with the principles expressed in AS 1470 and AS 1657.

### 3.3 MACHINE LAYOUT AND WORKING AREA

Sufficient space should be provided around machines to handle the material with the least possible interference from or to workers or other machines. Machines should be so placed so that it will not be necessary for an operator to stand in or near an aisle, and the layout of machines should allow for easy maintenance and repair.

### 3.4 LIGHTING

Adequate illumination of the working area shall be provided by natural or artificial means or both. Artificial lighting shall be in accordance with the provisions of AS/NZS 1680.2.4.

### 3.5 ELECTRICAL

Electrical wiring and equipment shall be in accordance with AS/NZS 3000, AS 1543, AS/NZS 61241.3 and the requirements of the relevant regulatory authority.

### 3.6 NOISE

When a machine could create a noise hazard which has not been controlled at the design phase, and the noise levels are in excess of those permitted by the regulatory authority, or are such that they could affect the health of any person, all necessary steps shall be taken, during installation, to provide a means of reducing the transmission of noise.

## SECTION 4 PLANT SAFETY, WORK SYSTEMS AND RISK CONTROL MEASURES

### 4.1 MACHINE GUARDING—GENERAL CONSIDERATIONS

#### 4.1.1 Compliance

This Section sets out general requirements for the design of wood processing machinery to achieve an acceptable level of safety. Additional requirements for the safeguarding of specific types of wood processing machines are given in other Parts of this Standard.

The interaction between people and a machine, in all aspects of its use, needs to be carefully considered and the interface between people and machines needs to be designed with full consideration of human limitations.

Employers should provide or maintain plant and systems of work that are safe and without risks to the health of employees.

Where a risk assessment indicates that engineering controls are appropriate, machine guarding should comply with AS 4024.1 and the specific requirements of this Standard.

#### 4.1.2 Guarding general

All plant should be so designed or protected to prevent the risk of injury by contact with moving parts or being struck by projectiles ejected from the plant.

Such protection should be in-built.

#### 4.1.3 Construction and application

Machinery guards should be constructed in accordance with the requirements of AS 4024.1. They may be fixed guards, adjustable or controlled by mechanical or electrical interlocking systems. In certain circumstances, photo electric systems or combinations of various forms of guarding may be used. Heavy or frequently adjusted guards should incorporate a system of pneumatics, electric's or some other means to move or adjust the guard in preference to manual operation.

Fixed guards should be securely fixed in place and should not be able to be removed without the use of engineering tools.

A system of colour coding machinery guards will assist in identifying and maintaining guarding in position. No machinery should be operated unless all guarding is secured and correctly adjusted. All machinery guarding should be maintained in good working order and employees adequately instructed, trained and supervised to ensure proper usage.

### 4.2 CONTROLS

#### 4.2.1 General

The electrical equipment of the machine shall comply with the requirements of AS 1543.

#### 4.2.2 Isolation

All machines shall be fitted with means to isolate them from all energy sources including electrical, fluids under pressure and compressed springs. Such isolators shall be clearly identified. They shall be capable of being locked in the 'off' (open circuit) position only, if reconnection could endanger exposed persons. In the case of machines supplied with electricity through a plug capable of being plugged into a circuit, separation of the plug is sufficient.

The isolator shall also be capable of being locked 'off' where an operator is unable, from any of the points to which the operator has access, to check that the energy is still cut off.

After the energy is cut off, it shall be possible to dissipate normally any energy remaining or stored in the circuits of the machines without risk to exposed persons.

As an exception to the above requirements, certain circuits may remain connected to their energy sources in order, for example, to hold parts, protect information, light interiors, etc. In this case, special steps shall be taken to ensure operator safety. (See also AS 4024.1.)

#### **4.2.3 Tagout/lockout**

A tag is usually an easily identified label which is attached to the main isolator of the machine when the machine is shut down. It should contain the date, name of person invoking the tag and the reason for shutdown. A tag should only be removed by the person who placed it.

If due to unforeseen circumstances the tag cannot be removed by the person who placed it there, the authorized supervisor should determine the circumstances in which the tag may be removed and shall carry out a search to ensure no other person is present in the area. When it is verified that the area is empty, the tag may be removed.

Lockout systems are inherently safer than a tagout system and should be used in preference to tagout systems.

#### **4.2.4 Safety and reliability of control systems**

Control systems shall be designed and constructed so that they are safe and reliable, in a way that will prevent a hazardous situation arising. Above all they shall be designed and constructed in such a way that—

- (a) they can withstand the rigours of normal use and external factors; and
- (b) errors in logic do not lead to dangerous situations.

Safety related parts of control systems shall be designed and selected having regard to risk assessment and in accordance with AS 4024.1.

The following minimum category of control shall apply unless higher categories are defined in the machine specific Standards:

- (i) The minimum level for any safety related control system shall be category 1.
- (ii) The minimum level for safety device control systems which prevent risk in a danger zone during operations such as machine setting, programming, process change over, fault finding cleaning or maintenance, or similar shall be category 2.
- (iii) The minimum level for safety device control systems which prevent risk in a danger zone during manual loading or unloading of the workpiece shall be category 3.

### **4.3 CONTROL DEVICES**

#### **4.3.1 Starting**

It shall be possible to start machines only by voluntary actuation of a control provided for the purpose.

The same requirement applies—

- (a) when restarting the machine after a stoppage, whatever the cause; and
- (b) when effecting a significant change in the operating conditions (e.g. speed);

unless such restarting or change in operating conditions is without risk to exposed persons.

This essential requirement does not apply to the restarting of the machines or to the change in operating conditions resulting from the normal sequence of an automatic cycle.

Where machines have several starting controls and the operators can therefore put each other in danger, additional devices, e.g. enabling devices allowing only one part of the starting mechanism to be actuated at any one time shall be fitted to eliminate such risks.

It shall be possible for automated plant functioning in automatic mode to be restarted easily after a stoppage once the safety conditions have been fulfilled.

#### **4.3.2 Normal stopping**

Each machine shall be fitted with a control whereby the machine can be brought safely to a complete stop.

Operating of any stop control shall not, at any point in the machine cycle cause danger e.g. in respect of hydraulic circuits energy supplies or logic control circuits.

Each workstation (operator's position) shall be fitted with a control to stop some, or all, of the moving parts of the machines, depending on the type of hazard, so that the machine is rendered safe. The machine stop control shall have priority over the start controls.

Once the machine or its dangerous parts have stopped, the energy supply to the actuators concerned shall be cut off.

#### **4.3.3 Emergency stop**

An emergency stop device is a device which, regardless of the power source, e.g. electrical, pneumatic or hydraulic, requires deliberate action to bring a machine to rest when danger is recognized. The emergency stop should not be used for normal stopping. Emergency stops shall not be relied on as a means of isolation or immobilization.

An emergency stop device when operated shall stop the machine as quickly as possible and apply a brake where provided. An emergency stop is not an alternative to guarding. Care should be taken that the operation of the emergency stop does not, in itself, increase the risk of injury from another source. Handles, bars and push-buttons used for actuating the emergency stop should be coloured red and suitably marked, prominently located and readily accessible from all operator positions. Push-buttons shall be of the mushroom head latch-in, or lock-in manual reset type.

While push-buttons are the preferred form of emergency stop device, other devices providing equivalent levels of safety are acceptable.

Where there is more than one control or workstation, an emergency stop device shall be positioned at each station. Emergency control between and around the workstation may also be provided by use of trip wires or pressure-sensitive cables. In these circumstances it may be desirable to incorporate a visual indicator. The emergency stop should be located within easy reach.

All emergency stops on a machine shall remain active at all times.

Release or resetting of the emergency stop device shall not cause the machine to operate. Restarting shall only be possible by operation of the normal start control.

#### **4.3.4 Stop categories**

There are three categories of stops as follows:

- (a) Category 0: stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop.
- (b) Category 1: a controlled stop with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved.
- (c) Category 2: a controlled stop with power left available to the machine actuators.

### 4.3.5 Mode selection

#### 4.3.5.1 Selection of control and operating modes

If machinery has been designed and built to allow for its use in several control or operating modes presenting different safety levels (e.g. to allow for adjustment, maintenance, inspection and the like), it shall be fitted with a mode selector which can be locked in each position. Each position of the selector shall correspond to a single operating or control mode.

Combination machines shall use a selector switch to permit activation of only one section of the machine at a time.

The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operator (e.g. access codes for certain numerically controlled functions, etc.).

#### 4.3.5.2 Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance

Where, for setting, programming, process changeover, fault-finding, cleaning or maintenance of machinery, a guard has to be displaced or removed or a safety device has to be neutralized, and where it is necessary for the purpose of these operations for the machinery to be put in operation, safety of the operator may be achieved using a manual control mode which simultaneously—

- (a) disables the automatic control mode (this implies, among others, that no hazardous operation may result from any sensor changing its state),
- (b) permits operation of the hazardous elements only by triggering an enabling device, a hold-to-run control device or a two-hand control device (see AS 4024.1); and
- (c) permits operation of the hazardous elements only in enhanced safety conditions (e.g. reduced speed, reduced power/force, step-by-step e.g. with a limited movement control device or other adequate provision) while preventing risks from linked sequences.

This control mode shall be associated with at least one of the following measures:

- (i) Restriction of access to the danger zone as far as possible.
- (ii) Emergency stop control within immediate reach of the operator.
- (iii) Portable control unit (teach pendant) and/or local controls allowing sight of the controlled elements.

### 4.3.6 Speed changing

Where the machine is designed to use different tools and where there is a risk of overspeeding a tool, a speed changing device shall be provided. Where the machine is designed to operate at more than one tool speed, the controls shall be so designed and positioned that the selection can be made safely and reliably e.g. moving parts stopped when changing the belts.

Machines with devices for changing the tool speed whilst running, and which can use tooling incapable of running at the higher speed, shall only be capable of being started in the lowest speed.

Machines with devices for changing the tool speed or direction of rotation shall be prevented from accidental selection in the unintended mode e.g. with a switch lock.

Machines with software control of speeds shall be operated with a consistent set of tool addresses.

The selected speed shall be clearly indicated and visible from the operating position both before and after actuation.

Machines with an infinitely variable change of tool speed by means of frequency converters, may have particular hazards, e.g. uncontrolled speed change.

#### **4.3.7 Integrated feed**

Where the workpiece is fed to the tool by an integrated feed, the feed movement and the tool movement shall be interlocked where there is a risk of contact between the workpiece and the stationary tool creating a hazard.

#### **4.3.8 Control duplication**

Where controls are duplicated, for example inside a sound enclosure with another set of controls outside the sound enclosure they shall be so arranged that with the exception of the emergency stop when one set of controls is operable the other is inoperable. Provisions for complete isolation overriding all other control shall be made at the master control station.

#### **4.3.9 Complex installation**

The stop controls, including the emergency stop, shall be so designed that they can stop not only the machine itself but also all equipment upstream or downstream if its continued operation can be hazardous.

#### **4.3.10 Failure of the power supply or the control circuit**

Any interruption or reenergizing after an interruption or fluctuation in whatever manner of the power supply to the machine shall not lead to a hazardous situation.

A fault in the control circuit logic, or failure of or damage to the control circuit shall not lead to a hazardous situation.

In particular—

- (a) the machines shall not start unexpectedly;
- (b) the machines shall not be prevented from stopping if the command has already been given;
- (c) no moving part of the machines or workpiece held by the machines shall fall from the machine or be ejected;
- (d) automatic or manual stopping of any moving parts shall be unimpeded; and
- (e) the protection devices shall remain fully effective.

### **4.4 PROTECTION AGAINST MECHANICAL HAZARDS**

#### **4.4.1 Stability**

Machines and their elements shall be designed to be stable, i.e. so that they do not fall over and are not capable of being unintentionally moved by vibration, wind pressure, impact or other foreseeable external forces, or internal dynamic forces, e.g. inertia forces, electrodynamic forces.

If this recommendation cannot be fulfilled adequately by design e.g. by stable weight distribution, then stability shall be obtained by special safety measures. For example, movements of parts of the machine may be restricted, indicators or alarms to warn if stability is endangered, or interlocks to prevent tipping may be provided, or the machine may be securely anchored to a foundation. Both static and dynamic stability shall be considered. If special safety measures are required, a warning shall be provided on the machine or in the instruction handbook.

#### 4.4.2 Risk of break up during operation

Risks associated with breaking up during operation shall be minimized by taking account of at least the following:

- (a) *Mechanical stresses* Mechanical stresses include—
  - (i) stress limitation by implementation of correct calculation, construction and fastening methods as regards, for example, bolted assemblies, welded assemblies;
  - (ii) stress limitation by, for example overload prevention, ‘fusible’ plugs, pressure-limiting valves, breakage points or torque-limiting devices;
  - (iii) avoiding fatigue in elements under variable stresses notably cyclic stresses; and
  - (iv) static and dynamic balancing of rotating elements.
- (b) *Materials* Considerations include—
  - (i) material properties;
  - (ii) corrosion, ageing, abrasion and wear;
  - (iii) material homogeneity; and
  - (iv) toxicity of materials.

#### 4.4.3 Tool holder and tool design

All tools, tool spindles and their associated parts shall be manufactured from materials that are fit for the purpose for which they have been designed.

Rotating tools, except boring tools, shall be marked with the maximum permissible speed.

Rotating tools shall be balanced to minimize vibration.

Tools, tool sets and tool bodies shall be designed so that they can be mounted on the machine without any possibility of loosening during starting, running or braking.

On tools for hand fed machines, the projection of the cutting edge shall be limited. Where it is necessary to prevent the tool spindle from rotating during tool changing, safe means shall be provided by the manufacturer.

#### 4.4.4 Devices to minimize the possibility or the effect of ejection

Devices shall be provided where there is a risk of ejection. They may take the form of, but are not restricted to—

- (a) a stop fence for stopped work on a vertical spindle moulding machine;
- (b) a riving knife on circular sawing machines as shown in Figure 4.1(c);
- (c) a screen of fingers or stepped pawls, as on a thicknessing machine as shown in Figure 4.1(a), (b) and (d);
- (d) a baffle plate and a tunnel at the outfeed end on machines with tools in climb cutting operation as shown in Figure 4.2;
- (e) a riving knife or work guide and an anti-kickback or gripping device as shown in Figure 4.3; or
- (f) an enclosure.

Such devices shall—

- (i) give protection throughout the full capacity (height, width) of the machine;
- (ii) withstand the force of material hitting it; and
- (iii) where the device contains moving parts, e.g. fingers, such parts shall always be free to operate and be easily maintained.