Guidelines for the Safe Use of Machinery
About these Guidelines

*Guidelines for the Safe Use of Machinery* applies to leaders, employees, contractors, supervisors, and health and safety representatives. They provide important information for the health and safety of those who purchase, operate, clean, repair or maintain machinery.

Most work undertaken in Design and Technology classrooms involve machinery with moving parts. The risk of injury or harm must be assessed and action taken to eliminate or reduce the likelihood of injury or harm occurring. In most cases guarding will be the preferred option.

These Guidelines focus on guarding machines or the parts of machines most likely to cause injury or harm. Guarding is the most effective means of reducing the risk of injury or harm from dangerous parts of a machine. Failure to provide, attach or replace guarding on moving parts, or follow safe locking-out and tagging procedures are a serious risk to health and safety.

Regardless of which task or machine being used, those carrying out the operation must have the skills, knowledge, training and experience, to allow them to perform the operation safely. Machines must be used in accordance with the manufacturer’s instructions and operators must be provided with machines that are properly maintained.

All operators of machinery must be provided with information, instruction, training and supervision to allow them to perform tasks in a safe manner. Instruction and training should be provided:
- At induction of new staff.
- On introduction of new machines; and
- As refresher training, on an ongoing basis.

*Guidelines for the Safe Use of Machinery* comprises three parts.
- Part 1: General requirements provide general information pertaining to the safe use of plant.
- Part 2: Metalworking machinery provides essential information related to machinery commonly associated with metal materials.
- Part 3: Woodworking Machinery provides essential information related to machinery commonly associated with wood materials.

The information presented is provided to offer guidance on aspects of legislation. It is not to be taken as a statement of law and must not be construed to waive or modify any legal obligation.
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What is a guard?
A guard is a device designed to provide a physical or other barrier, which prevents or reduces access to dangerous areas of a machine. Guarding does not refer to personal protective equipment.

Why guard?
Where hazards cannot be controlled by elimination and substitution the next preferred method to control hazards is through engineering controls. Engineering controls involve physically changing the machine or work environment to prevent operators being exposed to potential hazards.

In the event there is a risk of exposure to dangerous parts during operation, examination, lubrication, adjustment or maintenance, that risk must be eliminated, or, where it cannot be eliminated, minimized. Where a risk assessment indicates engineering controls are appropriate machine guarding can eliminate or minimize the risk as far as is reasonably practicable.

Despite all machines having the same basic components, their safeguarding needs differ widely due to varying physical characteristics and operator involvement.

All moving machine parts that may cause injury must be securely guarded. This includes the point of operation, the power transmission apparatus and rotary or reciprocating parts.

- All guards must be correctly and securely fitted before operating a machine.
- Poorly designed or ineffectual guarding frequently contributes to machine operator injury.
- Guards must be appropriate and practical for the machine.
- Machinery guarding must be maintained in good working order.
- Guards must be robust, securely fastened and not easily circumvented.
Guarding compliance

- AS4024.1–1996 has the principal aim of eliminating machinery hazards, controlling or minimising risks through properly designed guards and safeguards, and the introduction of complementary safe work practices and training in correct use.
- AS4024.1-1996 does not discuss specific requirements unique to particular machines.
- These are covered in other relevant standards such as:

Mechanical hazards
- Revolving shafts.
- Discontinuous rotating parts.
- Abrasive wheels.
- Closing nips between platen motions.
- Reciprocating tools and dies.
- Revolving worms and spirals in casings.
- Nips between connecting rods or links.
- Rotating wheels, cranks or disks.
- The release of potential energy.

Non-mechanical hazards
- Access – slips, trips fall.
- Handling and lifting.
- Electricity - stored charges, static with potential for shock and burns.
- Chemical.
- Fire and explosion.
- Noise and vibration.
- Pressure and vacuum.
- Extremes of temperature.
- Inhalation of mists, fume, vapour gases and dust
- Suffocation.
- Ionising and non-ionising radiation – laser light welding.
**Danger areas**
The following areas on machinery are dangerous, and can be a risk to anyone near the machine:

**Non-operational parts** which move or transmit power such as:
- Belts and pulleys.
- Shafts and spindles.
- Slides and cams.
- Chain and sprocket gears.
- Flywheels and gear wheels.

**Operational parts** such as:
- Tools and dies.
- Guillotine blades.
- Cutters and knives.
- Saw blades.
- Drills and chucks.

**Identifying dangerous machine parts**
The classification of danger from machinery can be described as:
- Entanglement.
- Friction and abrasion (contact).
- Cutting (contact).
- Shear (traps).
- Stabbing and punctures, flying objects (ejection), rapidly moving parts.
- Impact.
- Crushing (traps).
- Drawing in (traps)
- Compressed air – or high-pressure fluid injection.
- Material ejected from machines.
- Release of potential energy.
- Any protrusions, which could cause injury.

**Machine hazards that guarding may control**
- Contact or entanglement with machinery.
- Trapped between machine and material or fixed structure.
- Contact with material in motion.
- Being struck by ejected parts of machinery.
- Being struck by material ejected from machine.
- Release of potential energy.
Checklist for appropriate provision of guarding

- Does the safeguard totally prevent approach to dangerous parts, when it is in its correct position and when working properly?
- Do the guards cover dangerous moving parts such as motor, belts, gear trains, pulleys and shafts?
- Is the safeguard reasonably convenient to use?
- Are there foreseeable reasons why an operator might attempt to override the guard?
- Can the guard be defeated or is it susceptible to misuse?
- Will the guard cope with the foreseeable machine failure?
- Are the components of the safeguard reliable?
- Is the safeguard straightforward and easy to inspect and maintain?
- Are the guards strong and rigid to prevent them touching the revolving wheels?
- Are the guards robust so accidental knocks will not displace or bend them?
- Do the guards cause minimum obstruction to the view of the process?
- Do the guards restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key?
- Do the guards introduce any other risks?
Types of guard
Machinery guards may be fixed guards, adjustable or controlled by mechanical or electrical interlocking systems. Guards should be selected on the basis that they provide the best physical barrier to prevent or minimize risks to the operator or others.

Fixed guards
- Have no moving parts and prevent contact with dangerous parts of the plant by providing a rigid barrier.
- Offer protection only when properly fixed in position.
- Should be easy to remove and replace, but only be able to be opened or removed with a tool.

Interlocking guards
- Moveable barriers, with the moving parts of the barrier interconnected with the control system for the plant.
- Isolate the energy source from plant so that moving parts will not operate unless the guard is closed.
- Interconnections are usually electrical, mechanical, hydraulic or pneumatic.
- Provide protection for a person from risk associated with maintenance or use of plant when regular access is required to an area that has the potential to cause injury.
- May not dissipate stored energy.

Automatic guards
- Automatically move into position as the plant, or cycle, is started.
- They are also known as push away guards.
- Are only suitable on slow plant/cycles.
- Automatic guards should only be used where the speed at which the guard is engaged will not introduce a new hazard to the operation of the plant.

Distance guards
- Prevent access to dangerous parts through a barrier or fence.

Trip guards (presence sensing devices)
- Designed to stop the plant when a person gets into a position where they can access the dangerous parts of the plant.
- Two types of commonly used presence sensing devices are:
  1. Photoelectric devices – Intangible barriers
     - Consist of a beam or beams of light, used to detect a person or object around dangerous parts of the plant.
     - Where a person or object is detected, the light beam is broken and the dangerous parts will be deactivated.
  2. Trip devices
     - Used to stop or make safe, dangerous parts of plant when the approach of a person or object is detected within a set area.

OHSW Regulations 1995
Part 3 Division 3.3 Hazard ID, Risk Assessment & Control

Control of risk

Guarding 3.3.3
(5) If guarding is used as a control measure, a person with the responsibility for the control of risk must ensure that any guard provided for the plant is—
(a) a permanently fixed physical barrier where no part of a person requires access to the dangerous area during normal operation, maintenance or cleaning; or
(b) an interlocked physical barrier where access to dangerous areas is required during the operating sequence; or
(c) if compliance with paragraph (a) or (b) is not reasonably practicable—a physical barrier securely fixed in position by means of fasteners or other suitable devices, which ensures that the guard cannot be altered or detached without the aid of a tool or key; or
(d) if compliance with paragraph (a), (b) or (c) is not reasonably practicable—a presence sensing safeguarding system.

(6) If a guard is used in accordance with subregulation (5), it must be—
(a) designed and constructed to make by-passing or defeating it, whether deliberately or by accident, as difficult as is reasonably possible; and
(b) of solid construction and securely mounted so as to resist impact and shock; and
(c) regularly maintained; and
(d) designed so as not to cause a risk in itself.

(7) If a part is designed to move at high speed and may break or disintegrate, or a workpiece may be ejected, any guarding must be adequate to effectively contain the fragments or workpiece.
Guard construction
Where guarding is not an integral part of the machine and has to be constructed and installed at the workplace, consideration should be given to how the guard should function.
• Preventing access.
• Containing the hazard; or
• A combination of both these safeguards.

Where a risk assessment shows an existing guard to be inappropriate or inadequate, any modifications or redesign should ensure the guard itself would not create a hazard.
• Trapping or shear points.
• Rough or sharp edges likely to cause injury.

Materials used for guarding
Guards can be made from durable material as appropriate for the purpose and may be:
• Solid sheet metal.
• Metal rod.
• Perforated or mesh material small enough to ensure that body parts cannot enter the danger zone.
• Acrylic or polycarbonate.
• Stainless steel.
• Rubber.
• Timber.

Consider the following when selecting a material for guarding or fitness for purpose:
• Weight.
  ♦ If the guard is too heavy it is unlikely to be replaced after maintenance.
• Strength and durability of the material.
• The effect on the machine’s performance and reliability.
  ♦ Does it cause the machine to overheat?
• Visibility
  ♦ Does it affect the visibility of the operator?
  ♦ Some plastics hold electrostatic charge, which attracts dust, making vision through the machine guard difficult.
• Control of other hazards?
  ♦ Does it affect the control of wood dust and noise?

AS 1470 – 1986 Health and Safety at work – Principles and practices

9.8.4 Provision of guards
Portions of machinery, plant and equipment that are not constructed or positioned so as to be permanently safe should be guarded or permanently screened to the greatest possible extent, and specific procedures should be implemented so as to prevent injury to employees or other persons.
The basic principle is that, unless a danger point or area is safe by virtue of design or its position, the machinery should be provided with an appropriate safeguard which eliminates danger before access to the danger point or area can be achieved.
Guards should be constructed of appropriate material of adequate strength, and should be effectively attached and maintained. Such guards should not be capable of removal or adjustment without the use of tools.
Guards should not interfere with the controls nor hamper the operation or regular maintenance of the machine or unit to which they are attached. The fitting of a guard should, in itself, not create a hazard.
In this regard, particular attention should be given to ergonomic aspects such as:
(e) posture of operator (including reach);
(b) controls and levers (size, position and operation);
(c) foot pedals;
(d) visual displays; and
(e) lighting

AS 1470 – 1986 Health and Safety at work – Principles and practices

9.8.2 Protection against personal contact
All machinery, plant or equipment including attachments should be designed, constructed, located or guarded so as to prevent accidental personal contact with parts which could cause injury because of their motion, temperature, sharpness, or electrical charge, or because of other reasons. It is extremely important that safety and interlocking devices should be such that, if they fail, they fail to a safe mode.
Duties of manufacturers and suppliers of plant

Manufacturers and suppliers of plant should take all practicable steps to ensure that it is designed, manufactured and tested so that its installation, use, maintenance, repair, dismantling and cleaning will not cause harm to any person.

Manufacturers of machinery and plant should take all practicable steps to provide comprehensible information and instructions to any supplier about the use for which their machinery was designed, manufactured and tested, its correct use, adjustment, installation, maintenance, dismantling, repair and any other relevant matters.

To ensure that noise control measures specified by designers are effective, manufacturers should ensure that suitable materials are used when constructing noise enclosures and controls for machinery.

Suppliers of machinery and plant should take all practicable steps to provide comprehensible information and instructions to any purchaser or hirer, about the use for which it was designed, manufactured and tested and its correct use, adjustment, installation, maintenance, dismantling and repair and any other relevant matters. A risk assessment must also be provided.

Standards

A standard is a document, which provides information and the options available regarding safe work practices or work materials. Many standards exist which provide technical guidance to designers and manufacturers for the safe design and manufacture of plant.

Australian Standards provide general information to meet occupational health and safety obligations. Some may be listed in the Regulations as Approved Codes of Practice.

Approved Codes of Practice provide practical guidance to meet the legal requirements of the Act and Regulations and must be followed unless an equal or better solution/s can be applied.

All items of plant should be designed, manufactured and used according to an approved standard, preferably an Australian Standard, or an approved overseas standard.

If in the event that there is not a specific standard relating to the plant or machine then the supplier must be able to stipulate that the plant or machine complies with Australian Standard AS 4024.1 –1996 Safeguarding of machinery Part 1: General principles.

- Whilst AS4024.1-1996 details general underlying principles for machine guarding and identifying hazards and risks arising from the use of machinery it does not provide guidance for safeguarding any particular machine.
Risk management process
A risk management process is a systematic way of making plant as safe as possible.

Step 1 – Identify the hazards

Step 2 - Assess the risks
Have the control measures introduced any new hazards?

Step 3 - Control the risks
Have the control measures eliminated or reduced the risks?

Step 4 - Review

OHSW Regulation 1995
Part 3 Division 3.3 Hazard Id. Risk Assessment & Control

Control of risk
3.3.3 (1) One or more of the following must be used to eliminate or, where that is not reasonably practicable, minimise any risk to health or safety:
(a) firstly, the application, so far as is reasonably practicable, of engineering controls, including substitution, isolation, modifications to design and guarding;
(b) secondly, if steps taken under paragraph (a) do not minimise the risk, the application, so far as is reasonably practicable, of administrative controls, including safe work practices;
(c) thirdly, if steps taken under paragraphs (a) and (b) do not minimise the risk, the provision of appropriate personal protective equipment.

Hazards
According to the Occupational Health Safety & Welfare Regulations 1995, a hazard is something which has the 'potential to cause injury or illness'.

Hazards commonly associated with machinery in Design and Technology areas include:
- Moving machine parts that may cause lacerations, entanglements and crushing injuries.
- Flying objects, which may hit the operator or others in the vicinity.
- Kickback, which can cause impact injuries on certain types of cutting and abrasive machinery.
- Noise from machinery.
- Sharp edges on or machines that may cause lacerations and bruising.
- Dust and fragments that may cause eye injury
- Dust that is inhaled.
Risk assessment
According to the Occupational Health Safety & Welfare Regulations 1995, a risk is the 'likelihood of injury or illness arising from exposure to any hazard'.

The purpose of risk assessment is to consider the risk factors involved in each hazard and rank them in priority order. In doing so, a judgement can be made as to the most serious and most likely hazards. Risk assessment provides a systematic way of determining:
- Hazards that need to be tackled first.
- Hazards that can be managed in the medium term.
- Hazards that can be managed at some point in the future, but not necessarily immediately.

Risk assessments need to consider:
- Frequency and level of exposure.
- Pattern of exposure (continuous or intermittent).
- Adequacy of existing control measures.
- Consequences of injury.

One way of assessing risk is to consider the chance of the hazardous situation occurring (the likelihood) and the extent of the harm that would result (the consequence). When these are considered an assessment of how serious the risk is can be made.
## Risk assessment tool

### Consequences

<table>
<thead>
<tr>
<th>Consequences</th>
<th>1 Insignificant</th>
<th>2 Minor</th>
<th>3 Moderate</th>
<th>4 Major</th>
<th>5 Catastrophic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dealt with by In-house first aid.</td>
<td>HIGH (H)</td>
<td>HIGH (H)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
</tr>
<tr>
<td>Medical help needed. Treatment by medical professional Hospital outpatient.</td>
<td>HIGH (H)</td>
<td>HIGH (H)</td>
<td>HIGH (H)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
</tr>
<tr>
<td>Significant Non-permanent injury. Overnight hospitalisation (inpatient)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
</tr>
<tr>
<td>Extensive permanent injury. (Eg. loss of finger/s) Extended hospitalisation.</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
</tr>
<tr>
<td>Death. Permanent disabling injury. (Eg. blindness, loss of hand/s, quadriplegia).</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
</tr>
</tbody>
</table>

### Likelihood

- **A** Almost certain to occur in most circumstances
- **B** Likely to occur frequently
- **C** Possible and likely to occur at some time
- **D** Unlikely to occur but could happen
- **E** May occur but only in rare and exceptional circumstances

<table>
<thead>
<tr>
<th>Likelihood</th>
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<th>3 Moderate</th>
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<td>HIGH (H)</td>
<td>HIGH (H)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
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</tr>
<tr>
<td>MEDIUM (M)</td>
<td>HIGH (H)</td>
<td>HIGH (H)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
</tr>
<tr>
<td>LOW (L)</td>
<td>MEDIUM (M)</td>
<td>HIGH (H)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
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<tr>
<td>LOW (L)</td>
<td>LOW (L)</td>
<td>MEDIUM (M)</td>
<td>HIGH (H)</td>
<td>EXTREME (X)</td>
<td>EXTREME (X)</td>
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<tr>
<td>LOW (L)</td>
<td>LOW (L)</td>
<td>MEDIUM (M)</td>
<td>HIGH (H)</td>
<td>HIGH (H)</td>
<td>HIGH (H)</td>
</tr>
</tbody>
</table>
Prioritising the risk rating

Once the level of risk has been determined the following may be of use in determining control measures.

Extreme (X)
- Act immediately.
- Lock-out the machine to either eliminate, substitute or implement engineering control measures.
- An identified extreme risk does not allow scope for the use of administrative controls, even in the short term.
- The machine must remain locked out until it is either removed from service or appropriately guarded.

High (H)
- Act immediately to either eliminate, substitute or implement engineering control measures.
- If these controls are not immediately accessible, set a timeframe for their implementation and establish interim risk reduction strategies for the period of the set timeframe.
- At the end of the set timeframe, if elimination, substitution or engineering controls have not been established, a further risk assessment must be undertaken.
- An achievable timeframe must be established to ensure that elimination, substitution or engineering controls are implemented.
- Risk (and not cost) must be the primary consideration in determining the timeframe.
- A timeframe of greater than 6 months would generally not be acceptable for an identified high risk on any machine.

Medium (M)
- Until elimination, substitution or engineering controls can be implemented, institute administrative or personal protective equipment controls.
- These “lower level” controls must not be considered permanent solutions.
- The time for which they are established must be based on risk.
- At the end of the time, if the risk has not been addressed by elimination, substitution or engineering controls a further risk assessment must be undertaken.
- Where interim measures are applied:
  - Put administrative controls in place to limit the use or access to the machine etc.
  - Pay particular attention to supervision and training.

Low (L)
- Institute permanent controls in the long term.
- Permanent controls may be administrative in nature if the hazard has low frequency, rare likelihood and insignificant consequence.
- Where interim measures are applied:
  - Put administrative controls in place to limit the use or access to the machine etc.
  - Pay particular attention to supervision and training.
Identifying hazards and assessing risks

There may be hazards arising from the plant itself, its associated work practices and the environment in which it will be used.

In Design and Technology for example:

- A hazard is the exposed circular saw blade on a circular saw. It has the potential to cause injury if a person’s body parts contact the rotating blade or if work piece is flung out.
- Without safety precautions, there exists a significant risk for the operator to be injured.
- The risk can be reduced in the first instance by ensuring the correct type of guarding is fitted and that the riving knife is correctly set and the correct thickness.
- The risk can be further reduced by ensuring that:
  - The circular saw is regularly maintained and in good working condition.
  - The guard is correctly fitted and operating correctly when the machine is being operated.
  - A push stick is used where necessary.
  - Appropriate measures have been taken to reduce the noise levels when the machine is being operated.
  - The light is sufficient to see clearly and effective dust extraction system is installed and in good condition.
  - The teacher has appropriate knowledge and expertise to be able to correctly teach the students how to use the machine.
  - The students have appropriate levels of skill and maturity to use the machine safely.
  - The students wear appropriate PPE.
  - There is sufficient space for the student to use the machine correctly.
  - The organization and class rules prevent other students from interfering with the student who is operating the machine.

When identifying hazards and assessing risks in Design and Technology, it is important to consider:

- The condition of machinery and its suitability for the activity and use by the students in a particular class.
- Safety concerns related to the learning environment, such as layout, physical conditions, noise levels, lighting and quality of air.
- The teacher’s skill and experience.
- The personal skill level of students as well as their knowledge of the activity and environment, their attitude, confidence, previous experience and any disabilities and special medication need.
- Records of previous incidents, accidents or near misses.
Hierarchy of control
Where a risk to safety and health has been identified, controls must be introduced to eliminate or minimise it. The following ‘hierarchy’ can be used as a guide. Most often a combination will be required to reduce a risk to the desired level. Choose controls from the highest level possible.

1 Elimination
• Removing the hazard or hazardous work practice is the most effective control measure.
  ♦ The machine is too old to be made safe to use or suitable methods to control exposure to people involved in the work or people in the general work area from the hazard are not practicable.

2 Substitution
• Substituting or replacing a hazard or hazardous work practice with a less hazardous one.
  ♦ Provide an alternate item of plant that is safer and that can be used to perform the same tasks.

3 Isolation
• Isolating or separating the hazard or hazardous work practice from people involved in the work, or people in the general work area from the hazard.
  ♦ Install a barrier or screen or locating a circular saw in its own room.

4 Engineering Controls
• If a hazard cannot be eliminated, substituted or isolated, an engineering control is the next preferred control measure.
  ♦ Install guarding and implement programmed maintenance.

5 Administrative Controls
• Include work practices that reduce the risk.
  ♦ Limit use to only authorized persons. Adequate training, instruction and supervision for authorized persons. Published safe work procedures for each item of plant.

6 Personal Protective Equipment
• Should be considered only when other control measures are not practicable or to increase protection.
  ♦ Mandatory use of eye and ear protection.

Review
Deciding on and implementing a control measure is not the end of the risk management process. Control measures must be assessed to determine:
• Whether the risk have been adequately controlled; and
• That no hazards have been created by the control measures.
The process should continue until the risk is reduced to the lowest practicable level and the process must be repeated whenever circumstances change.
Basic principles of acquiring/purchasing plant
To minimize potential problems before proceeding with a purchase it is essential to ensure that the plant:

- Is capable of being adequately installed on the intended or available site.
- Can be operated by intended staff and/or students who have the necessary skills and competencies to operate the plant.
- Is capable of performing the intended task.
- Is designed for its intended task.
- Can be readily maintained and supported.
- Does not introduce any significant health and safety risk.
- Is supplied with appropriate documentation such as how it should be correctly used and maintained.
- Is adequately described so that an informed choice as to its suitability can be made.
- Meets the appropriate Standards and Codes with which it must comply.
  ♦ The OHS&W Act and OHS&W Regulations Section 3.
  ♦ AS 4024.1 Safeguarding of machinery Part 1: General principles.
  ♦ Any other specific AS/NZS.

Acquisition/purchasing
Research the range of machinery available to suit your needs and wants in light of the above advice.

1. Once the purpose or function of the plant has been identified develop your own specification, which describes the features and requirements that must be met.
2. To ensure that the supplier confirms their legal obligations suppliers must:
   - Provide a Risk Assessment for the required machine.
   - Complete the Confirmation of Order form.
     ♦ The Confirmation of Order form confirms that the item/s to be supplied conform/s to the requirements of the OHS&W Act (SA), OHS&W Regulations1995 and appropriate AS/NZS.
     ♦ Suppliers should ensure noise reduction is considered in the design and installation of plant so that noise levels do not exceed $L_{Aeq}^{8h}$ of 85 dB(A).
4. Forward the Acquisition/Purchase notice to the Health & Safety services (R11/7).
   - On receipt of this notice a BLAMS Bar Code will be issued.
5. Once the plant has been placed on site, installed and commissioned a risk assessment of the hazards using the Risk Assessment Process Part A and Part B pro formas must be conducted and documented for each item of machinery purchased and any associated system of work for that machine.
6. Appropriate controls must be put in place to eliminate or minimize any risks identified.
**Layout of machinery**

Working clearances must be established between machines and obstacles to allow safe operation of every machine without limitation. There must be sufficient floor space to accommodate people, plant, machinery, and material without congestion or risk of collision.

Attention should be given to the following:

- Congestion or operator movements near machinery that are likely to cause problems must be avoided.
- The layout must not encourage hazardous movements in relation to operation, cleaning or maintenance.
- The size of materials to be processed through each machine.
- Space required for auxiliary stands and/or worktables.
- The layout should minimise unnecessary movements by people and materials.
- Existing and anticipated machine needs.
- The relative position of each machine to one another for efficient material handling.
- Simple and well understood flow lines that reduce the likelihood of persons coming near dangerous machinery.
- Provision of non-slip flooring and work surfaces.
- Noise produced by machinery may interfere with concentration and can cause operator stress.
  - Noise can lead to mistakes and it can also prevent a verbal warning being communicated.
- Service pipes and cables should be placed either:
  - Below ground, clear of machinery foundations and be provided with covers of adequate strength; or
  - At a height as to have clear headroom.
- Service pipes and conduits should be colour coded in accordance with Australian Standard **AS 1345 – 1995 Identification of the contents of pipes, conduits and ducts.**
Safety around machines

Access and egress
- The space allocated for normal movement or emergency access or egress must be at least 600mm wide.
- If the side boundaries are not clearly defined they should be clearly marked with 50mm wide lines.
  - ‘Sunflower yellow’ is the basic or background colour used to denote caution (sometimes used in conjunction with black) in accordance to Australian Standard AS 1318 Colours for the occupational environment and Australian Standard AS 2700 Colour standards for paints and related materials.

Operator zones
- The space allocated for machine operators should be 600mm minimum from the working extremities of the particular machine.
- Operator zones must be clearly defined and marked with 50mm wide lines.
  - ‘Sunflower yellow’ is the basic or background colour used to denote caution (sometimes used in conjunction with black).

Machine zones
Machines should ideally be located near walls. This reduces the hazard of traffic passing behind the machine and allows connection to services. If machines are placed back to back they should be separated by safety screening 900mm to 1500mm above floor. The screening should be impact-resistant and transparent for supervision.

OHS&W Regulations 1995
Part 2 Division 2.1 Access and Egress

Access and egress
2.1.1 (1) The purpose of this regulation is to prescribe standards that must be observed at a workplace so that a person may —
(a) move conveniently and safely about the workplace; and
(b) leave the workplace in an emergency; and
(c) have safe access to any place or workplace amenity.
(2) A person who undertakes work at a workplace, or on or about a workplace, must be provided with a safe means of access to and egress from—
(a) the place where the work must be performed; and
(b) any amenities provided for the use of that person.
(3) A passage or other space used for normal movement about the workplace or intended for emergency egress must be kept free of any obstruction that could hinder or prevent the safe and rapid egress of a person in an emergency and if work must occur in the passage or space, the space for egress must be at least 600 mm wide.
(4) If—
(a) the side boundaries of an aisle are not otherwise clearly defined; and
(b) it is reasonable that the boundaries of the aisle be defined in the interests of health and safety, the side boundaries of the aisle must be clearly marked by lines that are—
(c) not less than 50 mm wide; and
(d) painted or otherwise delineated on the floor in a permanent manner; and
(e) coloured sunflower yellow; and
(f) maintained in a clearly visible condition.
Lighting

Lighting in work areas should be bright enough to eliminate shadow and prevent eyestrain.

Adequate appropriate lighting and visibility for the safety of people operating machinery is contingent on:
• Direction and intensity of lighting.
• The contrast between background and local illumination.
• Colour of the light source.
• Under certain lighting conditions, moving objects or machinery may look as if they are stopped or moving in a different manner from their actual movements.
• The elimination of distractions from surroundings by means of suitably positioned screens.
• Maintenance of lighting systems and equipment.
  ♦ Flickering or intermittent lights must be repaired or replaced immediately.
  ♦ Fluorescent tubes have limited effective light and should be replaced at the recommended frequency suggested by the manufacturer.
• Uniform light around the workspace, which is free from reflection glare and shadows.
  ♦ A particular concern for machines that are positioned against a wall.
• A lighting luminance of 400 lx or better for machine operations.

If a risk assessment determines that the lighting falls below the required luminance for safe machine operation consider the installation of supplementary local lighting.

Supplementary local lighting must be of the low voltage type and be capable of being switched off independently.

Vibration can adversely affect the life of most lamps and it is recommended that anti-vibration springs be incorporated where Edison screw lamps are used to minimize the possibility of the lamp progressively unscrewing from the holder.
Noise regulations
It is essential that noise levels in Design and Technology classrooms are monitored and controlled in accordance with Division 2.10 Occupational Health Safety and Welfare (OHS&W) Regulations 1995 (SA) and ensure that appropriate protection is provided for students and staff.

The SA Regulations and guidelines adopt a workplace exposure level L_{Aeq,8h} of:
- 90 dB (A) for continuous exposure, or
- 140 dB (linear) for peak levels of exposure.

Designers, manufacturers, importers and suppliers of new plant must ensure noise reduction is considered in the design and installation so that noise levels do not exceed L_{Aeq,8h} of 85 dB(A).
- The L_{Aeq,8h} refers to the average noise exposure level throughout an eight hour working day measured on the A weighted noise scale.
- ‘A weighted’ means the measuring instrument has been adjusted to mimic the hearing characteristics of the human ear.

Noise control
Where noise levels exceed the exposure standard, appropriate measures must be taken to minimise the risk to students and staff.
- Where the exposure might exceed the standard, a person who has the appropriate training and experience to correctly perform the assessment must undertake the assessment.

Where practicable the following types of controls must be used to reduce noise levels in the workplace:

1 Elimination
- Is the most effective control measure.
- Completely removes the noise hazard, or risk of exposure to the noise hazard.

2 Substitution
- Replace the noisy plant with new plant or quieter plant.
- The Regulations prescribe a noise level of L_{Aeq,8h} of 85 dB(A).

3 Engineering
- Procedures that reduce the sound level at the source of the noise or in its transmission, for example by:
  - Damping noisy panels.
  - Mounting machinery firmly on a sound-absorbing surface.
  - Using nylon instead of metal gears.
  - Altering the noise pathway by using partitions.

4 Administrative controls
- Organisational arrangements that substantially reduce the amount of time in the noisy area.

OHS&W Regulations 1995
Part 2 Division 2.10 Noise

Preliminary
2.10.1 (1) The purpose of this Division is to ensure—
(a) that persons at work are not exposed to unsafe noise; and
(b) that unsafe noise in the workplace is minimised.
(2) For the purposes of this Division—
(a) the sound pressure level is the level of noise determined at an employee’s ear position, determined in accordance with AS 1269 Occupational noise management Part 3: Hearing protector program, without taking into account any protection that may be afforded by a personal hearing protector; and
(b) the value of L_{peak} must be determined by using sound-measuring equipment with a peak detector-indicator characteristic that complies with AS 1259 Sound level meters, Part 1: Non-integrating.

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  - Damping noisy panels.
  - Mounting machinery firmly on a sound-absorbing surface.
  - Using nylon instead of metal gears.
  - Altering the noise pathway by using partitions.

4 Administrative controls
- Organisational arrangements that substantially reduce the amount of time in the noisy area.
**Power supply**
Machinery is commonly supplied with a 415-volt three-phase motor. 240-volt single-phase motors are available on request.

It is recommended that the power supply to machinery be hardwired.

Because of the risk of damage to some machine wiring it is advisable to provide additional protection by using wiring conduit.

**Isolating switch**
Each machine must have a functional individual isolating switch that disconnects all motive power that conforms to Australian Standard AS 1543 – 1985 Electrical Equipment of Industrial Machines.

The isolating control must:
- Have a one ON and one OFF position only.
- Be clearly marked with 1 and 0 or ON and OFF.
- A means of locking in only the OFF position.
  - This lock enables the machine to be ‘Tagged and Locked Out’ for maintenance and / or situations where a risk is present.

Isolation controls must be prominently located and mounted such that:
- The handle of the disconnecting device shall be easily accessible and located between 600mm and 1900mm above the floor.
- It is in dry and clean position.
- It does not interfere with adjustments or maintenance of machine and vice versa.
- Provision is made for adequate protection against mechanical damage.

**OHS&W Regulations 1995**
Part 2 Division 2.5 Electrical

2.5.1 The purpose of this Division is—

(b) to ensure that persons at work are, as far as is reasonably practicable, safe from the risks of injury caused by electricity; and

(c) to minimise the risk of injury, electrical shock or fire at a workplace through the use of, or on account of, any electrical installation or electrical plant; and

(d) to ensure any electrical work performed on any electrical installation or electrical plant is carried out by a competent person.

AS 1473.1-2000 Wood-processing machinery-safety
Part 1: Primary timber milling machinery
Section 3 Plant Layout and machine installation

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

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[Image of CAUTION sign]

**CAUTION**
A licensed electrician must install hard-wired machines and the electrician must provide a certificate of compliance at the completion of the work.

[Image of LOCKABLE ISOLATING CONTROL]

**LOCKABLE ISOLATING CONTROL**

[Image of DANGER TAG]

**DANGER TAG**

Acknowledgement:
SOS Safety Signs Pty Ltd
**Motor starter**

All fixed machinery must be fitted with an effective and robust Direct on Line (DOL) Start/Stop switch.


The START button must be:
- Any other colour than red.
  - The recommended colour is green.
- Be flush or recessed to prevent accidental starting.
- Be identified by the word START or the symbol I.

The STOP button must:
- Be red in colour.
- Have a mushroom head.
- Be identified by the word STOP or the symbol 0.

The DOL Start/Stop Switch must be located and securely mounted such that:
- It is within easy reach of the operator in their normal working position.
- Not less than 600mm above the working level on which the operator stands.
- It cannot be accidentally operated.
- The operator does not come within the proximity of moving machine parts when using the switch.
- It does not interfere with adjustments or maintenance of machine and vice versa.
- Provision is made for adequate protection against mechanical damage.
- The starter support structure is sufficiently rigid to prevent external impact shocks from accidentally activating the machine.
No volt relay
The Direct on Line (DOL) switch must have a ‘No-Volt Relay’ incorporated into the circuit. This ensures that once power is lost the machine cannot start until the Start button is deliberately activated.

A relay is usually fitted inside the DOL switch.
- This relay “pulls in” contactors that connect the machine to the electrical supply.
- The relay can only be activated when pressing the Start control.
- The Stop control interrupts the supply to the relay and so the machine stops.
- A loss of mains power will also deactivate the relay.
- This ensures that once the power is lost the machine cannot start unless a deliberate action takes place such a person presses the start button.

Testing for no volt relay
Activating the Start button is the only way to restart the machine where a No Volt Relay is fitted to the On/Off starter.

- Start the machine and let it run.
- Switch off the isolating switch.
- The machine will stop. The supply has been cut.
- Switch the isolating switch back on.
- If the machine now automatically restarts it does not have a No Volt Relay fitted.

OHS&W Regulations 1995
Part 2 Division 2.5 Electrical

Electrical installations etc.

2.5.4: Any electrical installation, plant, materials, equipment or apparatus within a workplace must be so designed, constructed, installed, protected, maintained and tested so as to minimise the risk of injury, electrical shock or fire.

OHS&W Regulations 1995
Part 2 Division 2.5 Electrical

Inspection and testing of electrical plant

2.5.7(1) Regular inspection and testing must be performed on electrical plant in the workplace if the supply of electricity is through a socket outlet to:
(a) hand held electrical plant; or
(b) electrical plant that is moved while in operation; or
(c) electrical plant that is moved between operations in circumstances where damage to the electrical plant or to a flexible supply cord could reasonably occur; or
(d) electrical plant where electrical safety could be affected by the operating environment.
(2) If electrical plant is fixed, it must be inspected and tested after taking into account:
(a) information provided by the designer or manufacturer of the electrical plant; and
(b) any hazard identification and risk assessment process that is relevant to the use of the electrical plant in its intended work environment.
Emergency stop device (E-stop)

An emergency-stop device (E-stop) is required where the machinery manufacturer or a risk assessment by the owner operator determines that the machine will be safer by the fitting an E-stop device.


An E-stop is a control device that is in addition to the normal DOL On/Off starter.

- E-stop devices require deliberate action to bring a machine to rest when danger is recognized.
- An E-stop device when operated must stop the machine as quickly as possible and apply a brake where provided.
- Usually the E-stop device is in the form of a mushroom-headed button that can be “hit” in an emergency.
- The E-stop must be of the latch in type so that the machine cannot restart until manually reset.
- Resetting will not cause the machine to start but requires the action of the START control.
- An E-stop device should not be used for normal stopping.
- An E-stop must not be relied on as a means of isolation.

An E-stop must be located and mounted such that:

- It is readily accessible and operable from the normal operating position in an emergency situation.
- It cannot be accidentally operated.
- Does not interfere with adjustments or maintenance of machine and vice versa.
- Provision is made for adequate protection against mechanical damage.
- It is not affected by excessive vibration.

OHS&W Regulations 1995
Part 3 Division 3.3 Hazard ID, Risk Assessment & Control

Control of risk 3.3.3

Emergency stops and warning devices

(12) Emergency stop devices must—
(a) be prominent, clearly and durably marked, and immediately accessible to each operator of the plant; and
(b) have handles, bars or push buttons which are coloured red; and
(c) as far as reasonably practicable operate reliably and be fail-safe.

(13) If a risk assessment identifies a need to have an emergency warning device, such a device must be installed in a position which enables its purpose to be achieved easily and effectively.

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(13) If a risk assessment identifies a need to have an emergency warning device, such a device must be installed in a position which enables its purpose to be achieved easily and effectively.
Installing plant
Installation procedure includes risk management, provision of information, and inspection and testing.

The installer must ensure that:
- Risks arising from installation are either eliminated or minimized.
  - Manual handling.
  - Barricades.
  - Temporary support structures.
  - Crushing hazards.
- Due regard is taken of the designers’ or manufacturers’ instructions.
- The people engaged in the installation are competent.
- There is sufficient information to enable the plant to be installed in a way that minimizes risks to health and safety.
- That plant is installed in a suitable position so that it can be operated and maintained safely.
- The plant is laid out properly so that safe access and egress are available.
- Where plant is designed for installation in position on a secure base it is installed so that it cannot move when operated.
- The plant is not transferred into service unless a process of commissioning has determined that it is safe to do so.

OHS&W Regulations 1995
Part 3 Division 3.2 Duties

Installation and commissioning

3.2.19 (1) An employer must ensure that any risk to health and safety arising during the installation, erection or commissioning of plant is eliminated or, where that is not reasonably practicable, minimised.

OHS&W Regulations 1995
Part 2 Division 2.5 Electrical

Competency requirements

2.5.3 Any electrical work performed on any electrical installation or electrical plant at a workplace must be carried out by a competent person who must be, if required by the Plumbers, Gasfitters and Electricians Act, 1995, licensed under that Act.

Margin Note
Reg 2.5.3 - A competent person would also need to have a suitable electrical licence where this is required under the Plumbers, Gas Fitters and Electricians Act, 1995; in other instances training on specific hazards (eg working at heights) will be relevant.
Commissioning

Commissioning is a process carried out on plant before that plant is placed into service to ensure that it performs according to the design criteria. Commissioning procedure includes risk management, provision of information, and inspection and testing.

During commissioning, installers are under the same obligation to minimize health and safety risks. This means that:

- Competent people who have been provided sufficient information, training and instruction carry out commissioning.
- Commissioning is conducted in accordance with specifications of the manufacturer or supplier.
- Commissioning does not impose stresses on the plant that exceed the design specifications.
- Plant is inspected, to determine whether it has been erected or installed in accordance with design specification.
- Plant is maintained and cleaned in a manner recommended by the designer and manufacturer or a competent person.
- If plant is damaged to the extent that operating it would provide any additional risk, the plant is either withdrawn from service or repaired.
- Only competent people, who have been provided sufficient information, training and instruction, operate plant.
- Plant is only used for the purpose for which it was designed, or a purpose that has been determined safe by a competent person.
- Maintenance, cleaning and repairs are not carried out on operating plant unless the plant is stopped and subjected to positive measures to protect people’s safety.
  ♦ This may include a combination of lockout or isolation, danger tags or other control measures.
- Plant is inspected and tested to ensure the plant will perform within the design specifications.
- As a result of commissioning, plant can be transferred into active service without risk to health and safety when it is used properly and for the purpose for which it was designed and manufactured.
- The person in control of the workplace is notified of any hazards that may affect commissioning, or result from commissioning.
- Manufacturer’s operating and maintenance instructions are made available to employees.
- A risk assessment is undertaken.
- A Safe Operating Procedure is developed prior to handover.

AS 1470 -1986
Health and safety at work- Principles and practices

9.4 COMMISSIONING AND ACCEPTANCE

Before any machinery, plant or equipment is brought into operation, measures shall be taken to ensure that:
(a) machinery, plant or equipment is not used or operated until it has been ascertained that such use or operation does not expose any person to risk of injury;
(b) the manufacturer’s operating and maintenance instructions/manuals are readily available to employees and job instructions have been prepared.

OHSW Regulations 1995
Part 3 Division 3.2 Duties

Record Keeping

3.2.35 (1) An employer must, in relation to any plant specified in subregulation (2), while the plant is operable and under the employer’s control, make records on any relevant tests, maintenance, inspection, commissioning or alteration of the plant, and make those records available to any employee or relevant health and safety representative.
Training and supervision

It cannot be assumed that people intuitively know or can informally learn about machine safety.

When training people to operate machinery the following things must be explained.

- Actual and potential hazards and appropriate controls.
- Correct use and adjustment of guards.
- Safe operating procedures.
- Emergency and first aid procedures.
- What the machine does.
- How the machine works.
- The intended use of the machine.
- Limitations and capabilities of the machine.
- How to check and adjust the machine prior to starting it.
- How to recognise faults with the potential to cause harm.
- How to start and stop the machine.
- Location and operation of other controls
- Purpose of guards and other safety devices.

Manufacturer’s recommendations should be taken into consideration when developing training programmes.

A person with thorough knowledge of the machine should closely supervise each operator until it is demonstrated that the operator is fully acquainted with the machine and allied duties.

Ongoing supervision should also be maintained to ensure safe work practices are followed, and machines are operating in a safe and correct manner.

OHS&W Regulations 1995
Part 3 Division 3.2 Duties

Use

3.2.20 (1) An employer must ensure that any risk to health and safety arising from plant in use, or associated systems of work, is eliminated or, where that is not reasonably practicable, minimised.

(2) Without limiting the generality of subregulation(1), an employer must ensure --

(a) that any plant, other than plant which is operated by members of the public, is not operated by a person unless that person has received adequate information and training, and is supervised to the extent necessary to minimize any risk to health or safety;
General training advice

Machine operator training should include:
1. The method of starting and stopping the machine.
2. Hazards, which arise in the course of normal working.
3. The need to ensure that the machine has come to rest before making any adjustments or during the manual removal of waste, or during the oiling or greasing of the machine.
4. Lockout/tag out procedures.
5. The function of the guards and safety devices and the need for ensuring they are kept in good condition, properly mounted and in correct adjustment.
6. How to recognise, as far as possible, faults which may occur in a machine, guard or safety device, and the need for reporting to the person in charge those faults which are identified.
7. The need to avoid wearing loose flowing garments and ornaments, and to wear hair either cut short or securely fixed or confined close to the head by a net or other covering, so as to avoid being caught in moving machinery parts.
8. The need to wear appropriate protective safety equipment as follows:
   (i) Eye protectors in the vicinity of machinery.
   (ii) Ear protectors whenever noise exposure exceeds acceptable limits.
   (iii) Safety aprons.
   (iv) Gloves, except where hands may closely approach moving parts of machinery.
   (v) Safety footwear.
9. The need for the operator and any other person to stand out of the line of possible kickback.
10. The need to keep the machine and working area free from accumulations of materials, waste, hand tools and obstructions of any kind.
11. The need to avoid reaching over any cutting tool.
12. The need to turn off the power before leaving the machine, and not to leave it running unattended.
13. The need to be certain that hold-downs and anti-kickback devices are positioned properly, and the work piece is being fed through the cutting tool in the correct direction.
14. The need to avoid the use of a dull, gummy, bent or cracked cutting tool.
15. The need to ensure that keys and adjusting tools have been removed before turning on the power.
16. The use of accessories designed specifically for the machine.
17. The adjustment of the machine to allow minimum exposure of cutting tool necessary to perform the operation.
18. The scheduling of work to avoid frequent adjustments to machines and altering the position of guards.
19. The need to avoid using machines for work beyond their stated capacity or capability, as indicated by the machine manufacturer.
20. The need to keep floors around machines clear of wood chips and saw dust which may cause the floor to be slippery.
Personal protective equipment (PPE)

Engineering controls that eliminate the hazard at the source offer the best and most reliable means of safeguarding. Whenever engineering controls are not available or fully capable of protecting employees, personal protection equipment (PPE) must be worn to minimize the risk of injury.

PPE refers to the equipment worn to reduce exposure to hazards and includes such items as:

- **Eye protection (goggles, glasses).**
  - AS/NZS 1336: 1997 *Recommended practices for occupational eye protection.*
- **Hearing protection (ear plugs, ear muffs).**
  - AS/NZS 1270: 1999 *Acoustics - Hearing protectors*
- **Respiratory protection (respirators, face masks, cartridge filters).**
  - AS/NZS 1715: 1994 *Selection, use and maintenance of respiratory protective devices.*
- **Hand protection (gloves).**
- **Foot protection (safety boots).**
- **Head protection (hard hats).**
- **Body protection (aprons, safety harnesses).**
  - AS 3765: 1990 *Clothing for protection against hazardous chemicals.*

Note: PPE includes any substance used to protect health, for example, sunscreen.

PPE is the least effective control measure because the hazards and risks are still present. There are issues of proper fit and design for different individuals. PPE can sometimes be awkward, uncomfortable and limiting, which may make people less likely to use such equipment. PPE should be used as part of an integrated organisational approach to health and safety management. It should complement other control methods, not replace them.

Acknowledgment: www.BOC.com.au/
To provide adequate protection, PPE must always:

- Be appropriate for the particular hazards.
  - Operators must be adequately trained in the need for PPE.
- Be maintained in good condition.
- Fit properly and be comfortable under working conditions.
  - Operators must wear and/or use PPE in accordance with instructions received.
- Be kept clean, fully functional, and sanitary.
  - Apart from ensuring that multiple use PPE is correctly used, handled, stored, cared for and maintained, appropriate procedures on suitable cleaning and sterilisation must be provided.
- Be stored in accordance with the manufacturer's recommendations.
  - Some manufacturers of respirators provide sealed storage cases for this purpose. If such storage methods are not provided, then appropriate alternative methods can be economically devised (eg. empty 4 litre ice cream containers or other resealable plastic containers) to ensure that PPE is stored in hygienic conditions prior to its next use.

**PPE plan**

If personal protective equipment is used to minimize exposure to hazards, a plan should be developed. As part of this plan, determine and record:

- The basis for selecting each type of equipment used in the work area.
- Operator training needs.
- Exclusive use of personal protective equipment by operators, where relevant.
- Fitting requirements for individual items of personal protective equipment.
- Cleaning and disinfecting procedures
- Storage requirements of the equipment.
- Maintenance and/or replacement requirements.
- Periodic assessments to ensure that the equipment is used properly and is effective.

ACT WorkCover PPE 03.1

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**OHS&W Regulations 1995**

**Part 2 Division 2 .12 Personal Protection**

**Personal protection**

2.12.1 (1) The purpose of this regulation is to ensure that personal protective equipment and clothing is provided and maintained where a risk at work could be minimised by its use.

(a) appropriate taking into account the nature of the particular hazard and the relevant work; and
(b) an effective size and fit, and reasonably comfortable, for a person who must use or wear it; and
(c) if the sharing of the equipment or clothing could present a hygiene risk, provided to a person for exclusive use, or sterilised after each use; and
(d) regularly cleaned, and maintained and stored in good order and effective condition.

(5) A person who must use or wear equipment or clothing under this regulation must receive proper training and instruction in the use and maintenance of the equipment or clothing.

(6) If the use or wearing of equipment or clothing could affect proper communication with another, appropriate steps must be taken to ensure that this situation does not create a risk to health or safety.

(7) This regulation does not require a person to use or wear equipment or clothing in circumstances where to do so would create a greater risk to health or safety.

(8) A hazardous area where personal protective equipment or clothing must be used or worn must be identified by signs that comply with the relevant requirements of AS 1319 Rules for the design and use of safety signs.
Purchasing PPE

A person who designs, manufactures, imports or supplies personal protective equipment, has a duty to ensure the availability of adequate information about the use for which it has been designed, manufactured, tested and examined. Any other information necessary to ensure that the equipment may be used without risks to safety and health of any person should also be provided.

Designers, manufacturers or suppliers of PPE can give advice on the specifications and appropriate use of their products. This is important because, for example, no one type of glove provides adequate protection against all chemicals. A respirator designed to be effective against medium air levels of a chemical may not be effective against high levels of the same chemical (or low levels of another chemical).

PPE items should be purchased from suppliers who ensure that only approved (Australian Standard or equivalent marking) PPE will be provided. A number of Australian Standards specify minimum requirements for PPE of different types. PPE should not be used unless it is designed to meet the minimum requirements of relevant standards. Compliant PPE items should contain a special sticker, label or stamp with the approval on it. These identification markings show the Australian Standards logo as well as quoting the relevant Australian Standards number.

To ensure equipment provides adequate protection:

- Consult with suppliers and manufacturers to determine the appropriate type of personal protective equipment (PPE) for each hazard.
- Ensure that each item of PPE meets an appropriate standard (e.g. look for the Standards Australia markings).
- Refer to any Material Safety Data Sheets (MSDS) or other health and safety information provided by the manufacturer, supplier or importer of a product.
Hearing protection devices

Where elimination, substitution, engineering and administrative controls do not reduce the exposure to below $L_{A_{eq}}^{8h} 90\text{dB}(A)$ the noise exposure must be measured so that appropriate personal hearing protectors can be selected and provided.

- These are not the preferred method for preventing hearing damage because they do not reduce the noise itself.


Staff and students can be made aware of noise risks and the action required to protect hearing by:

- Undertaking training in how to fit and use and maintain appropriate PPE.
- Ensuring that hearing protectors are worn at all times where hearing protectors are specified for use.
  - Removing hearing protectors for short periods in a noisy area reduces their effectiveness and leads to inadequate protection.
- Indicating PPE requirements on machinery.
- Reporting faulty equipment that may pose a risk of excessive noise.
Industrial safety colour code


Red
Signal red used alone or in conjunction with white lettering, stripes or edging identifies danger.
- Prohibition.
  - Red circle and slash indicates an activity is not permitted.
- Fire protection equipment and signage.
- Stop buttons for electrical switches.
- Emergency stop controls for machinery.

Yellow
Sunflower yellow used alone or in conjunction with black lettering, stripes or edging identifies hazards.
- Warning signs.
  - Yellow triangle warns of hazards in a workplace.
- Machinery guards.
- Operator zones.

Green
Jade green used alone or in conjunction with white lettering, stripes or edging identifies safety.
- Location of safety or first aid equipment.
- Safety instruction signs.
  - Green rectangle signs show emergency information.

Blue
Bright blue used alone or in conjunction with white lettering, stripes or edging identifies mandatory action or information where there is no specific hazard.
- Mandatory signs.
  - Blue circle signs show protective equipment must be worn.
- Information signs.
  - Parking areas.

Acknowledgement
SOS Safety Signs Pty Ltd
Sign classification and use
Safety signs are classified according to their function.

Regulatory signs
- Prohibition signs that indicate that an action or activity is not permitted.
- Mandatory signs that an instruction must be carried out.

Hazard signs
- DANGER signs warning of a particular hazard or hazardous condition that is likely to be life threatening.
- Warning signs that alert people to a hazard or hazardous condition that is not likely to be life threatening.

Emergency information signs
- Signs indicating the location of, or directions to, emergency related facilities such as exits, safety equipment or first aid facilities.

Fire signs
- Signs advising the location of fire alarms and fire-fighting equipment.

Sign location
Where appropriate, safety signs in accordance with Australian Standard AS 1319 –1994 Safety signs for the occupational environment should be prominently displayed.

- Signs should be located where the messages are legible and are clearly visible.
  - Visibility can be improved if contrast exists between the sign and its immediate background.
  - Avoid placing several signs close together as the effect may be so confusing as to make it difficult to distinguish the individual messages conveyed by the signs.
- Signs should be mounted as close as practicable to the observer’s line of sight.
  - For a standing adult this will be 5 degrees up or down from a point 1500mm above the line of sight.
  - Mount signs such that they will not be a hazard.
- Regulatory signs and hazard signs should be located in relation to a particular hazard as to allow a person sufficient time after first viewing the sign to heed the warning.
- Signing must be employed which clearly describes the Personal Protective Equipment requirements for each machine or item of equipment.
- For maximum effectiveness signs must be maintained in good condition.

Acknowledgement
SOS Safety Signs Pty Ltd
Plant maintenance

Plant includes any machinery, their related equipment (including scaffolding), appliances, implements or tools and any components or fittings. The plant regulations do not apply to manually powered, hand-held tools.

Maintenance is the process of restoring, refurbishing, or preserving plant in order to keep the plant safe and operational.

- Certain items of plant used in schools, such as pressure vessels and vehicle hoists, are subjected to legislative requirements that prescribe the standard and frequency of maintenance task.
- Importers and suppliers must provide adequate maintenance instructions for the equipment they supply.

Maintenance must be carried out in a way that protects the health and safety of all people including the person/s carrying out the maintenance task as well as other personnel in the work area.

- Erection of signs and barricades may be required.
- Tag and Lock procedures.
- Maintenance personnel can be exposed to substances such as cleaning or degreasing products and lubricants, which may be hazardous to their health.
  - Adequate precautions must be taken.
  - Personnel must be fully informed about the nature of hazards present.
  - A material safety data sheet (MSDS) describes the properties and hazards of a material or substance.
- Installed safety devices, such as guards, are replaced before the plant is returned to service.

A documented maintenance schedule should be developed for all plant and time should be allocated specifically for this purpose.

- The procedure outlined on each specific maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.

Housekeeping

Cleanliness around machinery must be maintained to ensure guards, bearings, motors and electrical equipment function correctly and to prevent tripping and fire hazards.

- Work areas must be kept clear and clean of dust and debris, which may cause a trip/slip or fire hazard.
- Adopt safe work practices.
  - Manual handling when shifting waste bins.
  - PPE required for some housekeeping operations.
  - MSDS must be available when handling substances that may be hazardous to health.

OHS&W Regulation 1995
Part 3 Division 3.2 Duties

Record keeping

3.2.44 The owner of plant to which the requirements of these regulations apply by virtue of regulation 3.2.36 must-
(a) make records of any relevant tests, maintenance, inspection, commissioning or alteration of the plant, or of any risk assessment carried out in accordance with regulation 3.2.37; and
(b) keep those records for at least five years or, if an approved code of practice specifies a different period, for that period; and
(c) except where the plant is being sold for scrap or as spare parts for other plant—ensure that those records are transferred to any person who purchases or otherwise acquires the plant (other than on hire or lease) from the owner.

OHS&W Regulations 1995
Part 3 Division 3.2 Duties

Use

3.2.20 (1) An employer must ensure that any risk to health and safety arising from plant in use, or associated systems of work, is eliminated or, where that is not reasonably practicable, minimised.

(2) Without limiting the generality of subregulation (1), an employer must ensure—

(h) that facilities and systems of work are provided and maintained so as to minimise any risk to the health or safety of a person who maintains, inspects, or cleans the plant; and
(i) that inspections, maintenance and cleaning are carried out having regard to procedures recommended by the designer or manufacturer, or those developed by a competent person; and
(j) if access is required for the purpose of maintenance, cleaning or repair, that the plant is stopped, and that one or more of the following are used to minimise any risk to health or safety:
  (i) lockout or isolation devices;
  (ii) danger tags;
  (iii) permit to work systems;
  (iv) other control measures; and
  (k) if it is not reasonably practicable to carry out cleaning or maintenance while the plant is stopped, that operational controls which permit controlled movement of the plant are fitted and safe systems of work used; and
(l) that any safety feature or warning device of plant is maintained, and tested on a regular basis.
- Isolate the machine from power source at the end of operation.
- Leave the machine in a safe and tidy state.
- Machinery **must not** be cleaned out while it is in motion.

Recommended housekeeping practices that are considered essential are:
- Arranging all equipment to permit safe and efficient work practices.
  - It is important to have definite places for tools to be kept when not in use.
- Providing for materials and supplies to be safely stored.
  - Materials need to be stored or stacked securely and in such a way as to make them accessible without impairing the security of the stored materials. This calls for suitable storage space and for a careful study of proper racks, containers, bin lockers, etc.
  - Provisions should be made to adequately store the variety of materials used in school workrooms.
  - Attention should be given to accessibility, lighting and ventilation in storerooms.
- Providing appropriate type and quantity of waste containers.
  - Oily rags, waste paper, scrap materials and other flammable materials should be cleaned up daily and placed in suitable metal or other non-flammable containers.
- Properly disposing of combustible waste materials.
- Having floors regularly cleaned.
- Prohibiting the storage of excess materials and debris on benches in the work areas.
- Maintenance of aisle space.
  - Adequate aisles should be maintained in all facilities and storage rooms. This aisle space or travel zone can be maintained more readily if the area needed is clearly marked on the floor by yellow lines.
  - A general rule is that main aisles should be parallel to the flow of materials in process. Main aisles should be 1200mm wide. Aisles should be kept clear of materials or equipment at all times.
- Conducting regular inspections to maintain clean and orderly conditions.
- Cleaning splash guards and collecting pans of all machines that use oil and coolants.
- Maintaining supply of brooms, bench brushes, paper towels and other cleaning equipment.
- Using housekeeping tools, equipment and supplies properly.
- Reminding students of their responsibility to keep the workroom clean and orderly.
- Organizing a housekeeping routine that involves all students.
Tag and lockout system

The accidental operation of a machine undergoing installation, commissioning, repair, maintenance or cleaning could represent a severe hazard.

In order to prevent or minimize the risk an OUT OF SERVICE tag and a DANGER tag/lockout system should be implemented.

Out of service tags

Yellow and black out of service tags are visual safeguards designed to reduce risk. They are used on plant, equipment or machinery, which is taken out of service due to fault, damage or malfunction.

The tag must be fixed to the isolating control and include the reason/s for out of service.

When the reason for placing the out of service tag no longer exists, the person who attached the tag may remove an out of service tag.

- In the event of an illness a tag may be removed by the supervisor, once the safety of all personnel is ensured.

Out of service tags DO NOT provide personal protection to the individual.

An out of service tag should in place BEFORE personal danger tags are attached, and it should be the last removed before the plant, equipment and machinery is restarted.

Danger Tags

Red and black danger tags are used to warn people about hazards associated with equipment and machinery maintenance.

Before starting work, where a person could be endangered by the operation of the machine, the machine must:

- Be properly isolated.
- Have a DANGER tag securely attached to the isolator.
  - Appropriate details must be completed on the tag.
  - Each person working on the machinery must place their personal danger tag on the isolator.

The person who attached the danger tag must remove tags.

- In the event of an illness a tag may be removed by the supervisor, once the safety of all personnel is ensured.

Lockout

Where people could be endangered by the operation of plant or the release of stored energy, the plant must:

- Be properly isolated and stored energy must be released.
- Have a DANGER tag and personal lock applied to the isolating control.
  - Each person should apply an individual padlock to the isolating control.
  - A danger tag identifying the person who placed the lock and the reason for placing the lock must accompany the placement of a lock.
Energy isolation procedure

Lockout is the term applied to a system or procedure designed to control all situations where the unexpected energization, start-up or release of stored energy of the equipment, machinery or process, would be likely to endanger or injure personnel. It may also be used to refer to the actual task of applying proper locks.

The following procedure must be followed by the person carrying out the isolation in consultation with the person responsible for the plant.

1. Notify the person responsible for the plant as to the reason and duration of the isolation.
2. Switch off the machinery or equipment.
3. Switch off the power source(s) at the isolating control(s).
4. Apply personal lock(s) to multiple lock attachment(s).
   - Each personal lock must be marked or tagged to identify the person using it.
   - Combination locks must not be used for this procedure.
5. Test control buttons to be sure that the power source has been disconnected.
6. Perform repairs and/or maintenance.
7. All personnel working on a machine are to remove their lock(s) as soon as they have completed their maintenance or repairs.
   - The person who attached the danger tag must remove tags.
   - In the event of an illness a tag may be removed by the supervisor, once the safety of all personnel is ensured.
8. Upon completion, clear away all tools and personnel.
9. Replace all guards and protective devices.
10. Ensure that everyone is clear of the machine.
11. Start the machine or equipment to return it to normal.

OHS&W Regulations 1995
Part 3 Division 3.2 Duties

3.2.20
(1) An employer must ensure that any risk to health and safety arising from plant in use, or associated systems of work, is eliminated or, where that is not reasonably practicable, minimized.
(2) Without limiting the generality of subregulation (1), an employer must ensure—
   (j) if access is required for the purpose of maintenance, cleaning or repair, that the plant is stopped, and that one or more of the following are used to minimize any risk to health or safety:
      (i) lockout or isolation devices;
      (ii) danger tags;
      (iii) permit to work systems;
      (iv) other control measures; and
   (k) if it is not reasonably practicable to carry out cleaning or maintenance while the plant is stopped, that operational controls which permit controlled movement of the plant are fitted and safe systems of work used; and
   (l) that any safety feature or warning device of plant is maintained, and tested on a regular basis.

AS 4024.1 - 1996
Safeguarding of machinery Part 1: General principles

14.4.3.2 Padlocking. The isolation device may be designed so that one or more padlocks can be fitted or alternatively the device may be used with a multi-padlock hasp. Each person should apply should apply an individual padlock or key to each relevant control.

The placement of a lock should be accompanied by a danger tag which identifies the employee who placed the lock and the reasons for its placement.
Repairs
Repairs or any maintenance activity must not change the machine from the original design specification. Repairs, other than those done in accordance with the designer’s and/or the manufacturer’s recommendations may introduce unwanted and unanticipated risk.

Modification repairs, which have adverse implications for the safety of plant, include:
- Using parts of inferior quality.
- Strengthening components that frequently fail or seem excessively weak.
- Abandoning preventative maintenance procedures in favour of breakdown maintenance.
- Making expedient temporary repairs.

Competent people who have been provided sufficient information, training and instruction to carry out repairs must do so in accordance to manufacturer’s instructions.

Records of repairs must be kept on the Maintenance Schedule.

OHS&W Regulations 1995 Part 3
Division 3.2 Duties

Repair

3.2.21 An employer must ensure—
(a) if the function or condition of plant is impaired or damaged to an extent that increases the risk to health or safety, that a competent person assesses the damage and advises the employer of—
(i) the nature of the damage; and
(ii) whether the plant is able to be repaired and, if so, what repairs must be carried out to minimise any risk to health or safety; and
(b) that any repairs, inspection or testing is carried out by a competent person; and
(c) that repairs to plant are carried out so as to retain the plant within its design limits.
Plant alterations
Modifications can produce unforeseen results. No change in operating parameters should be undertaken without that change being subjected to a risk management process.
• Hazard identification.
• Risk assessment.
• Risk control.

Alterations or modifications must be completed in a way, which ensures that:
• The modified plant is suitable for the intended task.
• The alterations have not introduced any new hazards.
  ♦ Entanglement.
  ♦ Crushing.
  ♦ Shearing or stabbing points.
  ♦ Ignition source.
• The operation of the modified plant does not generate hazardous conditions.
  ♦ Increase pressure.
  ♦ High or low temperatures.
  ♦ Creation of hazardous atmosphere such as dust or noise.
• All work undertaken is carried out by competent people who are provided with sufficient information to enable the plant to be modified in a manner, which minimizes risks to health and safety for all persons.
• The modifications are not in conflict with the designer or manufacturer’s recommendations.
  ♦ Does the modification alter the capability of the plant to perform as originally designed?
• Where alterations are proposed, these are authorized only by, or on behalf of, the person having legal responsibility for the machine.
• Any alterations beyond the original design meet OHSW Regulations and relevant standards.
• The plant is not returned to service unless a process of commissioning testing determined it is safe to do so.
  ♦ When the modification is complete, and prior to re-commissioning, a competent person should inspect the plant to ensure that the modified plant appears ready for service.
  ♦ All work undertaken must be inspected and tested by a competent person having due regard for the original design specification for the plant.

OHS&W Regulations 1995 Part 1 Division 3.2 Duties
Record Keeping
3.2.35 (1) An employer must, in relation to any plant specified in subregulation (2), while the plant is operable and under the employer’s control, make records on any relevant tests, maintenance, inspection, commissioning or alteration of the plant, and make those records available to any employee or relevant health and safety representative.
Disposal of plant
Part 3 of the Occupational Health, Safety and Welfare (OHSW) Regulations (SA), 1995 provides regulations to protect the health and safety of people at work from the risks arising from plant.

This protection is expected to be achieved through the implementation of the Regulations, which require that:
- Hazards are identified.
- Risks are assessed.
- Risks are controlled.
- Design, manufacture, installation, use, maintenance, storage and disposal all meet certain requirements.

Reasons for disposal
Items can be identified as suitable for disposal because they:
- Are no longer required due to changed procedures, functions or usage patterns.
- No longer comply with occupational health and safety standards.
- Occupy storage space and will not be needed in the foreseeable future.
- Have reached their optimum selling time to maximise returns.
- Are found to contain hazardous materials.
- Are beyond economical repair but able to be sold for scrap or spare parts.
- Are suitable for dumping only.

Methods of disposal
Plant may be disposed of in the following ways:
- Sold.
- Sold for salvage (scrap or spare parts)
- Traded-in.
- Transferred to another DECS site or State Government agency.
- Donated (requires Chief Executive approval).
- Dumped (where there is no material value for the item or the cost of the sale is greater than the return on the sale).

If a site manager determines that plant is to be disposed, they must ensure that a delegate with appropriate disposal authority approves the transaction and that the correct disposal method and procedure has been selected. Advice and direction shall be sought from the Manager, Procurement to ensure the intended disposal meets Government requirements.

Disposal by sale or transfer
If a site manager determines that the plant is suitable for sale or transfer they must ensure:
- A hazard identification is carried out using the Hazard Identification Checklist for Plant Disposal.
- Retain a copy for school (worksite) records.
- The purchaser/receiver of goods is advised in writing of the identified hazards associated with the plant and that the plant is not to be used until the hazards are rectified.
• This is done before supply by providing the purchaser/receiver of goods with:
  ♦ A Hazard Identification Checklist for Plant Disposal.
• The purchaser/receiver returns a copy of the Condition of Acceptance of Goods letter.
  ♦ Retain a copy for school (worksite) records.
• A Disposal Notice is completed and a copy forwarded to DECS Health & Safety Services (R11/7).

**Disposal of plant for salvage**
If a site manager determines that the plant is only suitable for salvage they must ensure:
• A hazard identification using the Hazard Checklist for Plant Disposal is undertaken.
  ♦ Retain a copy for school (worksite) records.
• Information stating that the plant is only suitable for scrap or spare parts is provided to the salvager. This must be done before supply by providing the salvager:
  ♦ A Hazard Checklist for Plant Disposal.
  ♦ The information must highlight that the plant must not be placed in service in the form in which it is supplied.
• The salvager returns a copy of the Condition of Acceptance of Goods letter.
  ♦ Retain a copy for school (worksite) records.
• A Disposal Notice is completed and a copy forwarded to DECS Health & Safety Services (R11/7).

**Disposal of plant by dumping**
If a site manager determines that the plant is only suitable for dumping they must ensure:
• Any procedures required for dumping are carried out with due regard for health and safety at all times.
• A competent person carries out the disposal of plant containing materials that present a risk to health or safety
• Pollutants are not released.
• That a competent person undertakes the task of rendering the plant inoperable.
• A Disposal Notice is completed and a copy forwarded to DECS Health & Safety Services (R11/7).

**Dismantling and storing machinery**
In the event that plant requires dismantling and placement in storage all procedures must be carried out with due regard for health and safety at all times.
• Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
• A competent person must carry out the dismantling.
• Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.
• Ensure all energies are released.

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**Guidelines for the Safe Use of Machinery**

**OHSW Regulations 1995**
Part 3 Division 3.2 Duties

**Dismantling, storage and disposal of plant**

(1) If plant is dismantled, an employer must ensure—

(a) that the dismantling is carried out by a competent person; and

(b) insofar as it is readily available, that any relevant information prepared for the purposes of these regulations is made available to the person carrying out the dismantling.

(2) If plant, including plant which is dismantled, is to be stored, an employer must ensure that the storage is carried out by a competent person.

(3) If plant to be disposed of contains materials presenting a risk to health or safety, an employer must ensure that the disposal is carried out by a competent person.
Buffing Machine

Buffing Machines are used in Design & Technology to remove oxides and scratches from metal and scratches from plastic.

A Buffing Machine consists of an electric motor fitted with threaded tapered spindles to which buffing mops are attached.

These have a right hand or left hand thread, depending on which end of the machine is used, thus firmly screwing each mop in place when the machine revolves.

Mops are selected according the type and condition of material being used. The mops are impregnated with cutting or polishing compounds.

The motor is fully enclosed to prevent entry of abrasive materials used in the polishing process.

WARNING

Buffing Machine injuries can occur if:
- Hair or clothing becomes entangled in rotating machinery parts.
- Material is ejected by the buffing action.
- An operator comes into contact with rotating mops or spindles.
**Buffing Machine guarding**

Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

Because of the operating characteristics of the Buffing Machine it is difficult to completely guard.

Buffing Machines must be guarded in these ways:

1. Guarding, which encloses dangerous moving parts, such as the tapered spindles, by means of fixed guards
2. These guards must allow spindles to run freely and allow mops to be fitted without rubbing on the guard.
Purchasing a Buffing Machine

General
A Buffing Machine should:
• Meet **DECS Standards for Plant and Equipment: Part A**
• Have spare parts readily available through a local distributor.
• Be supplied with all tools required for the operation of the machine.
• Be supplied with detailed instruction.parts manual.
• Be of robust construction.
• Be suitable for continuous use, similar to that found in industry.
• Produce less than 85 dB(A) at the point of operation.
• Meet the provisions of the OHS&W Act and OHS&W Regulations 1995 Part 3.
• Meet the safety requirements of Australian Standard **AS4024.1 – 1995 Safeguarding of machinery Part 1: General principles.**
• Be supplied with a risk assessment.

Parameters
A Buffing Machine should:
• Be mounted on a robust pedestal.
• Have a stand sufficiently rigid in design for the buff to be vibration free and stable in use.
• Have a double-ended spindle.
• Be double ended with right and left handed threads.
• Have threaded taper spindles.
• Be fitted with preloaded bearings to eliminate end float.
• Be fitted with sealed bearings to eliminate lubrication and seal out dust.

Technical Details
A Buffing Machine should have:
• A minimum spindle diameter 19mm.
• Mop size: 2 X 150mm – 200mm (approximately) diameter.
• A motor 415V/3/50 minimum 0.75 kW, or 240V/1/50 minimum 0.75 kW.
• Speed approximately 2800 r.p.m.
Positioning a Buffing Machine

A Buffing machine depending on the brand and model can weigh approximately 50 Kg.

Most workshop floors should be sufficient to carry the weight of a Buffing Machine. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Buffing Machine onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Buffing Machine rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Buffing Machine must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Buffing Machine is bolted to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

Extraction plant may be used with this machine and this may well affect the options when siting this machine.

The installation, spacing, services and foothold around a Buffing Machines must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
- A low stand should be considered to suit the operational requirements of the shorter student.
Spatial allowances for a Buffing Machine

The following graphic indicates the recommended spatial allowances for a Buffing Machine and operator.

- Only a single operator may use a Buffing Machine.
- It should be noted that the measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

BUFFING MACHINE
**Commissioning a Buffing Machine**

A Buffing Machine must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

5. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

6. A Buffing Machine must be securely fixed to its pedestal and the pedestal subsequently secured to the floor.
   - Under no circumstances must the machine be left to stand unsecured.

7. Guarding must be in place and function correctly.
8. All nuts, bolts and grub screws must be in place and tight.
9. The machine must be in a clean condition.
10. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.
11. A licensed electrician must install hard-wired equipment.
12. When electrical connection has been made, an authorised person must confirm the direction of spindle rotation.
   - Switch on and at the same time switch off to view direction.
   - The spindle must run in a clockwise direction when viewed from the left side of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a direction test may result in serious operator injury and damage to the machine.

13. Switch gear must be tested for correct operation
14. Connect machine to dust extraction system if provided.
15. Lubrication points should be serviced and all moving parts should move freely but with little slop or backlash.
16. Attach Buffing Machine Safety Operating Procedures
17. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
18. Associated housekeeping equipment should be installed in a suitable nearby location.
19. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
20. Warranties must be processed and forwarded to the appropriate parties.
21. The details of the machine must be entered in the school's record and in the Buffing Machine Maintenance Schedule.
22. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
**Buffing Machine safe work procedure**

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of the Buffing Machine.

- Operators must be **properly instructed** in the **safe operation** and the characteristics of the machine and materials involved.
  - The **safe handling** of the workpiece when buffing and the **position of the hands** relative to the work piece.
  - This machine has the capacity to **grab** workpiece.
- Only operators who have been authorized as properly trained and competent should be allowed to operate machines.
- Adequate instruction and supervision are essential.
- Ensure the machine is operated according to the manufacturer’s recommendation.
- A mop must be kept on the tapered spindle at all times as a protective measure.
- Do not use the side of the mop.
- Operators must wear the appropriate Personal Protective Equipment.
- Good hearing protection must be worn for some operations
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- Ensure that any body parts or clothing do not get near the mop during operation.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
- Jigs and work holding devices must be used when buffing small work pieces.
Buffing Machine safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. The Buffing Machine must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine. Foreign materials may cause poor footing.
5. Do not leave machine running unattended.
   - Turn off the power and make sure the machine has stopped completely before leaving the area.
6. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing. Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Dust mask must be worn.
   - Sturdy Footwear to be worn at all times in work areas.
7. Long and loose hair must be contained.
8. Rings, watches, jewellery must not be worn. Medic alert identity (if worn) must be taped.
9. Use proper type of polishing wheel for the material being processed.
10. Ensure mops are in a serviceable condition before use.
11. Apply buffing compound to the bottom of the wheel so that excess will be thrown away from the operator.
12. Workpiece should be held in front of the mop, and slightly below the centre of the mop.
13. Do not present an edge or corner to the mop as the workpiece may be caught in the mop and torn from the operator’s hands.
14. Bring the machine to a complete standstill and Isolate the machine from power before cleaning or making adjustments.

WARNING
Beware of the rotating mops and spindles, which can cause entanglements.

WARNING
All guards must be in place and operating before using this machine.

WARNING
Gloves, apron or any other fabric must not be used to hold workpiece.

WARNING
This machine has the capacity to grab work piece if improperly presented to the mop.
Safety hazards of a Buffing Machine

Point of operation
• Contact with the mops and spindles may occur during operation.

In-running nip points.
• Clothing, hair or hands may be caught by and pulled into unprotected spindles.
  ♦ Under no circumstances should an operator bend down near this machine whilst it is operating.
  ♦ The operator must be aware of the position of their hands and fingers in relation to the mops at all times.

Flying particles and material
• Airborne particulates, buffing compound and worn mop, can be thrown up into the operator’s face.
  ♦ Buffing Machines generate significant quantities of airborne particulates and residue, which may create health problems.
  ♦ Adequate ventilation is necessary and appropriate PPE may be needed for some operations.
**Buffing Machine maintenance**

A documented maintenance schedule must be developed for this machine and time should be allocated specifically for this purpose.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Buffing Machine is a low maintenance machine.

- Ensure spindle guards are in place and securely fixed.
- Ensure mops are in sound condition and securely attached to tapered spindles before operating.

**WARNING**

Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.
Decommissioning a Buffing Machine

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Buffing Machine the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the Buffing Machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment to the Buffing Machine.
6. Any fixings securing the equipment to its bed should be removed.
7. If the machine is on a pedestal carefully move the machine so that it lies lengthwise along the ground.
   - Observe correct manual handling procedures and ensure the machine neither does nor create a trip hazard.
   - A competent person to facilitate convenient handling may dismantle the Buffing Machine from the pedestal.
8. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
9. School records and electrical testing databases must be amended.
**Buffing machine glossary**

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

**Guard**
A physical barrier that prevents or reduces access to a danger point or area.

**Hard Wired**
A method of electrical connection, which is permanent as against the normal plug and socket method of supplying electrical power. Hard-wired equipment must be connected and disconnected by a licensed electrician.

**Hazard**
a situation at the workplace capable of potential harm.

**Lux**
A unit of measurement relating to light.

**Mop**
Cloth discs, which are fitted to the spindle of a buffing machine. They are loaded with an abrasive and used in the buffing process.

- **Sisal mops** are made from woven sisal cord and are stitched to produce a hard, coarse surface for use with emery cutting compound.

- **Calico or cotton mops** are made from soft, unbleached material and stiffened by the application of special dressings. Unstitched mops allow a soft, flexible surface to come into contact with the work piece. Stitched mops are used if additional hardness is required. They are used in conjunction with Tripoli buffing compounds to produce a high polish.

- **Swansdown mops** are very soft, unstitched mops used to produce a very high polish. They are used in conjunction with Rouge buffing compounds to produce an extremely high polish.

**Risk**
The probability that the potential harm may become a reality.

**Spindle**
A rotating device widely used in machine tools, such as lathes, milling machines, drill presses, and so forth, to hold the cutting tools or the work, and to give them their rotation.

**Three Phase Power**
A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.
Cold Saw

A Cold Saw is used in Design and Technology to:

- Crosscut metal tube, rod, bar and sections to length.
- Cut mitres and bevel cuts.
  - The saw arm can be swung from side to side to adjust the horizontal angle of the cut.

Cold Saws are multi-purpose circular saws that use a High Speed Steel (HSS) blade that cuts above the material. During the cross cutting operation the stock to be cut is firmly clamped underneath the blade in a machine vice. The operator pulls down on a handle to move the blade, which is flooded with cutting fluid, through the workpiece being cut so that the material can be pushed away from the operator.

A Cold Saw’s blade is fixed and does not walk or wander. Cold sawing produces square or perpendicular cuts and minimal or no burrs.

Because it is a cold cutting process, cold sawing does not work harden the workpiece, which can be a benefit for a workpiece that requires subsequent finishing with cutting tools.

Cold sawing is suitable for cutting smaller-diameter or thin-walled material that requires tight tolerances. While some Cold Saws can handle round tube up to 85mm diameter and round solid up to 50mm diameter they are most effective at cutting stock with a maximum OD of 44mm.

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**WARNING**

COLD SAWS ARE DANGEROUS MACHINES

- Amputations may occur if the operator’s hands and fingers come into contact with the saw blade.
- Eye injuries can occur due to flying metal chips.
- Entanglement of hair and clothing may occur if contact is made with the revolving saw blade cannot be completely guarded.
Cold Saw Guarding

Machinery must have in place guard ing which isolates moving parts and the point of operation from direct contact with the operator.

A Cold Saw must be guarded in these ways:

1. **A fixed (hood) guard** to enclose the non-cutting part of the saw blade
   - The upper guard must protect the operator from flying metal, swarf and broken saw teeth.
   - This guard should extend at least as far down as the saw spindle.

2. Side guards that cover at least the outside edge of the exposed saw teeth. These can be:
   - **Self-closing side guards**
     - Rise and open on contact with the workpiece.
     - A 'clamshell guard' that covers the saw blade with a scissor opening action as the cut is made.
     - In the at-rest position, the sides of the lower exposed part of the blade must be guarded from the tips of the teeth inward radially with no gullet exposure.
     - There should be no access to the saw blade of any design when in the rest position.
     - The guard must not inhibit the intended use of the saw.

3. Machines should be fitted with:
   - An operating automatic return device, so that the saw returns to its safe rest position above the workpiece when the saw is released.
   - An automatic brake that stops the rotation of the saw spindle within 10 seconds or less.

4. A workpiece vice that is high enough to support the workpiece must be provided so that it can be moved either side of the cutting line.

5. Adequate workpiece support is essential for all cross-cutting operations.
   - Large workpieces should be supported using extension tables or roller supports at either side of the table.

Cold Saw Guards should:

- Be strong and rigid.
- Be rigid to prevent them touching the revolving blades.
- Made from a material such as aluminium or similar, so that in the event of contact with the blade, neither the guard nor the blade will disintegrate.
- Be robust so those accidental knocks will not displace or bend them.
- Constructed so that it is not easily deflected, which would expose the blade.
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
• Be difficult to by-pass or disable.
• Cause minimum obstruction to the view of the process.
• Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
• Be easy to adjust so that they can be set correctly.
• Be regularly maintained to keep them easy to adjust.
• Not introduce any other risks.
• Cover dangerous moving parts such as motor and shafts.
Purchasing a Cold Saw

General
A Cold Saw should:
- Meet *DECS Standards for Plant and Equipment: Part A*.
- Have spare parts readily available through a local distributor.
- Be supplied with detailed instruction/parts manual and all tools required for the operation of the machine.
- Be of robust construction and suitable for continuous use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Cold Saw should:
- Have a stand sufficiently rigid for the Cold Saw to be vibration free and stable when used.
- Have a fully integrated automatic coolant system.
- Be supplied with a serviceable coolant pump with coolant held in the machine base.
- Be capable of two-speed operation for the cutting of ferrous and non-ferrous materials.
- Have gear type drive with adjustable backlash.
- Have switching controls in an easy to reach location.
- Cut by manual operation.

Technical Details
A Cold Saw should have:
- An upper blade guard that completely encloses the blade down to a point that includes the end of the saw arbor.
  - The upper guard must protect the operator from flying metal, swarf and broken saw blade.
  - In the at-rest position, the sides of the lower exposed part of the blade must be guarded from the tips of the teeth inward radially with no gullet exposure.
  - The guard must not inhibit the intended use of the saw.
- A self-adjusting, floating guard that rises and falls and automatically adjusts to the thickness of the workpiece.
- A return device, so that the saw returns to its safe rest position when the saw is released.
- A three-phase, self-braking motor with overload protection: 240V/3/50, 2.2kW minimum capacity.
- Two blade speeds 42/85 r.p.m.
- Blade diameter 300mm. x 2.5mm. x 40mm. bore diameter.
- A minimum cutting capacity at 90° – 85mm. diameter.
- An angle cutting capability at 45° left and right.
- A capacity to perform adjustable angle cuts by 1° increments.
- A cam lock machine vice capable of moving to either side of the saw blade.
Positioning a Cold Saw
A Cold Saw depending on the brand and model weighs approximately 170 Kg.

Most workshop floors should be sufficient to carry the weight of a Cold Saw. The machine may be located on wooden or concrete floors provided they are in sound condition.
- Before moving a Cold Saw onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Cold Saw rests on a suitable foundation.
- On a floor or other support that ensures the plant is stable and secure against movement.
- A Cold Saw must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Cold Saw is bolted to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

It is recommended that a Cold Saw form part of the materials handling infrastructure and, as such, be best positioned in the materials store.
- A Cold Saw is normally positioned close to a wall with an integrated extended bench designed to support long workpieces.

The installation, spacing, services and foothold around a Cold Saw must be such as to ensure:
- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
- Sufficient lighting.

**WARNING**
A Cold Saw is a heavy machine.
DO NOT move the machine by yourself.
Assistance and lifting equipment will be required.
Serious personal injury may occur if safe moving methods are not followed.
Spatial allowances for a Cold Saw

The following graphic indicates the recommended spatial allowances for a Cold Saw and operator.

- Only a single operator may use a Cold Saw.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

METAL CUTTING COLD SAW
Commissioning a Cold Saw

A Cold Saw must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

2. A Cold Saw must be securely fixed to the floor.
   - Under no circumstances must a machine be left to stand unsecured.

3. All nuts, bolts and grub screws must be in place and tight.

4. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.

5. A licensed electrician must install hard-wired equipment.

6. When electrical connection has been made, an authorised person must confirm the direction of saw blade rotation.
   - Switch on and at the same time switch off to view direction.
   - The saw blade must run in a clockwise direction when viewed from the left side of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a cutter head direction test may result in serious operator injury and damage to the machine.

7. The work-piece table must be installed.
   - Note that there must be a rear backstop firmly fitted to prevent snatching of the timber when starting cuts.

8. Lubrication points should be serviced and all moving parts should move freely but with little slop or backlash.


10. Erect a sign indicating the maximum width of cut for the saw.

11. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.

12. Associated housekeeping equipment should be installed in a suitable nearby location.

13. File machine documentation supplied from manufacturer/supplier to ensure ready availability.

14. Warranties must be processed and forwarded to the appropriate parties.

15. The details of the machine must be entered in the school’s record and in the Cold Saw Maintenance Schedule.

16. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Cold Saw safe work procedures

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of a Cold Saw.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when sawing and the position of the hands relative to the work piece.
  - This machine has the capacity to break blades when forced into the workpiece.
  - Attention must be paid to unusual noises and visual indicators of improper operation.
- Ensure the saw blade meets with and is operated according to the manufacturer’s recommendation.
- Blades must be kept sharp.
  - A blunt blade requires more feeding pressure, which can be dangerous.
- Metal must be securely fastened in the work vice
  - When a mitre or angle cut is to be undertaken the machine must be set up with the metal secured in the vice, which is firmly locked in position.
  - Do not cut ‘free hand’.
- Approved Hearing protection must be worn.
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- The removal of off cuts must only occur when the saw blade is in a safe rest position and the saw blade has stopped rotating.
  - It is good practice to use a stick rather than hands to remove off cuts.
- Accidents can occur when operators cross their arms during cutting.
  - For example, they pull a workpiece along the backstop, from right to left, using the left hand instead of correctly pushing it along with the right.
  - Avoid reaching across the saw line.
  - Left-handed operators may require specific training.
- Make sure that the saw is fully retracted by positive pressure with the hand at the end of the cutting cycle.
- When loading moving or unloading workpiece ensure that the hands do not get near the blade.
Cold Saw safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. A Cold Saw must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
     - Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Approved Hearing protection is required.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn.
   - Medic alert identity (if worn) must be taped.
8. Check condition of the blade.
9. Ensure all locks are tightened before operating.
10. Ensure workpiece is securely held in workpiece vice.
11. Do not start the machine with the workpiece against the blade.
12. Allow the machine to develop full speed before sawing.
13. Allow the blade to do the work without forcing the saw.
14. The maximum cut must not be exceeded.
15. Do not reach over the blade for any reason.
16. Return the cutting head completely to the top of the saw after each cut.
   - Release the operator switch.
   - Do not remove hand from the operating handle unless the cutting head completely above the workpiece.
17. Avoid the accumulation of swarf, waste or stock on the machine table or on the floor.
18. Ensure that long and heavy pieces of metal are properly supported.
19. Bring the machine to a complete standstill and Isolate the machine from power before cleaning or making adjustments.
Safety Hazards of a Cold Saw

Point of operation
- Contact with the blade may occur.
  ♦ Lacerations or amputations from rotating blade.

In-running nip points.
- The rotation of the blade means that if something were to be caught then it would be "wound" down on to the blade or guard very quickly.
  ♦ Under no circumstances should an operator bend down near this machine whilst it is operating.
  ♦ The operator must be aware of the position of their hands and fingers in relation to the blade at all times.

Flying debris
- Metal swarf, fines, can be thrown up into the operator’s face by the action of the blade.
  ♦ A workpiece can be ejected from the machine after being caught by the blade.
  ♦ Broken blade can be ejected from the machine.
  ♦ Certain coolants may cause an allergic reaction in people.
Cold Saw maintenance

A documented Cold Saw maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.

- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Cold Saw is not in itself a high maintenance machine.
- Using sharp saw blades contributes significantly to the safe operation of a Cold Saw.
  ♦ Keep blades sharp, properly set and firmly secured so that they will cut freely without having to force the blade against the work piece.
  ♦ Obtain and follow instructions from supplier for correct maintenance on saw blades.

- Routine maintenance, cleaning and lubrication is required to ensure the saw and its safeguards operate properly.
  ♦ The slides, runways, pivots and bearings of a Cold Saw often become clogged with fines, which impedes free running.
  ♦ Ensure the guarding on the lower portion of blade operates correctly and the return device is fully functional.
- Ensure coolant delivery system is checked and adjusted to provide sufficient flow to the point of operation.
  ♦ The coolant delivery system often becomes clogged with fines, which impedes coolant flow.
  ♦ Coolant flow should be sufficient to wash swarf away during the sawing operation.
  ♦ Coolant (suds) must be completely changed at the end of each tem and disposed according to the MSDS.

WARNING
Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.

WARNING
Take care to avoid lacerations when carrying and installing Saw blades.
**Decommissioning a Cold Saw**

A risk assessment using the *Risk Assessment Process Part A* and *Part B* proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Cold Saw the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment such as spanners, Allen keys, workpiece vice etc. to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Remove saw blade to prevent lacerations.
8. Protect any machined surface with a suitable corrosive preventative.
9. Carefully move the Cold Saw so that the machine does not create a hazard.
   - Observe manual handling procedures when moving the machine.
10. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
11. School records and electrical testing databases must be amended.

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**WARNING**

Because of the size and weight of a Cold Saw it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
Cold Saw Glossary

**Backstop**  A fixed fence that enables quick, easy and secure location of the work-piece.

**Bevel**  Any surface that is not at right angles to another surface.

**Chamfer**  The surface produced by planing off the two adjacent surfaces at an angle of $45^\circ$.

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

**Feed rate**  The rate of movement of the tool into the work

**Fence**  An adjustable guiding device fitted to a machine.

**Guard**  A physical barrier that prevents or reduces access to a danger point or area.

**Hazard**  A situation at the workplace capable of potential harm.

**Kickback**  Unexpected movement of the work piece opposite to the direction of feed.

**Lux**  A unit of measurement relating to light.

**Risk**  The probability that the potential harm may become a reality.

**Spindle**  The Spindle is the actual moving part of the machine and is powered from the motor.

**Suds**  A liquid coolant which is used to facilitate machining operations.

**Swarf**  Waste material generated by the machining of metal.

**Three Phase Power**  A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.
Drilling Machine

A Drilling Machine is primarily used in Design & Technology for accurate drilling of holes. Mortising can be carried out on this machine with the aid of various attachments.

A Drilling Machine consists of a base that supports a column that in turn supports a table. Work can be supported on the table with a vice or hold down clamps, or the table can be swivelled out of the way to allow tall work to be supported directly on the base.

The table height can be adjusted with a table lift crank then locked in place with a table lock. The column also supports a head containing a motor.

The motor turns the spindle at a speed controlled by a series of stepped pulleys. The spindle holds a drill chuck to hold cutting tools (twist drills, forstener bits, spade bits, hole saws etc). The quill is moved up and down with a lever or capstan wheel.

WARNING

The main types of injury are caused by:
- Entanglement of hair or clothing in rotating machinery parts.
- The operator attempting to hold the workpiece by hand while drilling. When the drill enters the work, it can catch and twist the workpiece from the operator, which results in an uncontrolled rotating piece of material.
- Chips or swarf may be thrown by the drilling action.
Drilling Machine Guarding

Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

A Drilling Machine must be guarded in the following ways:

- All pulleys and drive belts must be completely shrouded by guarding to prohibit access.
- Where the belts or pulleys are accessed on an operational basis in order to change the drill speed then the guard must be equipped with an electrical interlocking guard, preventing the machine from being operated while the guard is not in place.
- An adjustable drill chuck guard must also be utilised to protect the operator from the rotating chuck.
- The chuck guard should also protect the operator from broken twist drills and swarf, which may be ejected with considerable force from the point of operation.
- When lowered the drill chuck guard should eliminate the possibility of the chuck key (where keyless chucks are not employed) being left in the chuck.

Drilling Machine Guards should:

- Be strong and rigid.
- Be rigid to prevent them touching revolving spindles and chucks.
- Be robust so that accidental knocks will not displace or bend them.
- Constructed so that it is not easily deflected, which would expose moving machine parts.
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
- Be firmly fixed in such a manner that a tool is required to remove.
- Be difficult to by-pass or disable.
- Cause minimum obstruction to the view of the process.
- Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
- Be easy to adjust so that they can be set correctly.
- Be regularly maintained to keep them easy to adjust.
- Not introduce any other risks.
- Cover dangerous moving parts such as motor, belts, gear trains, pulleys and shafts.
Purchasing a Drilling Machine—Floor Mounted Pillar Type

General
A Floor Mounted Type Drilling machine should:
- Meet DECS Standards for Plant and Equipment: Part A
- Have spare parts readily available through a local distributor.
- Be supplied with all tools required for the operation of the machine.
- Be supplied with detailed instruction/parts manual.
- Be of robust construction.
- Be suitable for continuous use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be provided with a risk assessment.

Parameters
A Floor Mounted Type Drilling Machine should:
- Consist of a machine slotted base and round upright pillar.
- Have a table that is slatted to allow the fixing of a drill vice or clamps.
- Be provided with a table holding mechanism that will rotate 360 degrees around the pillar shaft.
- Have a rack and pinion table height adjustment.
- Be provided with a depth stop to limit the drilling depth.
- Have a quick acting belt tensioning release to allow for safe changing of speed.
- Be provided with an easily accessible guard with positive closing and fitted with an electrical interlock.

Technical Details
A Floor Mounted Type Drilling Machine should have:
- A maximum drilling capacity of 32mm.
- An alloy steel ground spindle shaft with a No. 3 Morse taper end.
- A minimum spindle travel of 100mm with adjustable depth gauge.
- An overall height not exceeding 1750mm.
- Rotatable table approximately 300mm x 300mm.
- Minimum column diameter of 60mm.
- Working distance range: spindle to table 0mm to 800mm.
- Minimum throat distance 195mm.
- Chuck 13mm minimum, keyless to suit Morse taper.
- A clear chuck guard.
- No. 1, No. 2 and No.3 Morse taper sleeve.
- Speeds 10 speeds approximately 150 to 3000 r.p.m.
- A 415V/3/50 - 0.75kW minimum electric motor or a 240V/1/50 – 0.75 motor.
Purchasing a Drilling Machine—
13mm Bench Type

General
- A 13mm Bench Type Drilling machine—should:
- Meet DECS Standards for Plant and Equipment: Part A
- Have spare parts readily available through a local distributor.
- Be supplied with all tools required for the operation of the machine.
- Be supplied with detailed instruction/parts manual.
- Be of robust construction.
- Be suitable for continuous use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be provided with a risk assessment.

Parameters
A 13mm Bench Type Drilling Machine should:
- Consist of a machined base and round upright pillar.
- Be provided with a table holding mechanism that will rotate 360 degrees around the pillar shaft.
- Have a table that rotates and is slotted to allow the fixing of a drill vice or clamps to the table.
- Have a rack and pinion table height adjustment.
- Have a quick acting belt tensioning release to allow for safe changing of speed.
- Be provided with a depth stop to limit the drilling depth.
- Be provided with an easily accessible guard with positive closing and fitted with an electrical interlock.

Technical Details
A 13mm Bench Type Drilling Machine should have:
- A table size of 300mm. x 500mm. (approximately).
- A base working surface 300mm. x 250mm. (approximately).
- A throat depth of 200mm (approximately)
- Minimum column diameter of 60mm.
- A minimum spindle travel 120mm.
- Minimum throat distance 195mm.
- Chuck 13mm minimum, keyless to suit Morse taper.
- A clear chuck guard.
- No. 1, No. 2 and No.3 Morse taper sleeve.
- Speeds 4 speeds minimum - approximately 500 to 4000 r.p.m.
- A machine vice – 100 mm minimum.
- A 415V/3/50 - 0.75kW minimum electric motor or a 240V/1/50 – 0.75 motor.
Positioning a Drilling Machine
A Drilling Machine - Floor Mounted Type depending on the brand and model can weigh approximately 150 Kg.
A Drilling Machine – Bench Mounted Type depending on the brand and model can weigh approximately 90 Kg.

Most workshop floors should be sufficient to carry the weight of a Drilling Machine. A Drilling machine may be located on wooden or concrete floors provided they are in sound condition.
- Before moving a Drilling Machine onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure the machine rests on a suitable foundation, for example, on a floor or other support that ensures the plant is stable and secure against movement.
- A Drilling Machine – Bench Type can be installed on a sturdy bench top.
  - Bench mounted plant should be bolted through the bench top.

A Drilling Machine – Floor Mounted type must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Drilling Machine is bolted to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

The installation, spacing, services and foothold around a Drilling Machine must be such as to ensure:
- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
- Sufficient task and general lighting.
Spatial allowances for a Drilling Machine

The following graphic indicates the recommended spatial allowances for a Drilling Machine and operator.

- Only a single operator may use a Drilling Machine.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

![Diagram of Drilling Machine Spatial Allowances]
Commissioning a Drilling Machine

A Drilling Machine must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.
2. A Drilling Machine must be securely fixed to the floor or bench depending on the type of the machine.
   - Under no circumstances must a machine be left to stand unsecured.
3. All nuts, bolts and grub screws must be in place and tight.
4. Belt drives must be checked for pulley alignment, serviceability and correct tensioning.
   - Ensure the belt profiles match the pulley type.
5. Machines employing a rack and pinion type table height adjustment must have an adequate locking mechanism, which allows operators to easily secure the table.
6. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.
7. A licensed electrician must install hard-wired equipment.
8. When electrical connection has been made, an authorised person must confirm the direction of spindle rotation.
   - Switch on and at the same time switch off to view direction.
   - The spindle must run in a clockwise direction when viewed from the front of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a direction test may result in serious operator injury and damage to the machine.
9. Lubrication points should be serviced.
10. Attach Drill Press Safe Operating Procedures.
11. Ancillary equipment such as machine vices, clamps, twist drills, hole saws etc. should be located in close proximity to the machine.
12. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
13. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
14. Warranties must be processed and forwarded to the appropriate parties.
15. The details of the machine must be entered in the school’s record and in the Drilling Machine Maintenance Schedule.
16. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Drilling Machine safe work procedure

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of a Drilling Machine.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when drilling and the position of the hands relative to the work piece.
  - A Drilling Machine has the capacity to grab workpiece if not securely held.
  - Beware of the rotating chuck and cutting tools, which can cause entanglements.
- A Drilling Machine must not be modified to perform tasks beyond its design specification.
  - It must not be used for drum sanding, moulding or milling operations all of which can be undertaken more safely and efficiently with purpose built machinery.
- Ensure the Drilling Machine is operated according to the manufacturer’s recommendation.
- Although the Drill Press is a relatively quiet machine some operations can be noisy necessitating hearing protection.
- A drill chuck guard must be used at all times as a protective measure.
- Chuck key (if used) must be removed immediately after tightening the chuck.
- Never place a taper shank tool, such as large diameter drill or tapered shank reamers in drill chuck.
  - Only straight shank tool such as standard drills can be clamped in chucks.
- Ensure drill speed matches cutting tool diameter.
  - Hard materials and large diameter drills require slower speeds.
- Use a correct ground drill bit for the material being drilled.
  - Sheet metal, acrylic and other brittle plastics can be difficult to drill.
- Workpiece must be securely held with a drill vice or clamped to the table.
  - Jigs and work holding devices must be used when drilling.
- Cutting tools must be regularly checked to ensure their operational suitability.
- Strip material or non-ferrous material should not be drilled unless securely clamped.
- Under no circumstances should an operator bend down near this machine whilst it is operating.
- Ease up on drilling as the drill starts to break through the bottom of the material.
- Properly designed drifts must be used to remove taper drills or chucks from spindle.
Drilling Machine safe operation
1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instructions and supervision are essential.
3. Operators must wear the appropriate Personal Protective Equipment.
4. Eye protection is mandatory.
5. Some operations can be noisy necessitating ear protection.
6. Operators must wear close fitting protective clothing. Ties, shirt sleeves and other loose items of clothing may become entangled in moving machine parts.
7. Sturdy Footwear to be worn at all times in work areas.
8. Long and loose hair must be contained.
9. Rings, watches, jewellery must not be worn. Medic alert identity (if worn) must be taped.
10. Twist drills, forstener bits, spade bits, hole saws or other cutting tools must be sharp and in sound condition.
11. It is vital that the workpiece is securely held.
12. In the case of thin material such as sheet metal a hand vice should be employed.
13. More substantial work pieces may require the use of a drill vice, vee-blocks and clamps or a combination of each.
14. When the drill enters the work, it can catch and twist the workpiece from the operator, which results in an uncontrolled rotating piece of material.
15. Run drill at correct RPM for diameter of twist drill and material.
16. See drill speed chart and move the belt to the correct position for that speed.
17. Do not drill with excessive pressure.
18. Ease up on drilling as the drill starts to break through the bottom of the material.
19. If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
20. Long workpieces must be supported by appropriate supports and must not obstruct passageways or create a trip hazard.
21. Barricades must be erected should the work piece extend beyond the work area.
22. Let the spindle stop of it’s own accord after turning the power off.
23. Never try to stop the spindle with your hands.
24. Do not leave machine running unattended.
25. Use a brush to remove swarf and never by hand or with a rag.
26. Completely stop the machine before removing swarf from a choked twist drill.
**Safety hazards of Drilling Machines**

**Point of operation**
- One of the most common causes of accidents that occur on a Drilling Machine is poor operator judgment such as the operator attempting to hold the workpiece by hand while drilling.
  - When the drill enters the work, it can catch and twist the workpiece from the operator, which results in an uncontrolled rotating piece of material.
- Other point-of-operation hazards include the rotating drill and hot chip generation when drilling metal.

**In-running nip points.**
- Clothing, hair or hands may be caught by and pulled into unprotected chucks and spindles.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
  - The operator must be aware of the position of their hands and fingers in relation to the chuck at all times.

**Flying chips and material**
- Chips and swarf can be thrown up into the operator’s face by the cutting action of the cutting toll resulting in eye injuries.
  - Certain types of dust may cause allergic reactions.
**Drilling Machine maintenance**

A documented *Drilling Machine maintenance schedule* must be developed for should be allocated specifically for maintenance purposes.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Drilling Machine is a low maintenance machine.

- Routine maintenance, cleaning and lubrication is required to ensure a Drilling Machine and its safeguards operate properly.
  - The rack and pinion of the able raising mechanism often become dusty, which impedes free running.
  - Ensure the drive belt guarding operates correctly.
  - Ensure drill chuck guard is in place and operates effectively.
  - The chuck guard may need to be replaced if operator’s view is restricted due a scratched screen.
- Ensure table lock and table safety collar are in sound condition.

**WARNING**

Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.
Decommissioning a Drilling Machine

A risk assessment using the Risk Assessment Process *Part A* and *Part B* proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Drill Press the following processes must be completed:

12. The machine must be tagged barring use.
13. A licensed electrician must disconnect hard-wired equipment.
14. Tape the mains cable/plug to the machine.
15. The machine should be in a clean condition.
16. Secure any ancillary equipment such as chuck key (if used) to the machine.
17. Any fixings securing the equipment to its bed should be removed.
18. Any belt drives should be freed from tension.
19. Protect any machined surface with a suitable corrosive preventative.
20. Carefully move Floor Mounted Type Drilling Machine so that it lies lengthwise along the ground.
   - Observe manual handling procedures and ensure the machine neither does nor create a trip hazard.
   - To facilitate handling a Drilling Machine may be dismantled by a competent person.
21. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
22. School records and electrical testing databases must be amended.

**WARNING**

Because of the size and weight of a Drilling Machine it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
# Drilling Machine glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbor</td>
<td>A spindle or shaft for holding cutting tools.</td>
</tr>
<tr>
<td>Belt Profile</td>
<td>The shape of the cross-section of a power transmission belt. Common examples are 'v', multi- 'v', flat and round belts. The belt profile must suit the pulley type.</td>
</tr>
<tr>
<td>Drill chuck</td>
<td>A device used to grip parallel shank drills and attach them to a rotating spindle.</td>
</tr>
<tr>
<td>Danger zone</td>
<td>Any zone within or around machinery in which any person is subject to a risk to health or safety.</td>
</tr>
<tr>
<td>Drift</td>
<td>Tapered tool made of hardened steel used to eject taper shank drills from quill.</td>
</tr>
<tr>
<td>Flute</td>
<td>A straight or helical groove machined into a cutting tool to provide cutting edges and clearance for chips of metal to escape.</td>
</tr>
<tr>
<td>Guard</td>
<td>A physical barrier that prevents or reduces access to a danger point or area.</td>
</tr>
<tr>
<td>Hard Wired</td>
<td>A method of electrical connection, which is permanent as against the normal plug and socket method of supplying electrical power. Hard-wired equipment must be connected and disconnected by a licensed electrician.</td>
</tr>
<tr>
<td>Hazard</td>
<td>A situation at the workplace capable of potential harm.</td>
</tr>
<tr>
<td>Jig</td>
<td>A device for holding a workpiece.</td>
</tr>
<tr>
<td>Lux</td>
<td>A unit of measurement relating to light.</td>
</tr>
<tr>
<td>Lock</td>
<td>A keyed padlock, which will secure a control device in the &quot;off&quot; position and prevent it from being reactivated. Combination locks or locks using magnetic keys or bars are not acceptable.</td>
</tr>
<tr>
<td>Morse taper</td>
<td>A self-holding standard taper largely used on small cutting tools such as drills, end mills, and reamers, and, on some machines, spindles in which these tools are used.</td>
</tr>
<tr>
<td>Quill</td>
<td>Rotating part of a drill, which holds the chuck.</td>
</tr>
<tr>
<td>Risk</td>
<td>The probability that the potential harm may become a reality.</td>
</tr>
<tr>
<td>Shank</td>
<td>The part by which a cutting tool is held.</td>
</tr>
<tr>
<td>Safety collar</td>
<td>Prevents the table from accidentally sliding down the column when the table-locking lever is released.</td>
</tr>
<tr>
<td>Taper</td>
<td>A wedge shape increasing uniformly in width, or diameter, along its length.</td>
</tr>
<tr>
<td>Three Phase Power</td>
<td>A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.</td>
</tr>
<tr>
<td>Twist drill</td>
<td>A commonly used parallel shank metal-cutting drill, usually made with two flutes running around the body.</td>
</tr>
</tbody>
</table>
Grinding Machines

Bench Grinder
A Bench Grinder is commonly used in Design & Technology for light general purpose grinding operations and tool sharpening.

Pedestal Grinder
A Pedestal Grinder is primarily used in Design & Technology for heavy general purpose grinding operations.

Grinding is the process of removing material by the cutting action of the countless hard and sharp abrasive particles of a revolving grinding wheel as they come in contact with the surface to be ground.

The grinding wheels are held between two flanged disks. Usually a roughing or coarse-grained wheel is mounted on one end of the spindle and a fine wheel on the other. A tool rest is provided for each wheel so that the work piece may be held or steadied while being ground.

The operator is protected against flying abrasive particles and ground material by the wheel guards and spark arrestors, which are integral parts of a machine. Safety glass shields are also provided for additional protection.

WARNING

The main types of injury are caused by:
- Entanglement of hair or clothing in rotating machinery parts.
- Fingers being caught between grinder wheel and work rest.
- Sparks or worn abrasive may be thrown by the grinding action.
- Body parts coming into contact with abrasive wheel.
- Ejected material or disintegrated abrasive wheel.
- Hot metal.
Grinder guarding
Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

Grinding machines must have guarding, which encloses dangerous moving parts by means of fixed guards.
- The angular exposure of the grinding wheel periphery and sides for guard must not exceed one quarter of the periphery.
- The exposure must start at a point not be more than 65° above the horizontal plane of the wheel.
- The guards must cover the spindle ends, nuts and flange projections.
- The guards must be mounted to ensure proper alignment with the wheel.
- The guards must be of sufficient mechanical strength to prevent part of the wheel being thrown out in the event of a wheel breakage.
- The spark arrestors must be maintained at a distance of no greater than 6mm from the grinding wheel face.
- A transparent eye screen, which is sufficiently large to discourage operators from looking round it, must be fitted on a grinder used for hand held work.
- A work rest maintained in good condition and adjusted as close as possible to the wheel with a maximum clearance of 1.5mm.
- Additional protection, in the form of an enclosure, which isolates the remaining work area from other personnel, may be necessary depending on the positioning of the machine.

AS 1485 –1983 SAFETY AND HEALTH IN WORKROOMS OF EDUCATIONAL ESTABLISHMENTS
7.5.5 Pedestal or Bench-type Grinding Machine. The following specific provisions apply to pedestal or bench-type grinding machines:

(a) A fixed guard should cover the major part of the wheel, with additional adjustable guarding to leave exposed only the portion of the wheel in use. To compensate for the reduced diameter of the wheel an adjustable tongue shall be fitted so that a minimum gap between the wheel and the guard can be maintained.

Acknowledgement:
Standards Australia
Purchasing a Bench Grinder

General
A Bench Grinder should:

• Meet DECS Standards for Plant and Equipment: Part A.
• Have spare parts readily available through a local distributor.
• Be supplied with all tools required for the operation of the machine.
• Be supplied with detailed instruction/parts manual.
• Be of robust construction.
• Be suitable for continuous use, similar to that found in industry.
• Not exceed noise levels of $L_{Aeq}^{8h}$ of 85 dB(A).
• Meet the provisions of the OHS&W Act and OHS&W Regulations 1995 Part 3.
• Be provided with a risk assessment.

Parameters
A Bench Grinder should:

• Be mounted on a robust pedestal.
• Have a double-ended spindle.
• Have a stand sufficiently rigid for the grinder to be vibration free and stable when used.
• Be supplied with wheel guards with exhaust outlets to the rear of the machine, adjustable spark arrestors, tool rests, 150 x 100 mm clear eye shields (tempered glass or polycarbonate) and detachable cup of non-corrosive, robust construction.
• Accommodate a range of work-rest angles leaving no gap between the rest and the wheel.

Technical Details
A Bench Grinder should have:

• A minimum spindle diameter 19mm.
• Two wheels: 200mm diameter. X 25.4mm x 19mm, one medium, and one fine.
• Adjustable tool rests minimum 6mm thick.
• Preloaded bearings to prevent end float.
• Either a 3-phase motor: 415V/3/50, 0.75 kW, speed approximately 2800 r.p.m. Or a single-phase motor: 240V/1/50, 0.75kW, and speed approximately 2800 r.p.m.
Purchasing a Pedestal Grinder

General
A Pedestal Grinder should:
• Meet DECS Standards for Plant and Equipment: Part A.
• Have spare parts readily available through a local distributor.
• Be supplied with all tools required for the operation of the machine.
• Be supplied with detailed instruction/parts manual.
• Be of robust construction.
• Be suitable for continuous use, similar to that found in industry.
• Not exceed noise levels of $L_{Aeq 8h}$ of 85 dB(A).
• Meet the provisions of the OHS&W Act and OHS&W Regulations 1995 Part 3.
• Be supplied with a risk assessment.

Parameters
A Pedestal Grinder should:
• Be mounted on a robust pedestal.
• Have a double-ended spindle.
• Have a stand sufficiently rigid for the grinder to be vibration free and stable when used.
• Be supplied with wheel guards with exhaust outlets to the rear of the machine, adjustable spark arrestors, tool rests, 150 x 100 mm clear eye shields (tempered glass or polycarbonate) and detachable cup of non-corrosive, robust construction.
• Accommodate a range of work-rest angles leaving no gap between the rest and the wheel.

Technical Details
A Pedestal Grinder should have:
• A minimum spindle diameter 25mm.
• Two wheels: 250mm diameter. X 40mm x 31.75mm, one medium, and one fine.
• Adjustable tool rests minimum 6mm thick.
• Preloaded bearings to prevent end float.
• A motor 415V/3/50, 1.1 kW, speed approximately 2800 r.p.m.
Positioning a Grinding Machine

A Bench grinder can weigh approximately 35 Kg excluding pedestal. A Pedestal grinder can weigh approximately 200 Kg.

Most workshop floors should be sufficient to carry the weight of a Grinding Machine. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Grinding Machine onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Grinding Machine rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Grinding Machine must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Grinding Machine is fixed to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

Extraction plant may be used with Grinding Machines and this may well affect the options when siting these machines.

The installation, spacing, services and foothold around grinding machines must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- Grinding sparks will not damage glazed surfaces or cause a fire hazard.
- All operators are afforded a good view of the point of operation of the equipment.
- A low stand should be considered to suit the operational requirements of the shorter student.
Spatial allowances for Grinding Machines

The following graphic indicates the recommended spatial allowances for a Grinding Machine and operator.

- Only a single operator may use a Grinding Machine.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.
**Commissioning a Grinding Machine**

Grinding machines must not be used until the following checks have been completed according to the manufacturers’ recommendation and necessary adjustments have been made.

1. A Grinder must be securely fixed to its bed.
   - Under no circumstances must a Grinder be left to stand unsecured.
2. All nuts, bolts and grub screws must be in place and tight.
3. The machine must be in a clean condition.
4. All guards must be in place and securely fixed as per manufacturer’s instructions for the specific guard.
5. Connect extraction plant, where this is available, to a Grinder before the machine becomes operational.
6. A licensed electrician must install hard-wired equipment.
7. Switchgear must be tested for correct operation.
8. Ensure all moving parts move freely.
   - Grinding Wheels should be inspected for defects using visual check and resonance test before mounting to spindles.
   - Check maximum speed rating of the wheel against machine speed.
   - Ensure the hole in the grinding wheel fits closely on the spindle.
   - Flanges should be of equal diameter, at least one-third diameter of the grinding wheel and relieved around the holes.
   - Unless flanges and washers are evenly seated on either side of the wheel before the locking nut is tightened, the wheel can crack and shatter.
   - Avoid over-tightening the locking nut, as this can exert hazardous forces on the wheel.
10. Ensure work rests are adjusted at centre height and to within 1.5 mm. of wheel face.
11. Rotate the wheels by hand to check the balance before switching on the power.
12. Test the machine by running the wheels for at least a minute to ensure proper operation.
   - The wheel must run true and not vibrate.
   - Vibration can be caused by incorrect wheel balance.
13. Attach Pedestal Grinder or Bench Grinder Safety Operating Procedures.
14. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
15. Ancillary equipment should be stored in close proximity.
16. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
17. Warranties must be processed and forwarded to the appropriate parties.
18. The details of the machine must be entered in the school’s record and in the Pedestal Grinder maintenance schedule or Bench Grinder maintenance schedule.
19. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Grinding Machine safe work procedure

Complementary equipment and the application of appropriate work practices and procedures are fundamental to the safe operation of the grinding machines.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when grinding and the position of the hands relative to the work piece.
  - Hands may be trapped between workpiece support and abrasive wheel.
  - This machine has the capacity to grab workpiece.
  - Beware of the rotating abrasive wheels, which can cause entanglement and abrasions.
- Ensure the abrasive wheels meet with and are operated according to the manufacturer’s recommendation
  - The wheel must not be operated at a speed in excess of the safe working speed recommended by the manufacturer.
- Never use a wheel that has been dropped or received a heavy blow, even if there is no apparent damage.
- The grinding wheels must be properly mounted.
- Before using a new wheel, let it run a few seconds at full speed to make sure it is balanced.
- Periodically check grinder wheels for soundness.
  - Suspend the wheel on a string and tap it. If the wheel rings, it is probably sound.
- Ensure that no combustible or flammable materials are nearby that sparks from the grinder wheel can ignite.
- Ensure that a guard covers at least 270° of the grinding wheel.
- Maintain the upper spark arrestor not more than 6mm above the grinding wheel for bench or pedestal grinders.
- Maintain the work rest at 1.5mm from wheel.
- The face of the wheel should dressed and maintained in good condition
  - The wheel dresser should be equipped with a guard over the top of the cutters to protect the operator from flying particles.
- Approved hearing protection must be worn.
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- The removal of waste must only occur when the machine is in a safe rest position and the wheels have stopped rotating.
- Ensure that any body parts do not get near the abrasive wheels.
- Allow the grinder to develop full operating speed before commencing the grinding operation.
- Do not stand directly in front of a grinding wheel when it is first started.
- Do not use a wheel that vibrates.
**Grinding Machine safe operation**

Only operators who have been authorized as properly trained and competent are allowed to operate machines.

1. Adequate instruction and supervision are essential.
2. The pedestal grinder must not be used to perform tasks beyond its design specification.
3. **One person only must operate** this machine at any time.
4. Ensure **workspace is clear** before operating machine.
   - Foreign materials may cause **poor footing**.
5. Operators must wear the appropriate **Personal Protective Equipment**.
   - **Eye protection** is mandatory.
   - Operators must wear **close fitting protective clothing**.
     - Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - **Dust mask** must be worn in an extremely contaminated or dusty environment.
   - **Hearing protection** is required.
   - **Sturdy Footwear** to be worn at all times in work areas.
6. **Long** and **loose hair** must be **contained**.
7. **Rings**, **watches**, **jewellery** must **not** be worn.
   - Medic alert identity (if worn) must be taped.
8. Use **proper** type of grinding wheel for the material being processed.
   - Do not grind non-ferrous materials.
9. The **work rest** must be set at **1.5mm** away from the abrasive wheel.
10. Ensure **wheels** are in a **serviceable** condition before use.
11. Allow the machine to **develop full speed** before grinding.
12. **Never force** the workpiece against a **cold wheel**.
13. **Slowly** move workpiece **across the face of wheel** in a uniform manner.
   - This will keep the wheel sound.
14. Grinding on the **side** of the wheel **must not occur** unless a suitable wheel designed for this purpose is fitted.
15. **Do not allow the machine to run unattended**.
16. The workpiece must **never be held** with a cloth, apron or any form of pliers.
   - If necessary a hand vice or similar lock grip can be used
17. Bring the machine to a **complete standstill** and **Isolate** the machine from power **before cleaning** or making **adjustments**.
18. Coolant **spilt** on the floor should be **immediately** absorbed and absorbent material suitably disposed.
Safety hazards of Grinding Machines

Point of operation
- Contact with the grinding wheel may occur during operation.
- Operator’s fingers may be trapped between work stop and abrasive wheel.
- Burns and burrs from the workpiece as a result of the grinding process.
  - The operator must be aware of the position of their hands and fingers in relation to the grinding wheels at all times.

Kickbacks.
- Operators must be aware of the potential of being hit by pieces of the machine or workpiece being flung off.
  - A workpiece can be ejected from the machine after being caught by the grinding wheels.

In-running nip points.
- Clothing, hair or hands may be caught by and pulled into the wheels.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
  - The operator must be aware of the position of their hands and fingers in relation to the grinding wheels at all times.

Flying particles and material
- Flying particles can be thrown up into the operator’s face by the action of the abrasive wheels leading to eye injuries.
  - Grinders generate significant quantities of airborne particulates and grinding residue, which may create health problems.
  - Adequate extraction is necessary and appropriate PPE may be needed for some operations.
Grinding Machine maintenance

A documented Pedestal Grinder maintenance schedule or Bench Grinder maintenance schedule must be developed and time should be allocated specifically for this purpose.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

Grinders are relatively low maintenance machines.

- The tool rest needs to be regularly checked and maintained at maximum distance of 1.5 mm. from the work face of the wheel.
- The grinding wheel face must be regularly dressed and maintained in good condition.
- Discard abrasive wheels:
  - When the diameter of the grinding wheel approaches that of the driving flanges.
  - When the work rest can no longer be correctly adjusted to the wheel diameter.
  - When the grinding wheel no longer cuts efficiently because of reduced peripheral speed.

Dressing a grinding wheel

Dressing is the process of restoring the sharpness of the grinding wheel by breaking away the dulled abrasive crystals or by removing the glazed or loaded surface of the wheel. This procedure provides new sharp cutting edges of the abrasive grains.

- Adjust the work rest away from the wheel so that the dresser is supported on the work rest and the heel of the dresser is hooked over the work rest.
- The point of contact should be slightly above the centre, and with the handle tilted upward at an angle.
- Slowly press the dresser against the face of the revolving wheel until it ‘bites’.
- Move the dresser back and forth to obtain a straight surface, and at the same time, hold the dresser rigidly enough on the work rest to maintain trueness while dressing.
- Once completed adjust the work rest to 1.5 mm. from the work face of the wheel.
Mounting a grinding wheel

- Wheels must be closely inspected prior to mounting and 'rung' to ensure that they are not damaged.
- The spindle speed of the machine must be checked to ensure that it does not exceed the maximum operating speed marked on the wheel.
- The grinder spindle has a right-hand thread on the right end and a left-hand thread on the other as a safeguard against the wheel loosening. Each wheel is mounted directly on the spindle and is held between a pair of flanged collars by either the right- or left-hand spindle nut.
- Great care must be used when mounting wheels so that no undue strains are set up, which might cause the wheel to break.
- Grinding wheels must fit freely on the spindle. Clearance between the wheel hole and the machine spindle is necessary to prevent excessive pressure arising from mounting pressure and spindle expansion. A wheel that fits tightly should never be forced on the spindle. Instead, the bushed hole should be scraped to make it fit freely.
- Bushing, where used, must not interfere with seating of the flanges nor affect the balance of the wheel.
- Blotters of soft compressible material covering the entire contact area of the flanges are always placed between the side of the wheel and the flanged collars. This lessens the danger of setting up strains in the wheel, causing it to crack.
- The clamping nut should be drawn only tight enough against the flanged collar to prevent the wheel from turning on the spindle.
- Flanges must be maintained in good condition. Where the bearing surface has been warped or damaged they must be replaced.
- After mounting, the wheel must be checked for trueness and balance.
- When starting the grinder with a newly mounted wheel for the first time, always stand to the side of the wheel and allow it to run for one minute before starting to grind.
- This will guard against any injury in the event the wheel is faulty and should break apart.
Decommissioning a Grinding Machine

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Grinding Machine the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the grinder.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment to the Grinder.
6. Any fixings securing the equipment to its bed should be removed.
7. If the machine is on a pedestal carefully move the machine so that it lies lengthwise along the ground.
   - Observe correct manual handling procedures and ensure the machine neither does nor create a trip hazard.
   - A competent person to facilitate convenient handling may dismantle the Grinder from the pedestal.
8. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
9. School records and electrical testing databases must be amended.

WARNING

Because of the size and weight of a Grinding Machine it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
Grinding Machine glossary

Arbor
A spindle or shaft for holding cutting tools.

Blotters
Soft compressible material, which is always placed between the side of the grinding wheel and the flanges. Blotters must cover the entire contact area of wheel flanges. This reduces the danger of setting up strains in the wheel, causing it to crack.

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

“dB(A)”
means decibels of A-weighted sound pressure level. ‘A weighted’ means the measuring instrument has been adjusted to mimic the hearing characteristics of the human ear.

Direct-on-line-starter
Starter that connects the line voltage across the motor terminals in one step.

Dressing
Dressing is the process of restoring the sharpness of the grinding wheel by breaking away the dulled abrasive crystals or by removing the glazed or loaded surface of the wheel, thus presenting new sharp cutting edges of the abrasive grains.

Flanges
Collars, discs or plates between which grinding wheels are mounted.

Grinding
Grinding is the process of removing material by the cutting action of the countless hard and sharp abrasive particles of a revolving grinding wheel as they come in contact with the surface to be ground.

Grinding Face
The surface of the grinding wheel upon which grinding is carried out.

Grinding Wheel
A revolving cutting tool made up of abrasive particles that are held together by a glue-like material called the bond. Almost all grinding wheels made for pedestal grinders are made with artificial abrasives, namely silicon carbide and aluminium oxide.

Guard
An enclosure designed to retain the pieces of the abrasive wheel should it be broken during operation.

Hard Wired
A method of electrical connection, which is permanent as against the normal plug and socket method of supplying electrical power. Hard-wired equipment must be connected and disconnected by a licensed electrician.

Hazard
A situation at the workplace capable of potential harm.

Loading
A condition caused by grinding the wrong material with a grinding wheel or using too heavy a grinding action.

Lock
A keyed padlock, which will secure a control device in the "off" position and prevent it from being reactivated. Combination locks or locks using magnetic keys or bars are not acceptable.

Lux
A unit of illuminance.

Reducing Bush
Inserts used to reduce the size of the hole in a grinding wheel so that it can be correctly mounted on a smaller diameter spindle.

Ringing
A procedure for determining the soundness of a grinding wheel. The wheel is suspended on one finger or with a piece of string. A sound wheel, when tapped gently with a light non-metallic instrument, such as the handle of a screwdriver, will ring.

Risk
The probability that the potential harm may become a reality.

Spindle
A rotating device widely used in machine tools, such as lathes, milling machines, drill presses, and so forth, to hold the cutting tools or the work, and to give them their rotation.

Spark Arrestor
A thin, coated metal strip secured to the inside top of the wheel guard to deflect abrasive from the operator. Spark arrestors must be regularly adjusted to maintain efficiency.

Starter
Combination of all the switching means necessary to start and stop a motor in combination with suitable overload protection.

Three Phase Power
A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.

Truing
Truing is restoring the wheel's concentricity or reforming its cutting face to a desired shape by means of a wheel dresser.
Mill Drill

A Mill Drill is used in Design and Technology for precise removal of machineable metals and non-metals such as wood and plastic by feeding it into a rotating cutting tool.

A Mill Drill is similar to a robust drill press in which the axis of the spindle is vertical. The spindle is the main rotating shaft in which cutting tools are mounted. The machine is supplemented by a worktable, which can be moved side-to-side and front-to-back very accurately.

In operation, the workpiece is securely clamped to the worktable or is held in a machine vice which in turn is clamped to the worktable. A cutting tool rotates much like a twist drill, and the work is advanced past the cutting tool by means of the hand wheels that move the table. As cutting progresses, the head can be lowered in precise increments until the desired depth of cut is achieved.

By making a series of horizontal cuts across the surface of a workpiece, the end mill removes layers of material at a depth than can be accurately controlled to about one one-hundredth of a millimetre.

The most common cutting tool used with a Mill Drill is an end-mill. This looks like a stubby twist drill with a flattened end instead of a point. An end mill can cut into a workpiece either vertically, like a drill, or horizontally using the side of the end mill to do the cutting. This horizontal cutting operation imposes heavy lateral forces on the tool and the mill, so both must be rigidly constructed.

WARNING

- Severe lacerations may occur if the operator’s hands and fingers come into contact with cutters.
- Eye injuries can occur due to flying metal chips.
- Entanglement of hair and clothing may occur if contact is made with the revolving cutters power feed.

Warco ZX-16 MILL DRILL
Acknowledgement: http://www.warco.co.uk/
Mill Drill Guarding

Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

A Mill Drill must be guarded in these ways:

1. All pulleys, spindles and drive belts must be completely shrouded by guarding.
   - Where the belts or pulleys are accessed on an operational basis in order to change the speed then the guard must be equipped with an electrical interlocking guard, preventing the machine from being operated while the guard is not in place.

2. An adjustable chuck guard must be utilised to protect the operator from the rotating chuck.
   - The chuck guard should also protect the operator from broken milling cutters and swarf, which may be ejected with considerable force from the point of operation.

3. A workpiece vice that is high enough to support the workpiece must be provided so that it can be moved either side of the cutting line.

4. Have a run down time of 10 seconds or less.

5. Emergency Stop device/s in addition to the ON/OF Direct On Line (DOL) starter must be fitted to a Mill Drill
   - The Emergency Stop device/s must be immediately accessible to the operator when using the machine.

Mill Drill Guards should:

- Be strong and rigid to prevent them touching revolving spindles and chucks.
- Be robust so those accidental knocks will not displace or bend them.
- Constructed so that it is not easily deflected, which would expose moving machine parts.
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
- Be difficult to by-pass or disable.
- Cause minimum obstruction to the view of the process.
- Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
- Be easy to adjust so that they can be set correctly.
- Be regularly maintained to keep them easy to adjust.
- Not introduce any other risks.
- Cover dangerous moving parts such as motor, belts, gear trains, pulleys and shafts.
Purchasing a Mill Drill

General
A Mill Drill should:

- Meet DECS Standards for Plant and Equipment Part A.
- Have spare parts available through a local distributor.
- Be supplied with detailed instruction/parts manual and all tools required for the operation of the machine.
- Be of robust construction and suitable for heavy-duty use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Mill Drill should:

- Have a stand including coolant tray sufficiently rigid for the Mill Drill to be vibration free and stable when used.
- Have a fully integrated automatic coolant system.
- Be capable of multi-speed operation for the cutting of ferrous and non-ferrous materials.
- A run down time of 10 seconds or less.
- Have gear type drive with adjustable backlash.
- Have switching controls in an easy to reach location.
- Cut by manual operation.

Technical Details
A Mill Drill should have:

- Milling head located to column by ground key-way with adjustment to ensure consistent accuracy and alignment throughout the vertical travel.
- Drilling capacity 25mm.
- Column diameter of 78mm.
- Max. Distance spindle to table - 350mm approximately.
- Spindle speeds (6) - 110/160/310/510/880/1600 r.p.m. Approximately.
- Spindle stroke - 45mm. approximately.
- Spindle taper - 2 Morse.
- Quill diameter of 65mm.
- Head swivel - 360°.
- Head tilt left & right calibrate - 45° 0° 45°.
- Throat depth – 175 mm. approximately.
- Longitudinal travel - 635mm. approximately.
- Cross travel - 165mm. approximately.
- Table size - 590 x 160mm approximately with 3 tee slots.
- Max overall height - 1010mm approximately.
- Max overall width - 890mm approximately.
- A 75mm swivel milling vice.
Positioning a Mill Drill
A Mill Drill depending on the brand and model weighs approximately 150 Kg.

Most workshop floors should be sufficient to carry the weight of a Mill Drill and stand. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Mill Drill onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Mill Drill rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Mill Drill must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors, or coach screws for wooden floors.
- Where a Mill Drill is bolted to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

The installation, spacing, services and foothold around a Mill Drill must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
Spatial allowances for a Mill Drill

The following graphic indicates the recommended spatial allowances for a Mill Drill and operator.

- Only a single operator may use a Mill Drill.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

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Guidelines for the Safe Use of Machinery
Commissioning a Mill Drill
A Mill Drill must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

2. A Mill Drill must be securely fixed to the floor.
   - Under no circumstances must a machine be left to stand unsecured.

3. All nuts, bolts and grub screws must be in place and tight.
4. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.
5. Ensure there is adequate local and general lighting available.
6. A licensed electrician must install hard-wired equipment.
7. When electrical connection has been made, an authorised person must confirm the direction of the spindle rotation.
   - Switch on and at the same time switch off to view direction.
   - The spindle must run in a clockwise direction when viewed from the front of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a spindle direction test may result in serious operator injury and damage to the machine.
8. Lubrication points should be serviced and all moving parts should move freely but with little slop or backlash.
10. Mark in the machine operator zone.
11. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
12. Associated housekeeping equipment should be installed in a suitable nearby location.
13. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
14. Warranties must be processed and forwarded to the appropriate parties.
15. The details of the machine must be entered in the school’s record and in the Mill Drill Maintenance Schedule.
16. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Mill Drill safe work procedures

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of a Mill Drill.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when milling and the position of the hands relative to the work piece.
  - This machine has the capacity to break cutters when forced into the workpiece.
  - Attention must be paid to unusual noises and visual indicators of improper operation.
- Ensure the machine is operated according to the manufacturer’s recommendation.
- Cutters must be kept sharp.
  - A blunt cutter requires more feeding pressure, which can be dangerous.
- Workpiece must be securely fastened to the table by means of a milling vice, angle plate or clamping kit.
  - Do not cut ‘free hand’.
- It is usually regarded as standard practice to feed the workpiece against the milling cutter.
- Approved hearing protection must be worn
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- The removal of swarf must only occur when the cutter is in a safe rest position and the cutter has stopped rotating.
  - It is good practice to use a stick rather than hands to remove off cuts.
  - Never use rag or hands to remove swarf.
- When loading, moving or unloading workpiece ensure that hands do not get near the cutter.
- Remove milling cutters from machine when not in use.
- Gloves must not be worn when operating the machine.
- Use recommended cutting oil.
  - In general, a simple coolant is all that is required for roughing.
  - Finishing requires cutting oil with good lubricating properties to help produce a good finish on the workpiece.
  - Plastics and cast iron are almost always machined dry.
  - Refer to MSDS when handling lubricants and coolants.
Mill Drill safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. A Mill Drill must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
   - Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Hearing protection is required.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn.
   - Medic alert identity (if worn) must be taped.
8. Ensure milling cutter is appropriate for the material and task.
   - Check condition of the milling cutter.
9. Ensure all locks are tightened before operating.
10. Ensure workpiece is securely held to the table.
    - Observe correct clamping procedures.
    - Set up every job as close to the milling machine spindle as circumstances will permit.
11. Ensure guarding is in place.
12. Set the correct speed to suit the cutter diameter, the depth of cut and the material.
    - The maximum cut must not be exceeded.
13. Do not start the machine with the workpiece against the cutter.
14. Allow the machine to develop full speed before milling.
15. Allow the cutter to do the work without forcing the cutter.
16. Do not reach over the cutter for any reason.
17. Do not leave the machine running unattended.
18. Avoid the accumulation of swarf, waste or stock on the machine table or on the floor.
19. Ensure that long and heavy pieces of material are properly supported.
20. Bring the machine to a complete standstill and isolate the machine from power before cleaning or making adjustments.
Safety Hazards of a Mill Drill

Point of operation
- Contact with the cutter may occur.
  - Lacerations or amputations from rotating cutter
  - Lacerations from a stationery cutter during maintenance or cleaning operations.

In-running nip points.
- The rotation of the cutter or chuck means that if something were to be caught then it would be "wound" down on to the cutter very quickly.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
  - The operator must be aware of the position of their hands and fingers in relation to the chuck and cutter at all times.

Flying debris
- Swarf, fines, etc. can be thrown up into the operator’s face by the action of the rotating cutter.
  - A workpiece can be ejected from the machine after being caught by the cutter.
  - Broken cutter can be ejected from the machine.
  - Certain coolants may cause an allergic reaction in people.
  - Guarding must be in place.
  - PPE must be worn.
**Mill Drill maintenance**

A documented Mill Drill maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.

- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Mill Drill is not in itself a high maintenance machine.

- Using sharp milling cutters contributes significantly to the safe operation of a Mill Drill.
  - Keep cutters sharp, properly set and firmly secured so that they will cut freely without having to force the cutter against the work piece.
  - Obtain and follow instructions from supplier for correct maintenance on milling cutters.

- Routine maintenance, cleaning and lubrication is required to ensure the Mill Drill and its safeguards operate properly.
  - The slides, runways, pivots and bearings of a Mill Drill often become clogged with fines, which impedes free running.
  - Ensure the guarding operates correctly and the return device is fully functional.
- Ensure coolant delivery system (if fitted) is checked and adjusted to provide sufficient flow to the point of operation.
  - The coolant delivery system often becomes clogged with fines, which impedes coolant flow.
  - Coolant flow should be sufficient to wash swarf away during the sawing operation.
  - Coolant (suds) must be completely changed at the end of each term and disposed according to the MSDS.
Decommissioning a Mill Drill

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Mill Drill the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment such as spanners, Allen keys, workpiece vice etc. to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Remove milling cutters to prevent lacerations.
8. Protect any machined surface with a suitable corrosive preventative.
9. Carefully move the Mill Drill so that the machine does not create a hazard.
   - Observe manual handling procedures when moving the machine.
10. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
11. School records and electrical testing databases must be amended.

WARNING

Because of the size and weight of a Mill Drill it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
Mill Drill glossary

Angle plate  Precision holding device made of cast iron or steel. The two principal faces are at right angles and may be slotted for holding the work or clamping to a table.

Arbor  A shaft or spindle for holding cutting tools most usually on a milling machine.

Backlash  The lost motion or looseness (play) between the faces of meshing gears or threads.

Bed  One of the principal parts of a machine tool, having accurately machined ways or bearing surfaces for supporting and aligning other parts of the machine.

Bevel  Any surface that is not at right angles to another surface.

Burr  The sharp edge left on metal after cutting.

Chamfer  The surface produced by planing off the two adjacent surfaces at an angle of 45°.

Chuck  A device on a machine tool to hold the workpiece or a cutting tool.

Collet  A precision work holding chuck which centres finished round stock automatically when tightened.

Coolant  A common term given to the numerous cutting fluids or compounds used with cutting tools to increase the tool life and to improve surface finish on the material.

Cutting fluid  A liquid used to cool and lubricate the cutting to improve the work surface finish.

Cutting tool  A hardened piece of metal (tool steel) or High Speed Steel that is machined and ground so that it has the shape and cutting edges appropriate for the operation for which it is to be used.

Feed rate  The rate of movement of the tool into the work.

Fence  An adjustable guiding device fitted to a machine.

Gib  A tapered strip of metal placed between the bearing surface of two machine parts to ensure a precision fit and provide an adjustment for wear.

Guard  A physical barrier that prevents or reduces access to a danger point or area.

Jacobs chuck  Common term for the drill chuck used in either the headstock spindle or in the tailstock for holding straight-shank drills, taps, reamers, or small diameter workpieces.

Kickback  Unexpected movement of the work piece opposite to the direction of feed.

Machine tool  A power-driven machine designed to bore, cut, drill, or grind metal or other materials.

Milling  The process of machining flat, curved, or irregular surfaces by feeding the workpiece against a rotating cutter containing a number of cutting edges.

Morse taper  A self-holding standard taper largely used on small cutting tools such as drills, end mills, and reamers, and, on some machines, spindles in which these tools are used.

Rack  An array of gears spaced on a straight bar.

Spindle  The spindle is the actual moving part of the machine and is powered from the motor.

Suds  A liquid coolant which is used to facilitate machining operations.

Swarf  Waste material generated by the machining of metal.

T-bolt  Term for the bolts inserted in the T-slots of a worktable to fasten the workpiece or work-holding device to the table.

T-slot  The slots made in the tables of machine tools for the square-head bolts used to clamp the workpiece, attachments, or work-holding fixtures in position for performing the machining operations.

Ways  The flat or V-shaped bearing surfaces on a machining tool that guide and align the parts that they support.
**Bandsaw**

Bandsaws are used in Design & Technology for both straight sawing and curved cutting of timber, manufactured boards and plastics.

A Bandsaw has a thin, flexible endless blade with cutting teeth on one edge. The blade is stretched over two pulleys, the upper one idle, and the lower one driven by an electric motor. The blade runs through a hole in the worktable.

The operator hand feeds and guides the workpiece on a table against the blade to saw along a predetermined line.

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**BANDSAWS ARE DANGEROUS MACHINES.**

Injuries can occur if an operator’s hand slips when feeding material into the saw or if they hold their hands too close to the blade whilst cutting.

- Cuts or amputations to arms and hands from contact with the blade.
- Contact with the blade at the point of operation occurs because the operator’s hands may become too close the blade during cutting and Bandsaw blades cannot be completely guarded.

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Acknowledgment
http://www.gabbett.com.au
**Bandsaw guarding**

Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

A Bandsaw must be guarded in these ways:

3. Fixed or moveable interlocked guards to prevent bodily contact with moving parts of the power transmission apparatus during maintenance and cleaning procedures.

4. Guarding, which encloses the non-cutting area, such as the top and bottom pulleys and the whole of the blade in the non-cutting area, by means of fixed or interlocked moveable guards.

5. Where a Bandsaw is fitted with a tilting table, a fixed guard must guard the blade between the table and the bottom pulley guard at all angles of tilt.

6. The adjustable guard in the cutting zone must be attached to and move with the top saw blade guide and enclose the saw blade on all four sides.
   - The guard must be capable of adjustment down to the table.

7. The adjustable guard in the cutting zone must be adjusted to a position as close to the work as possible.
   - The machine must never be operated without the top or bottom guards adjusted accordingly.

8. Where the machine stopping time exceeds 10 seconds, a braking system must be fitted in accordance with AS 1473.2.

9. A push stick must be provided.
   - A facility to store the push stick must be provided on the infeed side of the machine.

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**ADJUSTABLE GUARD – TABLE BANDSAWS.**

**GUARDING BELOW THE TABLE.**

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**AS 1473.4 – 2001 Wood processing machinery – Safety**

**Part 4: Finishing machinery – Bandsawing machines**

**2.3 PREVENTION OF ACCESS TO MOVING PARTS**

**2.3.1 Guarding of tools on hand held machines**

**2.3.1.1 Guarding of the non-cutting area on hand held machines**

The following requirements apply:

(a) For bandsaws the non-cutting area of the tool, the top and bottom pulleys of the machine and the whole of the blade in the non-cutting area shall be enclosed by fixed or interlocked moveable guards

(b) Where the machine stopping time exceeds 10 s, a braking system in accordance with AS 1473.2 shall be fitted.

(c) The guard or guards shall comply with the requirements of AS 4024.1 and AS 1473.2.

(d) For all machines fitted with tilting tables, the part of the blade between the table and the bottom pulley guard shall be guarded at all angles of table tilt by a fixed guard. Any slot which allows removal of a blade from a guard shall take account of the requirements of AS 4024.1

**2.3.1.2 Guarding the cutting area on hand fed machines**

For table bandsaws the cutting area of the blade shall be provided with an adjustable guard which will be designed in such a way that it does not have to be removed from the machine during the blade changing. In all cases the guard shall be capable of adjustment down to the table.

The adjustable guard shall be attached to and move with the top saw blade guide and shall be designed so as to enclose the saw blade on all four sides. The adjustable guard control shall be capable of being held into position or provided with a self-locking adjustment.
Purchasing a Bandsaw

General
A Bandsaw should:
- Meet DECS Standards for Plant and Equipment: Part A.
- Have spare parts readily available through a SA distributor.
- Be of robust construction.
- Be suitable for heavy-duty use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Bandsaw should:
- Have a stand that is enclosed and sufficiently rigid for the Bandsaw to be vibration free and stable when used.
- Be provided with a chute system below the table to channel refuse to a collection point below the bottom saw wheel, having a flexible seal to allow the table to tilt.
- Have a fabricated or cast frame and provision to floor mount for stability.
- Be fitted with adjustable blade guides above and below the table.
- Have an adjustable tracking device fitted to the top wheel.
- Be fitted with efficient and appropriate outlets for dust extraction. Dust collection shall be made below the bottom saw wheel with an attachment that is readily removable to allow clearance of obstructions. Each dust collection point shall finish with 100 O.D. x 35 long spigot for connection of flexible hose.
- Have switching controls in an easy to reach location
- Produce less than 85 dB(A) at the point of operation.

Technical Details
A Bandsaw should have:
- Spoked wheels diameter 400mm.
- Either a 3-phase motor: 415V/3/50, 1.1 kW minimum capacity, or a single-phase motor: 240V/1/50,0.75 kW minimum capacity.
- Throat 350 – 450mm. (approximately).
- Table size 500 x 400mm (approximately).
- Table height 1000mm (approximately).
- Cutting capacity height x width 390 x 225mm.
- Max blade length 2700mm (approximately).
- Blade width capacity 6 – 16mm.
- Tilting table to 45°.
- Rip fence for parallel cutting.
Positioning a Bandsaw

A Bandsaw depending on the brand weighs approximately 200 Kg.

Most workshop floors should be sufficient to carry the weight of a Bandsaw. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Bandsaw onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Bandsaw rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Bandsaw must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Bandsaw is fixed to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

Extraction plant must be used with this machine and this may well affect the options when siting this machine.

The installation, spacing, services and foothold around a Bandsaw must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- It does not obstruct doorways and emergency exits.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
Spatial allowances for Bandsaws

The following graphic indicates the recommended spatial allowances for a Bandsaw and operator.

- Only a single operator may use a Bandsaw.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

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**WARNING**

ONE PERSON ONLY MAY OPERATE THIS MACHINE

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Saw, Band type, for Wood  

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**Commissioning a Bandsaw**

A Bandsaw must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

2. A Bandsaw must be securely fixed to its bed.
   - Under no circumstances must a Bandsaw be left to stand unsecured.

3. All nuts, bolts and grub screws must be in place and tight.

4. The machine must be in a clean condition.

5. All guards must be in place and securely fixed as per manufacturer’s instructions for the specific guard.

6. A Bandsaw must be connected with a dust extraction plant before becoming operational.

7. A licensed electrician must install hard wired equipment

8. Switchgear must be tested for correct operation.

9. Belt drives must be checked for pulley alignment, serviceability and correct tensioning.
   - Ensure the belt profiles match the pulley type.

10. Install a saw blade and adjust and tension.
   - Refer to manufacturer’s advice.

11. Adjust upper and lower saw guides according to manufacturer’s recommendation.
   - The saw guides should support the blade behind the gullets.
   - They should not grip the blade.

12. Test for proper operation by manually turning the wheels to check blade and wheel tracking and alignment.

13. Lubricate according to manufacturer’s recommendation.

14. Ensure all moving parts move freely.

15. Test the machine to ensure proper operation. For a Bandsaw to cut in an accurate and efficient manner it is essential that the:
   - Type of blade is suitable for the material being cut.
   - Machine is fitted with a blade of correct width for the operation being performed.
   - Blade teeth are sharp and correctly set.
   - Tracking and tension are correctly set.
   - Maximum thickness of the blade is suitable for the wheel diameter.
   - Blade guides and thrust wheels are properly set for the blade in use.

16. Install push stick storage facility and push stick on in feed side of machine.

17. Ensure there is an adequate level of lighting available.
19. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
20. Ancillary equipment such as sliding mitre fence should be stored in close proximity to the machine.
21. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
22. Warranties must be processed and forwarded to the appropriate parties.
23. The details of the machine must be entered in the school's record and in the Bandsaw maintenance schedule.
24. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Bandsaw safe work procedure

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of the Bandsaw.

- Operators must be **properly instructed** in the **safe operation** and the characteristics of the machine and materials involved.
  - The **safe handling** of the workpiece when machining and the **position of the hands** relative to the workpiece.
  - Beware of the **blade**, which can cause **cuts or amputations**.
  - Correct **adjustment** of the **top guide guard** and **bottom guard**.
  - Correct use of jigs, holders and templates.
  - Signals such as **regular clicking** when the saw is running indicate a **cracked blade**.

- Ensure the blades meet with and are operated according to the manufacturer’s recommendation

- Blades must be kept sharp.
  - Blunt blades require more feeding pressure, which may increase the potential for hands or limbs to slip and increases noise levels.
  - Bandsaw blades must be properly stored and must be sharpened or replaced as needed.

- Approved hearing protection must be worn.
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.

- The removal of waste must only occur when the machine is in a safe rest position and the blade has stopped rotating.
  - It is good practice to use a stick rather than hands to remove waste.

- Push sticks are essential safety appliances and must be provided.

- The machine must not be used to cut branches or second hand timber.

- Do not attempt to cut round or irregular stock.

- Jigs and work holding devices must be used when cutting small work pieces.

- Do not use hands or compressed air remove to dust or waste from the table.

- Coil and secure bandsaw blades when not in use.
  - Suitable gloves should be used when handling blades.
**Bandsaw safe operation**

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. The bandsaw must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing. Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Hearing protection is required.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn.
   - Medic alert identity (if worn) must be taped.
8. Waste extraction must be used for this machine.
9. Saw blade must be sharp and in sound condition.
   - Blades must be regularly checked to ensure their operational suitability.
10. Do not leave machine running unattended.
    10. Turn off the power and make sure the machine has stopped completely before leaving the area.
11. Ensure bottom blade guard is in place.
12. The adjustable guard should be as close to the work piece as practicable.
13. Ensure all locks are securely tightened before operating.
14. Allow the machine to develop full speed before using.
15. The work piece should be fed forward evenly and held firmly on the table to ensure effective control during cutting, whilst keeping the hands in a safe position.
16. When hand feeding against a fence a push stick should be used when feeding close to the blade.
17. Stop the machine before attempting to back away from the saw blade should it bind or pinch as this may pull the blade off the band wheels.
18. Do not force a wide blade on a cut of small radius.
   - Use relief cuts when cutting sharp curves.
   - Use a jig for cutting discs.
19. Avoid the accumulation of sawdust, waste or stock on the machine table or on the floor.
20. Ensure that long and heavy pieces of timber are properly supported.
21. Bring the machine to a complete standstill and Isolate the machine from power before cleaning or making adjustments.
Safety hazards of Bandsaws

Point of operation
• Contact with the moving blade may occur
   ♦ Operator’s hands may be too close to the blade and bandsaw blades cannot be completely guarded.

Flying chips and material
• Wood dust, and splinters, can be thrown up into the operator’s face by the action of the blade.
   ♦ Certain timber may cause an allergic reaction in people especially when exposed to fine dust.
   ♦ Dust extraction must operate efficiently.
Bandsaw maintenance

A documented Bandsaw maintenance schedule must be developed and time should be allocated specifically for this machine maintenance.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Bandsaw is a reasonably high maintenance machine in that the blade and guides require constant attention.

For a Bandsaw to cut freely without having to force the work piece against the blade:

- Keep blade clean, sharp, and properly set.
  - Obtain and follow instructions from supplier for correct maintenance on Bandsaw blades.
- Adjust the pulley cleaning equipment.
  - Clean any built up residue from the pulley tyres.
- Ensure the blade is suitable for the material being cut
  - The blade must be of the correct width for the operation being performed.
- Ensure the tension and tracking is correctly set.
- Ensure the blade guides and thrust wheels are correctly set for the blade being used.

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**WARNING**

Keep saw blades clean, sharp and properly set so that they cut freely without undue force.

**WARNING**

Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.

**WARNING**

Take care to avoid lacerations when carrying and installing saw blades.
Decommissioning a Bandsaw

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Bandsaw the following processes must be completed:

10. The machine must be tagged barring use.
11. A licensed electrician must disconnect hard-wired equipment.
12. Tape the mains cable/plug to the machine.
13. The machine should be in a clean condition.
14. Any belt drives should be freed from tension.
15. Disconnect the machine from dust collection unit and seal dust collection point.
16. Protect any machined surface with a suitable corrosive preventative.
17. Secure any ancillary equipment to the machine.
18. Any fixings securing the equipment to its bed should be removed.
19. When moving the machine observe correct manual handling procedures and ensure the machine does create a trip hazard.
20. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
21. School records and electrical testing databases must be amended.

WARNING

Because of the size and weight of a Bandsaw it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
## Bandsaw glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bevel</td>
<td>Any surface that is not at right angles to another surface.</td>
</tr>
<tr>
<td>Cross Cutting</td>
<td>Cutting a board perpendicular to or across the grain.</td>
</tr>
<tr>
<td>Danger zone</td>
<td>Any zone within or around machinery in which any person is subject to a risk to health or safety.</td>
</tr>
<tr>
<td>Defect</td>
<td>A flaw in timber such as a knot, split, etc. that can seriously weaken the timber.</td>
</tr>
<tr>
<td>Fence</td>
<td>An adjustable guiding device to permit cuts parallel to the blade.</td>
</tr>
<tr>
<td>Guard</td>
<td>A physical barrier that prevents or reduces access to a danger point or area.</td>
</tr>
<tr>
<td>Guides</td>
<td>The saw blade guides can be fixed pads, pegs or rotating rollers and support the blade behind the gullets of the blade.</td>
</tr>
<tr>
<td>Guide Post</td>
<td>Provides a mounting for the guard, thrust wheel and saw guides. It can be moved up or down to accommodate various thicknesses of timber.</td>
</tr>
<tr>
<td>Hazard</td>
<td>a situation at the workplace capable of potential harm.</td>
</tr>
<tr>
<td>Jig</td>
<td>A work holding device that safely holds and locates the workpiece.</td>
</tr>
<tr>
<td>Kerf</td>
<td>The width of cut made by a saw blade.</td>
</tr>
<tr>
<td>Knot</td>
<td>A disturbance or inclusion in the grain of the wood, caused by the growth of a branch.</td>
</tr>
<tr>
<td>Lux</td>
<td>A unit of measurement relating to light.</td>
</tr>
<tr>
<td>Push Stick</td>
<td>Typically a custom made aid, often sacrificial, which allows the safe operation of planing and sawing plant.</td>
</tr>
<tr>
<td>Ripping</td>
<td>Cutting with or along the grain in timber.</td>
</tr>
<tr>
<td>Risk</td>
<td>The probability that the potential harm may become a reality.</td>
</tr>
<tr>
<td>Spindle</td>
<td>The spindle is the actual moving part of the machine and is powered from the motor.</td>
</tr>
<tr>
<td>Table</td>
<td>This is the operating surface of the machine through which the blade runs.</td>
</tr>
<tr>
<td>Table insert</td>
<td>This is the small wooden or plastic section through which the blade passes. It is removable to allow replacement of the blade and renewal when it is worn.</td>
</tr>
<tr>
<td>Three Phase Power</td>
<td>A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy duty machinery</td>
</tr>
<tr>
<td>Thrust wheels</td>
<td>Positioned in line and just clear of the back of the blade when the blade is idling after being tensioned and tracked to give support to the blade when cutting.</td>
</tr>
<tr>
<td>Tracking</td>
<td>Tracking helps the blade run in the correct position on the band-saw pulleys. This is achieved by tilting the top pulley.</td>
</tr>
</tbody>
</table>
Circular Bench Saw

Circular Bench Saws are used in Design and Technology to cut accurate straight edges.

Depending on the blade type selected, they can be used to cut across or with the grain of timber. In addition, when an appropriate blade is selected they are used to cut manufactured boards and plastic materials.

Before using the operator makes any adjustments to the blade, saw guard and fence. Whilst holding the material the operator pushes it forward into the blade and continues past until the cut is completed. The guide is used to maintain a straight cut at the required width.

WARNING

CIRCULAR BENCH SAWS ARE DANGEROUS MACHINES

Injuries can occur if an operator’s hands slip as they are feeding material into the saw or if they hold their hands too close to the blade whilst cutting.

- Cuts or amputations to arms and hands, from contact with the blade.
- Contact with the blade at the point of operation occurs because the operator’s hands may become too close to the blade during cutting and Circular Saw blades cannot be completely guarded.
- Material can be violently ejected in the direction of the operator.
Circular Bench Saw guarding

Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

The danger presented by Circular Bench Saws is not entirely due to contact with a revolving blade. There is significant danger of timber being violently ejected at high speeds from the saw.

Circular Bench Saws must be guarded in three ways:
1. Fixed or interlocked bottom guards to prevent bodily contact with moving parts of the drive mechanism and the blade during maintenance and cleaning procedures.
2. A riving knife fixed below the level of the table and set behind and in line with the saw blade.
3. A securely mounted adjustable or self-adjusting top hood guard covering that part of the saw blade above the table.

Circular Bench Saw guards should:
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
- Be difficult to by-pass or disable.
- Cause minimum obstruction to the view of the process.
- Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
- Be easy to adjust so that they can be set correctly.
- Be regularly maintained to keep them easy to adjust.
- Not introduce any other risks.
- Be rigid to prevent them touching the revolving blades
- Be robust so those accidental knocks will not displace or bend them.
- Cover dangerous moving parts such as motor, belts, pulleys and shafts.
- In the case of the adjustable top hood guard be set as close as practicable to the timber being cut.
- Have provision for connection, both above and below the table, to an extraction system.

Where machines that are designed for use with saw blades up to a diameter of 315mm the top guard must be designed so that it is:
- Mounted on the riving knife or;
- Mounted separately from the riving knife but integral with the machine.

In the case of machines that are designed to accommodate a saw blade of diameter greater than 315mm the top guard must be mounted separately form the riving knife but integral with the machine.

The mounting arrangement for the guard support must be designed so that it cannot be removed from the machine without the use of a tool.

AS 1473.3 – 2001 WOOD PROCESSING MACHINERY- PART 3: FINISHING MACHINERY-CIRCULAR SAWING MACHINES

2.2 RISK OF BREAK-UP DURING OPERATION
Means shall be provided to contain blade tips ejected in the direction of the guards. Suitable means include, but are not restricted to-
(a) a saw guard below the table which should be made of steel with a breaking strength of at least 350N/mm² and a wall thickness of at least 2mm or of light alloy with a breaking strength of at least 180 N/mm² and a wall thickness of at least 5mm; and
(b) a saw guard above the table which should be made of the same materials required for the saw guard below the table, or be of polycarbonate or other plastic having equivalent strengths with a wall thickness of at least 3mm. Other materials exhibiting strength equivalent to those materials given above may be used.

AS 1473.3 – 2001 WOOD PROCESSING MACHINERY- PART 3: FINISHING MACHINERY-CIRCULAR SAWING MACHINES

2.4 DEVICES TO MINIMIZE THE POSSIBILITY OR THE EFFECT OF EJECTION
Every circular saw bench and dimension saw shall be supplied with riving knives to accommodate the range of saw blades which are intended for use with that machine as indicated with the instruction book.

Acknowledgement:
Standards Australia International
Riving Knife
The riving knife must accommodate the saw blade specified for use with the machine as indicated in the instruction handbook.

The riving knife must be splayed to provide a lead-in for the workpiece.

The riving knife should be adjusted so that:
- Its closest point to the saw blade is **3mm** and the maximum gap between the saw blade and riving knife is **8mm**.
- The vertical height at its tip is level with or higher than the highest point on the periphery of the saw blade.
- The shape of the riving knife should follow an arc not exceeding that of the largest saw used on the saw bench.
- The fixing slot does not protrude above the table.

Work Guides and Fences
Circular Saw benches must be fitted with a rip fence that is adjustable at right angles to the saw blade over the width of the table. Adjustments to the fence position must be possible without the assistance of a tool.

The workpiece guiding part of the fence must:
- Be made from a suitable material such as a soft alloy, wood, plastic etc., which will not damage the saw blade in the event of contact.
- Permit adjustment so that the outfeed end can be adjusted:
  - Forward to a point in line with the leading edge of the riving knife.
  - Rearward to a point that is in line with the first tooth of the largest saw blade for which the machine is designed at its maximum cutting height.
- Have two guiding surfaces with a high position for deep work and a low position for shallow or angled work
  - Machines designed for use with saw blades of a diameter of greater than 315mm a minimum height of 90mm in its highest position and a height of between 6 and 15mm in its lowest position.
  - Machines designed for use with saw blades up to a diameter of 315mm a minimum height of 50mm in its highest position and a height between 6 and 15mm in its low position.
Purchasing a Circular Bench Saw (tilting arbor)

General
A Circular Bench Saw (tilting arbor) should
- Meet DECS Standards for Plant and Equipment: Part A
- Be suitable for cutting solid timber and manufactured board up to 100mm thick at 90 degrees. Attachment of the guard must allow cuts to the centre of a 1200mm wide sheet.
- Have spare parts readily available through a local distributor
- Be of robust construction.
- Be suitable for continuous use, similar to that found in industry.
- Have switching controls within easy reach of the operator.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Circular Bench Saw (tilting arbor) should:
- Be mounted on a robust cabinet.
- Have a stand sufficiently rigid for the saw to be vibration free and stable when used.
- Be fitted with precision ripping and mitre fences.
- Have a tilting arbor (0 – 45°).
- Be provided with extension tables/sliding table as optional extras.
- Have provision for dust collection in the top surface of the saw guard.
- Have a chute system below the table to channel waste to a collection point below the operator with an attachment that is readily removable (by slide movement) to allow clearance of obstructions.

Technical Details
A Circular Bench Saw (Tilting Arbor) should have:
- Saw diameter: 300 maximum TCT combination approximately 60 teeth with riving knife to suit.
- A riving knife to rise/fall and tilt with blade.
- A one-piece arbor 25mm diameter (min).
- An approximate table size 700 x 1000mm.
- A 100mm (min) depth of cut at 90 degrees.
- A tilting mechanism of robust construction adequately protected from dust.
- Either a 3-phase motor: 415V/3/50, 2.0 kW minimum capacity, or a single-phase motor: 240V/1/50, 0.75kW minimum capacity
Positioning a Circular Bench Saw

A Circular Bench Saw, depending on the brand and model can weigh approximately 200 Kg.

Most workshop floors should be sufficient to carry the weight of a Circular Bench saw. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Circular Bench saw onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Circular Bench Saw rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Circular Bench Saw must be securely fixed into position using 'Dynabolts' or similar for concrete floors or coach screws for wooden floors.
- Where a Circular Bench Saw is bolted to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

It is strongly suggested that this machine form part of the materials handling infrastructure and, as such, is best positioned in the materials store.

- Extraction plant must be used with this machine and this may well affect the options when siting this machine.

The installation, spacing, services and foothold around a Circular Bench Saw must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- It does not obstruct doorways and emergency exits.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.

WARNING

A Circular Bench Saw is a heavy machine. DO NOT move the machine by yourself. Assistance and lifting equipment will be required. Serious personal injury may occur if safe moving methods are not followed.
Spatial Allowances for Circular Bench Saws

The following graphic indicates the recommended spatial allowances for a Circular Bench Saw and operator.

- Only a single operator may use a Circular Bench Saw.
- It should be noted that the measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

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Government of New South Wales
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Commissioning a Circular Bench Saw

A Circular Bench Saw must not be used until the following details have been completed according to the manufacturers recommendation and any necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.
2. A Circular Bench Saw must be secured to the floor.
   - Under no circumstances must the machine be left to stand unsecured.
3. Guarding must be in place and function correctly.
4. All nuts, bolts and grub screws must be in place and tight.
5. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.
6. A licensed electrician must install hard-wired equipment.
7. When electrical connection has been made, an authorised person must confirm the direction of spindle rotation.
   - Switch on and at the same time switch off to view direction.
   - The spindle must run in a **clockwise** direction when viewed from the left side of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a direction test may result in serious operator injury and damage to the machine.
8. Switchgear must be tested for correct operation.
9. Connect machine to dust extraction system.
10. Lubrication points should be serviced and all moving parts should move freely.
11. Housekeeping equipment should be installed in a suitable nearby location.
12. Install push stick storage facility and push stick on infeed side of machine.
13. Attach Circular Saw **Safety Operating Procedures**
14. Appropriate Personal Protective Equipment must be made available in close proximity to machine.
15. Ancillary equipment such as sliding mitre fence should be stored in close proximity to the machine.
16. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
17. Warranties must be processed and forwarded to the appropriate parties.
18. The details of the machine must be entered in the school’s record and in the Circular Saw **maintenance schedule**.
19. Conduct a risk assessment using the **Risk Assessment Process Part A** and **Part B** proformas to ensure that there is no likely health and safety risk to personnel.
Circular Bench Saw safe work procedure

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of the Circular Bench Saw.

- Only operators who have been authorized as properly trained and competent should be allowed to operate machines.
- Adequate instruction and supervision are essential.
- Do not fit a saw blade of greater capacity in either physical or rotational speed than the largest saw blade for which the machine is designed.
- Good hearing protection must be worn
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- Do not stand in line and behind of material that is being fed through the machine in case of kickback.
- The removal of waste must only occur when the machine is in a safe rest position and the saw blade has stopped rotating
  - It is good practice to use a stick rather than hands to remove waste.
  - Do not use compressed air to remove dust or waste off-cuts from the table.
- Ensure that any body parts do not get near the saw blade when loading, moving or unloading timber.
- Do not saw freehand.
- Always hold the stock firmly against the mitre gauge or a rip fence to position and guide the cut.
- Do not feed the work piece faster than the saw can accept.
- Gloves must not be worn whilst operating this machine.
- Turn off the power and make sure the machine has stopped completely before leaving the area.

Acknowledgement:
Standards Australia International

USE OF A PUSH STICK

Acknowledgement:
Standards Australia International
Circular Bench Saw safe operation

1. The Circular Bench Saw must not be used to perform tasks beyond its design specification.
2. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
3. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
     Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Dust mask must be worn in an extremely contaminated or dusty environment.
   - Hearing protection is required.
   - Sturdy Footwear to be worn at all times in work areas.
4. Long and loose hair must be contained.
5. Rings, watches, jewellery must not be worn. Medic alert identity (if worn) must be taped.
6. Dust extraction must be used for this machine.
7. Check condition of the saw blade.
   - Never attempt to remove gum or resin from a saw blade in motion. The saw must be stopped and power isolated before removing gum or resin, using a suitable solvent.
8. Ensure that manually adjustable guards are set to the minimum clearance from the timber being cut.
9. Ensure all locks are securely tightened before operating machine.
10. Allow the machine to develop full speed before sawing
11. Do not reach over the blade for any reason.
12. Do not leave machine running unattended
13. Avoid the accumulation of sawdust, waste or stock on the saw table or on the floor.
14. Use a push stick at least 300mm long for short or narrow timber and when removing off cuts from the table.
15. Ensure that long and heavy pieces of timber are properly supported when being cut.
16. Remove the rip fence from the machine when using the mitre gauge.
   - Material can be trapped between the saw blade and fence and be flung back at the operator.
   - A normal saw bench is not suitable for crosscutting long workpieces unless it is fitted with a sliding table capable of giving support for the full length of the workpiece.
   - Another person should not support the workpiece, as it is difficult to keep rates of feed identical at each end resulting in a possible kickback.
17. In the event of the workpiece jamming on the saw blade, immediately isolate power before attempting to free the workpiece.
   - Check the condition of the blade, riving knife or the alignment of the saw fence if the workpiece binds or is excessively hard to feed.
18. When acting as ‘taker-off’ behind the saw bench, always stand behind the saw and never approach from any other direction while timber is being sawn.
19. Bring the machine to a complete standstill and isolate the machine from power before cleaning or making adjustments.

Safety hazards of a Circular Bench Saw

Point of operation
- Contact with the blade may occur during operation.
- The operator must be aware of the position of their hands and fingers in relation to the saw blade at all times.

Kickbacks
- A workpiece can be ejected from the machine after being caught by the blade.
- Kickbacks can occur where the riving knife has been set too far behind the blade such that the workpiece being cut tries to clamp closed again after the passage from the blade. The blade grips the workpiece and ejects it towards the operator.
- Kickbacks can occur where the operator uses both the mitre gauge and the fence together. In this case material being cut is trapped between the blade and the fence. As the back of the blade catches the workpiece it will be flung out towards the operator.

Flying chips and material
- Wood shavings, and splinters, can be thrown up into the operator’s face by the action of the blade.
- Sawing produces copious amounts of dust, including pieces of debris, swarf etc.
  ♦ The dust and debris can be thrown up into the operator’s face by the action of the blade leading to eye injuries.
  ♦ Certain types of wood dust may cause allergic reactions.
  ♦ Saw dust has been determined to be a group A carcinogen by the International Agency for Research on Cancer (IARC).
  ♦ Hardwoods in general such as beech, oak and mahogany and native hardwoods (eucalypts) generate fine particles of dust and this has a prime link with nasal cancers. Softwood timbers from coniferous trees such as pines are less of a risk.
  ♦ Workers exposed to wood dusts have experienced a variety of adverse health effects such as eye and skin irritation, allergy, and reduced lung function, asthma and nasal cancer.
  ♦ Sharp pieces of acrylic in the eyes are both painful and difficult to get out.
  ♦ Dust extraction must operate efficiently.
Circular Bench Saw maintenance

A documented Circular Saw maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

The Circular Bench Saw is a relatively low maintenance machine.

- Using a sharp blade contributes significantly to the safe operation of a Circular Bench Saw.
  - Keep blades clean, sharp, and properly set so that they will cut freely without having to force the work piece against the blade.
  - Obtain and follow instructions from supplier for correct maintenance on saw blades.
  - To avoid downtime from re-sharpening, it is recommended having extra saw blades on hand
  - Examine saw blade for cracks or other defects when fitting or removing.
- Routine maintenance, cleaning and lubrication is required to ensure the saw and its safeguards operate properly.

WARNING
Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.

WARNING
Keep saw blades clean, sharp and properly set so that they cut freely without undue force.

WARNING
Take care to avoid lacerations when carrying and installing saw blades.
Selecting a Circular Bench Saw blade

- Ensure the blade meets with manufacturer’s recommendation for use with the saw.
- Choose a saw blade with the greatest number of teeth, of the smallest width for the job.
  - Blades with a larger number, hence smaller teeth generate less noise.
- Ensure the saw blade teeth have sufficient clearance to prevent burning.
- Opt for a saw blade with good vibration damping.
  - Some saw blades have vibration damping built in. This may be in the form of slots cut into the body of the saw blade.
  - A well-damped blade will respond with a dull ‘tick’, rather than a ‘ting’ when tapped.
- Choose a saw blade with gullets as small as possible, while still allowing for removal of material.
- Saw blades must be kept sharp.
  - A blunt saw blade is dangerous because it requires more feeding pressure, which causes the wood to break or shoot forward.

Fitting a Circular Bench Saw blade

- Ensure that the blade is a neat sliding fit on the spindle.
- Ensure that the faces of the flanges are clean so that, when tightened, they can exert even pressure on the saw blade.
- Ensure that the collars are the largest useable diameter and, in any case, not less than 2.5 times the diameter of the spindle.
- Ensure the collars are recessed and of adequate thickness.
- Never insert wedges between the saw blade and the collar to form what is commonly known as a wobble saw.
- Ensure that the riving knife matches the blade selected for use and is correctly adjusted.
Decommissioning a Circular Bench Saw

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Circular Bench Saw the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Any belt drives should be freed from tension.
6. Remove saw blade to prevent lacerations.
7. Secure any ancillary equipment to the machine.
8. Any fixings securing the equipment to its bed should be removed.
9. Disconnect the machine from dust collection unit and seal dust collection point.
10. Protect any machined surface with a suitable corrosive preventative.
11. When moving the machine observe correct manual handling procedures and ensure the machine does create a trip hazard.
12. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
13. School records and electrical testing databases must be amended.
Circular Bench Saw glossary

Anti-kickback device
In the case of a circular saw consists a thin plate mounted behind the saw. Its thickness should be greater than the plate of the saw but less than the kerf to reduce the risk of timber being ejected.

Belt Profile
The shape of the cross-section of a power transmission belt. Common examples are ‘v’, multi-‘v’, flat and round belts. The belt profile must suit the pulley type.

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

Defect
A flaw in timber such as a knot, split; etc. that can seriously weaken the timber.

Gullets
The spaces between the points of the teeth on a saw blade.

Hazard
A situation at the workplace capable of potential harm.

Kerf
The channel cut by a saw.

Kickback
Unexpected movement of the work piece opposite to the direction of feed.

Lock
A keyed padlock, which will secure a control device in the "off" position and prevent it from being reactivated. Combination locks or locks using magnetic keys or bars are not acceptable.

Lux
A unit of measurement relating to light.

Push stick
Typically a custom made aid, often sacrificial, which allows the safe operation of planing and sawing machinery.

Risk
The probability that the potential harm may become a reality.

Riving Knife
A thin plate mounted behind the saw. Its thickness should be greater than the plate of the saw but less than the kerf. It reduces ejection of material from the saw at high speed by preventing the cut workpiece closing on the saw blade or the sawn timber coming in contact with the cutting edge of the saw blade.

Spindle
The spindle is the actual moving part of the machine and is powered from the motor.

Three Phase Power
A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.
Disc Sander

Disc Sanders are used in Design and Technology to shape and finish workpieces by means of using coated abrasives to remove the material. They produce accurate straight edges on a variety of materials including solid timbers, manufactured boards and plastic materials.

The Disc Sander is a metal disc, driven by a motor, to which a coated abrasive disc is fixed. A table is provided to support the workpiece while sanding. A sliding mitre fence can be used to maintain a straight edge.

Before using the machine the operator makes any adjustments to the table angle. Whilst holding the workpiece the operator pushes it on the section of the disc, which moves toward the table forward into the abrasive disc.

WARNING

Injuries can occur if an operator’s hands slip as they are feeding material into the abrasive disc or if they hold their hands too close to the disc whilst sanding.

- Contact with the disc at the point of operation occurs because the operator’s hands may become too close to the disc during sanding and a sanding disc cannot be completely guarded.
- This machine produces large amounts of dust and must be used in conjunction with dust extraction plant.
Disc Sander Guarding
Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

A Disc Sander must be guarded in the following ways:
1. Fixed guards, which prevent bodily contact with moving parts of the power transmission apparatus during maintenance and cleaning procedures.
2. Guarding that must completely shroud the rear of the disk and its rim above and below the table.
   ♦ Only the work surface should be accessible.
   ♦ Provision should be made to allow the table to be tilted.
3. Have a gap no greater than **2mm** between the table and disc.

Disc Sander Guards should:
- Be strong and rigid.
- Be rigid to prevent them touching the revolving disc.
- Be robust so those accidental knocks will not displace or bend them.
- Constructed so that it is not easily deflected, which would expose the disc.
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
- Be difficult to by-pass or disable.
- Cause minimum obstruction to the view of the process.
- Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
- Be easy to adjust so that they can be set correctly.
- Be regularly maintained to keep them easy to adjust
- Not introduce any other risks.
- Cover dangerous moving parts such as motor, belts, gear trains, pulleys and shafts.
- Have provision for connection to an extraction system.
Purchasing a Disc Sander

General
A Disc Sander should:
- Meet *DECS standards for Plant and Equipment: Part A*
- Have spare parts readily available through a local distributor
- Be of robust construction.
- Be suitable for heavy-duty use, similar to that found in industry.
- Have switching controls in an easy to reach location.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Disc Sander should:
- Have a stand sufficiently rigid for the Disc Sander to be vibration free and stable when used.
- Have a stand /cabinet that is enclosed and sufficiently rigid approximately 1000mm from the floor.
- Have a gap no greater than 2mm between the table and disc.
- Be fitted with efficient and appropriate outlets for dust extraction.
- Have switching controls in an easy to reach location.

Technical Details
A Disc Sander should have:
- An approximate disc diameter of 350mm.
- Either a 3-phase TEFC induction motor: 415V/3/50, 1.0 kW minimum capacity, or a single-phase TEFC induction motor: 240V/1/50, 1.0 kW minimum capacity.
- A run down time of 10 seconds or less.
- Motor speed approximately 1400 rpm.
- A table size 400mm W. x 200mm D. (approximately).
- A machined groove in the table to accommodate a mitre guide.
- A mitre guide capable of producing angles between 0 - 45°.
- A tilting table to 45° whilst maintaining the 2mm clearance to disc.
- Dust collection hood to enclose the back, top circumference and below table section of the disc transforming to a collection point shall 95 O.D. x 35 long spigot for connection of flexible hose.
  - Provision should be made to minimise air leakage under the table whilst allowing the table to be tilted.
  - The hood must be sized to provide effective dust collection with airflow of 10/Lsec for the machine.
Positioning a Disc Sander

A Disc Sander depending on the brand and model can weigh approximately 100Kg.

Most workshop floors should be sufficient to carry the weight of a Disc Sander. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Disc Sander onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Disc Sander rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Disc Sander must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Disc Sander is fixed to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

The installation, spacing, services and foothold around the Disc Sander must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- It does not obstruct doorways and emergency exits.
- It rests on a suitable foundation, for example, on a floor or other support that ensures the plant is stable and secure against movement.
- Extraction plant is used with a Disc Sander.
  - This may well affect the options when siting this machine.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
- Effective general and task lighting is available.
Spatial Allowances for a Disc Sander

The following graphic indicates the recommended spatial allowances for a Disc Sander and operator.

- Only a single operator may use the Disc Sander.
- It should be noted that the measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm wide yellow or yellow/black line.

![Spatial Allowances for a Disc Sander](image_url)
Commissioning a Disc Sander

A Disc Sander must not be used until the following details have been completed according to the manufacturer’s recommendation and any necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

2. A Disc Sander must be secured to the floor.
   - Under no circumstances must the machine be left to stand unsecured.

3. Guarding must be in place and function correctly.

4. All nuts, bolts and grub screws must be in place and tight.

5. The machine must be in a clean condition.

6. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.

7. A licensed electrician must install hard-wired equipment.

8. When electrical connection has been made, an authorised person must confirm the direction of spindle rotation.
   - Switch on and at the same time switch off to view direction.
   - The spindle must run in a clockwise direction when viewed from the front of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a direction test may result in serious operator injury and damage to the machine.

9. Switchgear must be tested for correct operation.

10. Connect machine to dust extraction system.

11. Lubrication points should be serviced and all moving parts should move freely but with little slop or backlash.

12. Housekeeping equipment should be installed in a suitable nearby location.

13. Attach Disc Sander Safety Operating Procedures

14. Appropriate Personal Protective Equipment must be made available in close proximity to machine.

15. Ancillary equipment such as sliding mitre fence should be stored in close proximity to the machine.

16. File machine documentation supplied from manufacturer/supplier to ensure ready availability.

17. Warranties must be processed and forwarded to the appropriate parties.

18. The details of the machine must be entered in the school’s record and in the Disc Sander maintenance schedule.

19. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Disc Sander safe work procedure

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of a Disc Sander.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when sanding and the position of the hands relative to the work piece.
  - This machine has the capacity to grab workpiece if incorrectly presented to the disc.
  - Beware of the rotating disc, which can cause entanglements and abrasions.
- Ensure the machine is operated according to the manufacturer’s recommendation.
- Dust extraction must work efficiently.
- Abrasive discs must be kept in good condition and replaced when worn.
  - Excessive force applied to the disc can lead to body parts becoming in contact with the abrasive surface causing abrasions and lacerations.
- Operators must wear the appropriate Personal Protective Equipment.
  - Approved hearing protection must be worn for some operations.
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
  - Gloves must not be worn whilst operating this machine.
- Ensure that any body parts or clothing do not get near the disc during operation.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
- Refer to MSDS if using Disc Cements to secure the abrasive disc.
- Do not force the workpiece greater than the machine can accept.
- Jigs and work holding devices must be used when sanding small work pieces.
- The Disc Sander must not be used for the sharpening of cutting tools.
  - Sparks can cause wood dust collected in dust extraction system to explode.
- Turn off the power and make sure the machine has stopped completely before leaving the area.
- The removal of waste must only occur when the machine is in a safe rest position and the disc has stopped rotating.
  - Do not use compressed air to remove dust or waste off-cuts from the table.
Disc Sander safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. The Disc Sander must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating the machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
   - Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Dust mask may be worn as additional protection.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained
7. Rings, watches, jewellery must not be worn.
   - Medic alert identity (if worn) must be taped.
8. Dust extraction must be used for this machine.
9. Abrasive disc must be in good condition, of the correct grit and be securely mounted.
10. The adjustable table must be adjusted to within 2mm of the abrasive disc.
11. Work must be done only on that part of the disc that will push the work piece down on the table.
12. Never attempt to remove an excessive amount of material at any one time.
13. Do not allow the machine to run unattended.
14. Bring the machine to a complete standstill and Isolate the machine from power before cleaning or making adjustments.

WARNING

Guards must be in place and function correctly.

WARNING

Work only on that part of the disc that will push the workpiece down on the table.

WARNING

Never attempt to remove an excessive amount of material at any one time.
Safety Hazards of a Disc Sander

Point of operation
- Contact with the abrasive disc may occur during operation.
- Operator’s fingers may be trapped between work stop and abrasive wheel.
  ♦ The operator must be aware of the position of their hands and fingers in relation to the sanding disc at all times.

In-running nip points.
- Clothing, hair or hands may be caught by and pulled into rotating grinding wheel.
  ♦ Under no circumstances should an operator bend down near this machine whilst it is operating.

Kickbacks
- A workpiece can be ejected from the machine after being caught by the revolving disc.

Flying chips and material
- Dust and splinters, can be thrown up into the operator’s face by the action of the disc leading to eye injuries.
- Sanding produces copious amounts of dust, including pieces of debris, swarf etc.
  ♦ Certain types of wood dust may cause allergic reactions.
  ♦ Saw dust has been determined to be a group A carcinogen by the International Agency for Research on Cancer (IARC).
  ♦ Hardwoods in general such as beech, oak and mahogany and native hardwoods (eucalypts) generate fine particles of dust and this has a prime link with nasal cancers. Softwood timbers from coniferous trees such as pines are less of a risk.
  ♦ Workers exposed to wood dusts have experienced a variety of adverse health effects such as eye and skin irritation, allergy, and reduced lung function, asthma and nasal cancer.
  ♦ Sharp pieces of acrylic in the eyes are both painful and difficult to get out.
  ♦ Dust extraction must operate efficiently.
Disc Sander maintenance

A documented Disc Sander maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

The Disk Sander is a high maintenance machine.

- Replacement discs must be fitted before wear and tear failures occur.
- Ensure abrasive discs are securely attached to the metal disc before operating.
- The work support table must be adjusted to within 2mm of the abrasive disc at all times.
Decommissioning a Disc Sander

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Disc Sander the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Disconnect the machine from dust collection unit and seal dust collection point.
8. Protect any machined surface with a suitable corrosive preventative.
9. When moving the machine observe correct manual handling procedures and ensure the machine does create a trip hazard.
10. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
11. School records and electrical testing databases must be amended.

WARNING

Because of the size and weight of a Disc sander it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
### Disc Sander glossary

**Abrasive**
A hard substance that can be used to wear away another material. They are used for almost any dimensioning, grinding, sanding, finishing or surface conditioning application.

**Belt Profile**
The shape of the cross-section of a power transmission belt. Common examples are `v`-, multi-`v`-, flat, and round belts. The belt profile must suit the pulley type.

**Coated abrasive**
Consists of paper, cloth, combination, polyester film, metal, and fibre backings - with glue, resin, and waterproof bonds.

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

**Defect**
A flaw in timber such as a knot, split; etc that can seriously weaken the timber.

**Guard**
A physical barrier that prevents or reduces access to a danger point or area.

**Hazard**
A situation at the workplace capable of potential harm.

**Knot**
A disturbance or inclusion in the grain of the wood, caused by the growth of a branch.

**Lux**
A unit of measurement relating to light.

**Lock**
A **keyed padlock**, which will secure a control device in the "off" position and prevent it from being reactivated. Combination locks or locks using magnetic keys or bars are not acceptable.

**Risk**
The probability that the potential harm may become a reality.

**Three Phase Power**
A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.
Radial Arm Saw

A Radial Arm Saw is used in Design and Technology to:
- Cross cut boards to length.
- Square edges of manufactured boards.
- Cut housings.
  - The saw arm can be raised or lowered to adjust the depth.
- Cut mitres and bevel cuts.
  - The saw arm can be swung from side to adjust the side horizontal angle of the cut.

Radial Arm Saws are multi-purpose circular saws that cut above the timber. During the cross cutting operation the stock is pushed away from the operator and against a rear backstop.

Whilst a Radial Arm Saw is capable of performing ripping operations these are more easily and safely done on a Circular Bench Saw.

WARNING

RADIAL ARM SAWS ARE DANGEROUS MACHINES

Amputations can occur if the operator’s hands and fingers come into contact with the saw blade.
- This can occur if the operator holds stock within the hand hazard zone.
- Eye injuries can occur due to flying wood chips.
- Stock can be kicked away leaving the operator’s hand exposed to the saw blade.
Radial Arm Saw Guarding
Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

Radial Arm Saws must be guarded in these ways:

1. **A fixed (hood) guard** to enclose the non-cutting part of the saw blade
   - The upper guard must protect the operator from flying splinters, broken saw teeth and sawdust.
   - This guard should extend at least as far down as the saw spindle.
   - A dust extraction outlet is often incorporated into this guard.

2. Side guards that cover at least the outside edge of the exposed saw teeth. These can be:
   - **Self-closing side guards**
     - Rise and open on contact with the workpiece.
     - The guard must automatically adjust itself to the thickness of the material and remain in contact with the material being cut for the 90° position throughout the full working range.
     - These guards do not provide protection against contact with the saw blade from the front of the machine.
     - In the at-rest position, the sides of the lower exposed part of the blade must be guarded from the tips of the teeth inward radially with no gullet exposure.
     - There should be no access to the saw blade of any design when in the rest position.
     - The guard must not inhibit the intended use of the saw.
   - **Manually adjusted side guards**
     - There should be no access to the saw blade of any design when in the rest position.
     - These alone are unlikely to provide sufficient protection when in the rest position, since they may not adjust below fence height.
     - Side guards may not always be practicable when carrying out mitred cutting with a canted saw blade.
     - The guards must be as close as possible to the surface of the material being cut and no more than 10mm. above it.
     - The guard must not inhibit the intended use of the saw.

3. Machines should be fitted with:
   - An operating automatic return device, so that the saw returns to its safe rest position behind the rear fence when the saw is released.
   - An automatic brake that stops the rotation of the saw spindle within 10 seconds or less.

4. A rear backstop that is high enough to support the workpiece must be provided at either side of the cutting line.
5. A ‘Hand Danger Zone’ 150mm. from either side of the blade must be marked using a 50mm wide yellow or yellow and black line.

6. Adequate workpiece support is essential for all cross-cutting operations.
   - Large workpieces should be supported using extension tables or roller supports at either side of the table.

7. The travel of the saw must be limited so that no part of the saw blade can project beyond the front edge of the table.

8. Emergency Stop Button/s in addition to the ON/OF Direct On Line (DOL) Starter must be fitted to a Radial Arm Saw.
   - Two Emergency Stop buttons may be required if the saw is used to cut mitres.
   - The Emergency Stop button/s must be immediately accessible to the operator when using the saw.

Radial Arm Saw Guards should:
   - Be strong and rigid.
   - Be rigid to prevent them touching the revolving blades.
   - Made from a material such as aluminium or similar, so that in the event of contact with the blade, neither the guard nor the blade will disintegrate.
   - Be robust so those accidental knocks will not displace or bend them.
   - Constructed so that it is not easily deflected, which would expose the blade.
   - Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
   - Be difficult to by-pass or disable.
   - Cause minimum obstruction to the view of the process.
   - Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
   - Be easy to adjust so that they can be set correctly.
   - Be regularly maintained to keep them easy to adjust.
   - Not introduce any other risks.
   - Cover dangerous moving parts such as motor, belts, pulleys and shafts.
   - Have provision for connection to an extraction system.
Purchasing a Radial Arm Saw

General
A Radial Arm Saw should:
- Meet *DECS Standards for Plant and Equipment: Part A*.
- Have spare parts available through a local distributor.
- Be supplied with detailed instruction/parts manual and all tools required for the operation of the machine.
- Be of robust construction and suitable for heavy-duty use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Radial Arm Saw should:
- Have a stand sufficiently rigid for the Radial Arm Saw to be vibration free and stable when used.
- Have a dust extraction outlet incorporated into the fixed hood guard.
- Have a chute system below the table to channel waste to a collection point below the operator with an attachment that is readily removable (by slide movement) to allow clearance of obstructions.
- Have switching controls in an easy to reach location.

Technical Details
A Radial Arm Saw should have:
- An upper blade guard that completely encloses the blade down to a point that includes the end of the saw arbor.
  - The upper guard must protect the operator from flying splinters, broken saw teeth and sawdust.
  - In the at-rest position, the sides of the lower exposed part of the blade must be guarded from the tips of the teeth inward radially with no gullet exposure.
  - The guard must automatically adjust itself to the thickness of the material and remain in contact with the material being cut for the 90° position throughout the full working range.
  - The guard must not inhibit the intended use of the saw.
- A self-adjusting, floating guard that rises and falls and automatically adjusts to the thickness of the stock.
- A return device, so that the saw returns to its safe rest position when the saw is released.
- A rear fence that is high enough to support the workpiece at either side of the cutting line.
- A single-phase, self-braking TEFC induction motor with overload protection: 240V/1/50, 1.5kW minimum capacity.
- Durable cast iron arm with 8 roller bearings.
- Blade diameter 350mm with 30mm blade bore diameter.
- Maximum cutting width 630mm (20mm thick material).
- Maximum cutting height 100mm.
- Table dimension 975mm x 1580 approximately.
Positioning a Radial Arm Saw

A Radial Arm Saw depending on the brand and model weighs approximately 150 Kg.

Most workshop floors should be sufficient to carry the weight of a Radial Arm Saw. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Radial Arm Saw onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Radial Arm Saw rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Radial Arm Saw must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Radial Arm Saw is fixed to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

It is recommended that a Radial Arm Saw form part of the materials handling infrastructure and, as such, be best positioned in the materials store.

- Extraction plant must be used with a Radial Arm Saw and this may well affect the options when siting this machine.
- The Radial Arm Saw is normally positioned close to a wall with an integrated extended bench designed to support long work-pieces.

The installation, spacing, services and foothold around a Radial Arm Saw must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
Spatial allowances for a Radial Arm Saw

The following graphic indicates the recommended spatial allowances for a Radial Arm Saw and operator.

- Only a single operator may use a Radial Arm Saw.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

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Warning
ONE PERSON ONLY MAY OPERATE THIS MACHINE

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Spatial allowances for a Radial Arm Saw

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Guidelines for the Safe Use of Machinery
Commissioning a Radial Arm Saw

A Radial Arm Saw must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.
2. A Radial Arm Saw must be securely fixed to the floor.
   - Under no circumstances must a machine be left to stand unsecured.
3. All nuts, bolts and grub screws must be in place and tight.
4. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.
5. A licensed electrician must install hard-wired equipment.
6. When electrical connection has been made, an authorised person must confirm the direction of saw blade rotation.
   - Switch on and at the same time switch off to view direction.
   - The saw blade must run in a clockwise direction when viewed from the left side of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a cutter head direction test may result in serious operator injury and damage to the machine.
7. The work-piece table must be installed.
   - Note that there must be a rear backstop firmly fitted to prevent snatching of the timber when starting cuts.
8. Lubrication points should be serviced and all moving parts should move freely but with little slop or backlash.
10. Erect a sign indicating the maximum width of cut for the saw.
11. Mark in the ‘Hand Hazard Zone’.
12. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
13. Associated housekeeping equipment should be installed in a suitable nearby location.
14. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
15. Warranties must be processed and forwarded to the appropriate parties.
16. The details of the machine must be entered in the school’s record and in the Radial Arm Saw Maintenance Schedule.
17. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.

**WARNING**

Do not use petroleum-based solvents for cleaning. They have low flash points that make them extremely flammable. A risk of explosion and burning exists if these products are used.

**WARNING**

Use care when disposing of cleaning cloth/rag to be sure they do not create fire or environmental hazards.

**WARNING**

Guards must be in place and function correctly.

**WARNING**

The Radial Arm Saw should run smoothly, with little or no vibration or rubbing noises. Strange or unnatural noises should be investigated and corrected before operating machine further.
Radial Arm Saw safe work procedures

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of the Radial Arm Saw.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when sawing and the position of the hands relative to the work piece.
  - This machine has the capacity to throw workpiece back toward the operator.
- Ensure the saw blade meets with and is operated according to the manufacturer's recommendation.
- Blades must be kept sharp.
  - A blunt blade requires more feeding pressure, which can be dangerous.
- It is good practice to mark a ‘Hand Hazard Zone’ on the worktable.
  - This can be in the form of a yellow or yellow/black hatched line set at 150mm either side of the saw line.
  - Operators must be trained not to hold timber within this area during cutting.
  - The use of a workpiece holder or jig may be appropriate where small workpieces are being cut.
- Timber must be cut against a fence when undertaking docking or mitre work.
  - When mitre work is to be undertaken the machine must be set up to undertake this work with the timber secured against the backstop, in accordance with the manufacturer's instructions.
  - Do not cut 'free hand'.
- Approved protection must be worn
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- When cutting bowed timber place the bow against the table so the timber is less likely to bind on the saw blade and create a risk of kickback.
- The removal of off cuts must only occur when the saw blade is in a safe rest position and the saw blade has stopped rotating.
  - It is good practice to use a stick rather than hands to remove off cuts.
- Accidents can occur when operators cross their arms during cutting.
  - For example, they pull a workpiece along the backstop, from right to left, using the left hand instead of correctly pushing it along with the right.
  - Avoid reaching across the saw line.
  - Left-handed operators may require specific training.
- Make sure that the saw is fully retracted by positive pressure with the hand at the end of the return cycle.
- When loading moving or unloading timber ensure that the hands do not get near the blade.
Radial Arm Saw safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. The Surface Planer must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
   - Dust mask must be worn in an extremely contaminated or dusty environment.
   - Hearing protection is required.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn.
   - Medic alert identity (if worn) must be taped.
8. Waste extraction must be used for this machine.
9. Check condition of the blade.
10. Ensure all locks are securely tightened before operating.
11. Do not start the machine with the workpiece against the blade.
12. Allow the machine to develop full speed before sawing.
13. Do not reach over the blade for any reason.
14. Stand on the handle side when cross cutting. Pull the cutting head with the hand nearest the handle and manipulate the stock with the other hand.
15. Allow the blade to do the work without forcing the saw.
16. The maximum cut must not be exceeded.
   - Where the intended cut exceeds the maximum draw of the saw the workpiece should be cut half way and then rotated to complete the cut.
17. Return the cutting head completely to the back of the saw table after each cut.
   - Do not remove hand from the operating handle unless the cutting head is behind the fence.
18. Avoid the accumulation of sawdust, waste or stock on the machine table or on the floor.
19. Do not allow the machine to run unattended.
20. Ensure that long and heavy pieces of timber are properly supported.
21. Bring the machine to a complete standstill and isolate the machine from power before cleaning or making adjustments.
Safety Hazards of a Radial Arm Saw

Point of operation
- Contact with the blade may occur.
  - Lacerations or amputations from rotating blade.
  - The saw blade is not only very sharp, but is also revolving so fast as to appear as a blur. If contact were made during rotation, even for a millisecond, it would cause severe injury.
  - Operators should have a plan of which way to let their hands fall should the workpiece either jam or be suddenly snatched.

Kickbacks.
- Operators must be aware of the potential of being hit by pieces of the machine or workpiece being flung off.
  - A workpiece can be ejected from the machine after being caught by the blade.

In-running nip points.
- The speed of rotation of the blade means that if something were to be caught then it would be "wound" down on to the blade or guard very quickly.
  - Under no circumstances should an operator bend down near this machine whilst it is operating
  - Being caught by a workpiece snagging and then being dragged across the blade.
  - The operator must be aware of the position of their hands and fingers in relation to the blade at all times.
  - Operators should have a plan of which way to let their hands fall should the workpiece either jam or be suddenly snatched.

Flying chips and material
- Wood shavings, and splinters, can be thrown up into the operator's face by the action of the blade.
- Sawing produces copious amounts of dust, including pieces of debris, swarf etc.
  - The dust, due to the action of the blade, can be thrown up into the operator's face by the action of the blade leading to eye injuries.
  - Certain types of wood dust may cause allergic reactions.
    - Saw dust has been determined to be a group A carcinogen by the International Agency for Research on Cancer (IARC).
    - Hardwoods in general such as beech, oak and mahogany and native hardwoods (eucalypts) generate fine particles of dust and this has a prime link with nasal cancers. Softwood timbers from coniferous trees such as pines are less of a risk.
    - Workers exposed to wood dusts have experienced a variety of adverse health effects such as eye and skin irritation, allergy, and reduced lung function, asthma and nasal cancer.
  - Dust extraction must operate efficiently.
Radial Arm Saw maintenance

A documented Radial Arm Saw maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.

- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Radial Arm Saw is not in itself a high maintenance machine.

- Using sharp saw blades contributes significantly to the safe operation of a Radial Arm Saw.
  - Keep blades clean, sharp, properly set and firmly secured so that they will cut freely without having to force the blade against the work piece.
  - Obtain and follow instructions from supplier for correct maintenance on saw blades.
  - Use non-caustic oven cleaner to clean saw blade.

- Routine maintenance, cleaning and lubrication is required to ensure the saw and its safeguards operate properly.
  - The slides, runways, pivots and bearings of a Radial Arm Saw often become dusty, which impedes free running.
  - Ensure the guarding on the lower portion of blade operates correctly and the return device is fully functional.
Decommissioning a Radial Arm Saw

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Radial Arm Saw the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment such as spanners, etc. to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Remove saw blade to prevent lacerations.
8. Disconnect the machine from dust collection unit and seal dust collection point.
9. Protect any machined surface with a suitable corrosive preventative.
10. Carefully move the Radial Arm Saw so that the machine does not create a hazard.
   - Observe manual handling procedures when moving the machine.
11. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
12. School records and electrical testing databases must be amended.

WARNING

Because of the size and weight of a Radial Arm Saw it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
## Radial Arm Saw glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Backstop</td>
<td>A fixed fence that enables quick, easy and secure location of the workpiece.</td>
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<tr>
<td>Bevel</td>
<td>Any surface that is not at right angles to another surface.</td>
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<tr>
<td>Cross Cutting</td>
<td>Cutting a board perpendicular to or across the grain.</td>
</tr>
<tr>
<td>Chamfer</td>
<td>The surface produced by planing off the two adjacent surfaces at an angle of 45°</td>
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<tr>
<td>Danger zone</td>
<td>Any zone within or around machinery in which any person is subject to a risk to health or safety.</td>
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<tr>
<td>Defect</td>
<td>A flaw in timber such as a knot, split etc that can seriously weaken the timber.</td>
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<tr>
<td>Fence</td>
<td>An adjustable guiding device fitted to a machine.</td>
</tr>
<tr>
<td>Guard</td>
<td>A physical barrier that prevents or reduces access to a danger point or area.</td>
</tr>
<tr>
<td>Hazard</td>
<td>A situation at the workplace capable of potential harm.</td>
</tr>
<tr>
<td>Kickback</td>
<td>Unexpected movement of the work piece opposite to the direction of feed.</td>
</tr>
<tr>
<td>Knot</td>
<td>A disturbance or inclusion in the grain of the wood, caused by the growth of a branch.</td>
</tr>
<tr>
<td>Lux</td>
<td>A unit of measurement relating to light.</td>
</tr>
<tr>
<td>Ripping</td>
<td>Sawing along the grain direction in solid timber.</td>
</tr>
<tr>
<td>Risk</td>
<td>The probability that the potential harm may become a reality.</td>
</tr>
<tr>
<td>Spindle</td>
<td>The Spindle is the actual moving part of the machine and is powered from the motor.</td>
</tr>
<tr>
<td>Three Phase Power</td>
<td>A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.</td>
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Surface Planer

Surface Planers are used in Design and Technology to:

- Make a flat face on a piece of stock to prepare it for planing on a thickness planer.
- Produce straight edges on solid timber and manufactured boards.
- Clean up saw cuts on solid timber and manufactured boards.

The operator sets the depth of cut by adjusting the infeed table. The fence is set according to the width of the stock and the surface being planed and the type of operation being performed. Stock is passed over a cylindrical, multiple knife cutter head, whilst keeping the stock against the table surface or fence.

WARNING

SURFACE PLANERS ARE DANGEROUS MACHINES

Injuries can occur if the operator’s hands and fingers come into contact with the knives.

- This can occur if the operator does not use a holding device when planing narrow lengths of stock.
- Injuries can occur when the operator allows their finger to ride along the surface of the table as the stock is fed through.
- Stock can be kicked away leaving the operator’s hand exposed to the cutter head.
**Surface Planer Guarding**

Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

The danger presented by a Surface Planer is not entirely due to contact with a revolving blade. There is significant danger of timber being violently ejected at high speeds from the machine.

Surface Planers used in schools must be guarded in these ways:

1. **Below table guard**
   The below table guard must be of the fixed type to prevent bodily contact with moving parts of the drive mechanism and the cutter head.
   - The guarding must cover dangerous moving parts such as motor, belts, pulleys, shafts and cutter head.

2. **Cutter block guard for machines up to and including 100mm.**
   For surface planing machines with a useable working width up to and including 100mm the guards may be either manually adjusted bridge guards or swivel type (leg of mutton) guards.
   - Both the swivel guard (leg of mutton guard) and manually adjusted bridge guard must meet the requirements of Australian Standard **AS4024.1 – 1996 Safeguarding of machinery Part 1: General principles.**
   - A risk assessment must be undertaken to determine the most effective way to guard the cutter head.
   - A choice between swivel guarding and bridge guarding will be required for machines with a useable working width up to and including 100mm.

2.1 **Swivel guard (leg of mutton guard)**
A swivel guard covers all sections of the cutter head and automatically moves out of the way during operation, then automatically moves back into place after the planing operation. A swivel guard must be designed so that it:
   - Prevents accidental contact with the cutting knives.
   - Automatically adjusts itself to cover the unused portion of the cutting head.
   - Remains in contact with the workpiece at all times.
   - Whenever the fence is moved the cutter block must be fully guarded on the working and non-working sides of the cutter block.
2.2 Bridge guards

Bridge guards are manually adjusted guards that cover all sections of the cutter head. Bridge guards must be:

- Long enough to cover the table gap with the fence at maximum adjustment.
- Wide enough (at least equal to the cutter block diameter).
  - For large machines telescopic guards are available.
- Easily adjustable horizontally and vertically without the use of a tool.
- Adjusted before and after each use.
  - Whenever the fence is moved bridge guards must be adjusted to ensure that the cutter block is fully guarded on the working and non-working sides of the cutter block.
- Labelled with the following: This guard must be adjusted so there is no more than 2mm clearance from the timber.

3. Cutter block guard for machines wider than 100mm.

For surface planing machines with a useable working width greater than 100mm the guards must be of the bridge type.

Guards should:

- Be strong and rigid (to support heavy timbers).
- Be rigid to prevent them touching the revolving blades.
- Made from a material such as aluminium or similar, so that in the event of contact with the cutter block, neither the guard nor the cutter block will disintegrate.
- Be robust so those accidental knocks will not displace or bend them.
- Constructed so that it is not easily deflected, which would expose the cutter block.
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
- Be difficult to by-pass or disable.
- Cause minimum obstruction to the view of the process.
- Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
- Be easy to adjust so that they can be set correctly.
- Be regularly maintained to keep them easy to adjust and functioning.
- Not introduce any other risks.
- Cover dangerous moving parts such as motor, belts, pulleys and shafts.
### Purchasing a Surface Planer

#### General
A Surface Planer should:
- Meet *DECS Standards for Plant and Equipment: Part A*
- Have spare parts available through a local distributor.
- Be supplied with all tools required for the operation of the machine.
- Be supplied with detailed instruction/parts manual.
- Be of robust construction.
- Be suitable for continuous use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

#### Parameters
A Surface Planer should:
- Be mounted on a robust cabinet/stand sufficiently rigid for the Surface Planer to be vibration free and stable when used.
- Have a chute system below the table to channel waste to a collection point below the operator with an attachment that is readily removable (by slide movement) to allow clearance of obstructions.
- Have switching controls in an easy to reach location.

#### Technical Details
A Surface Planer should have:
- A guard that covers all sections of the cutting head on the working side and non-working side of the fence.
- Either a 3-phase motor: 415V/3/50, 2.0 kW minimum capacity, or
  - A single phase motor: 240V/1/50, 0.75 kW minimum capacity – 150mm surface planer
  - A single phase motor: 240V/1/50, 1.1 kW minimum capacity – surface planer
- A circular, 3 knives balanced cutter block.
- 150mm or 200mm wide table.
- Table throat opening no more than 65mm when tables are set or aligned with each other for zero cut.
- Perforated table tips for noise reduction.
- Overall table length: 1400mm – 1900mm (approximately)
  - The longer the table the better, unless short stock only is being planed.
- Table material. Cast iron.
- Parallel links table support.
- Fence material: Cast iron.
- Centre mounted stable fence.
  - Stop at 45 and 90 degrees.
  - Fence tilt in as well as out.
Positioning a Surface Planer

A Surface Planer depending on the brand and model can weigh as much as 200 Kg.

Most workshop floors should be sufficient to carry the weight of a Surface Planer. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Surface Planer onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Surface Planer rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Surface Planer must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.
- Where a Surface Planer is bolted to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

It is recommended that a Surface Planer form part of the materials handling infrastructure and, as such, be best positioned in the materials store.

- Extraction plant must be used with a Surface Planer and this may well affect the options when siting this machine.

The installation, spacing, services and foothold around a Surface Planer must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
Spatial allowances for a Surface Planer

The following graphic indicates the recommended spatial allowances for a Surface Planer and operator.

- A surface Planer is strictly a single operator only machine.
- The measurements displayed are considered minimum requirements.
- Sufficient space must be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

![Spatial allowances for a Surface Planer diagram]

SURFACE PLANER

Secondary School Code 580.27
Government of New South Wales
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**Commissioning a Surface Planer**

A Surface Planer must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

2. A Surface Planer must be securely fixed to the floor.
   - Under no circumstances must a machine be left to stand unsecured.

3. All nuts, bolts and grub screws must be in place and tight.

4. Belt drives must be checked for pulley alignment, serviceability and correct tensioning.
   - Ensure the belt profiles match the pulley type.

5. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.

6. A licensed electrician must install hard-wired equipment.

7. When electrical connection has been made, an authorised person must confirm the direction of cutter head rotation.
   - Switch on and at the same time switch off to view direction.
   - The cutter head must run in a clockwise direction when viewed from the left side of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a cutter head direction test may result in serious operator injury and damage to the machine.

8. Ensure knives are set at the proper height and tight.

9. Ensure infeed and outfeed tables are correctly aligned.

10. Lubrication points should be serviced and all moving parts should move freely.

11. Connect machine to dust extraction system.


13. Ancillary equipment such as push blocks and accessories should be located in close proximity to the machine.

14. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.

15. File machine documentation supplied from manufacturer/supplier to ensure ready availability.

16. Warranties must be processed and forwarded to the appropriate parties.

17. The details of the machine must be entered in the school’s record and in the Surface Planer Maintenance Schedule.

18. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.
Surface Planer safe work procedure

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of the Surface Planer.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the workpiece when planing and the position of the hands relative to the work piece.
  - The use of push sticks.
  - This machine has the capacity to throw workpiece back toward the operator.
  - Beware of moving machinery parts that cause entanglements.
- When surface planing, always cut WITH the grain rather than AGAINST it.
  - Cutting against the grain (going against the pattern of the wood’s growth rings) chips the wood instead of cutting it, making the workpiece rough and irregular and increasing the chances that a kickback will occur.
- Dust extraction must work efficiently.
- Check for damaged parts.
  - Before further use of a machine, a guard or other part that is damaged should be carefully checked to determine that it properly operates and performs its intended function.
  - Check for alignment of moving parts, binding of moving parts, breakage of parts, mounting, and any other conditions that may affect its operation.
  - A guard or other part that is damaged should be properly repaired or replaced.
- Do not over-reach.
  - Keep proper footing and balance at all times.
- Inspect stock carefully before it is fed it over the cutter head.
  - If you have any doubts about the stability or structural integrity of your stock, do not use it.
- Always use push blocks whenever surface planing.
  - Never place your hands directly over the cutter head infeed table.
- Do not stand directly at the end of either table.
  - The operator should be positioned just to the side of the infeed table to avoid injury from possible kickbacks.
- Never surface plane end grain.
- Never back the workpiece toward the infeed table.

WARNING
A Surface Planer must not be used for rebating.
Surface Planer safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. The Surface Planer must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
   - Dust mask must be worn in an extremely contaminated or dusty environment.
   - Hearing protection is required.
   - Operators must wear close fitting protective clothing.
   - Dust mask must be worn in an extremely contaminated or dusty environment.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn. Medic alert identity (if worn) must be taped.
8. Waste extraction must be used for this machine.
9. Never surface plane stock that has structural defects.
10. Check condition of the blades.
11. Check the depth of cut before using the machine.
    - Never make a single cut greater than 2mm.
12. Ensure all locks are securely tightened before operating machine.
13. Plane with the grain.
14. Do not plane end grain.
15. Do not stand in line of workpiece during planing operation.
    - Operator position should be just to the side of the infeed table to avoid possible kickbacks.
16. Allow the machine to develop full speed before planing.
17. Do not reach over the cutters for any reason.
18. Do not back the workpiece toward the infeed table.
19. Avoid the accumulation of sawdust, waste or stock on the machine table or on the floor.
20. Use a push block at least 300mm long for short or narrow timber.
    - Never place hands directly over cutter head.
21. Ensure that long and heavy pieces of timber are properly supported when being planed.
    - Never place the material directly on the cutting head.
    - Maintain control of the workpiece at all times.
    - Turn power off and do not leave machine until is has completely stopped.
23. Bring the machine to a complete standstill and isolate the machine before cleaning or making adjustments.
24. Reset machine to zero depth cut immediately after use.

Guidelines for the Safe Use of Machinery

WARNING
Guards must be in place and function correctly.

WARNING
The machine must not be used to plane, branches or second hand timber.

WARNING
DO NOT make adjustments while the machine is running. Ensure that the switch is off, power is isolated and moving parts have stopped before making adjustments.

WARNING
To avoid kickback hold the material firmly, control the rate of feed and do not attempt a heavy cut.

WARNING
Reset the machine to zero immediately after use.
**Surface Planer operation**

**Planing a face**

1. Make sure all safety instructions and procedures have been read and understood before attempting to operate a Surface Planer.
2. Adjust the depth of cut.
   - The recommended maximum depth of cut should be **2mm**.
   - Material width and hardness will have a bearing on this setting.
3. Adjust the fence to allow the whole of the face to be planed.
4. Place the timber on the infeed table to allow the surface to be planed with the grain.
   - Cupped boards should be placed with the concave side against the table.
5. Using a push block in both hands and exerting light downwards pressure sufficient to control the board, advance the material to the cutting head by sliding it along the table.
6. When the leading hand (with push block) gets within 100mm of the cutter head, lift it up and over the cutter head, and place the push block on the portion of the workpiece that is over the outfeed table.
   - Allow the cutters to do the work without forcing the timber.
7. At this point, the operator should focus their pressure on the outfeed end of the workpiece while feeding, and repeat the same action with their trailing hand when it gets within 100mm of the cutter head.
8. As soon as there is enough room, both hands (with the push block) should be placed on the outfeed side and feed rate continued until the material is past the cutters.
9. Repeat steps 5 – 8 until the stock is flat.

**Planing an edge**

1. Check the fence is 90° to the table.
2. Adjust the depth of cut.
   - The recommended maximum depth of cut should be **2mm**.
   - Material thickness and hardness will have a bearing on this setting.
3. Press the timber with the planed face against the fence with firm pressure.
4. Apply downward pressure and feed the work over the cutter block using the trailing hand to guide the workpiece through the cut.
5. If the operator’s leading hand gets within 100mm of the cutter head, lift it up and over the cutter head, and place it on the portion of the workpiece that is over the outfeed table.
6. At this point, the operator should focus their pressure on the outfeed end of the workpiece while feeding, and repeat the same action with their trailing hand when it gets within 100mm of the cutter head.
7. Repeat steps 3 – 6 until the surface is straight and square.

**WARNING**

Do not SURFACE stock less than 300mm. long X 20mm. wide and less than 15mm. thick.

**WARNING**

To keep your hands safe DO NOT let them get closer than 100mm. from the cutter head when it is moving.

**WARNING**

Do not EDGE stock less than 300mm long X 20mm. wide and less than 6mm. thick.

**WARNING**

To avoid kickback hold the material firmly, control the rate of feed and do not attempt a heavy cut.

**WARNING**

A Surface Planer must not be used for rebating.
Safety Hazards of a Surface Planer

Point of operation
- Contact with knives may occur, especially if holding device is not used.
- Lacerations or amputations from rotating blades.
  - The surface planer cutting knives are not only very sharp, but are also revolving so fast as to appear as a blur. If contact were made during rotation, even for a millisecond, it would cause severe injury.
  - The operator must be aware of the position of their hands and fingers in relation to the cutter block at all times.
  - Operators should have a plan of which way to let their hands fall should the workpiece either jam or be suddenly snatched.

Kickbacks
- Operators must be aware of the potential of being hit by pieces of the machine or workpiece being flung off.
  - A workpiece can be ejected from the machine after being caught by the knives.

In-running nip points.
- The speed of rotation of the blade means that if something were to be caught then it would be “wound” down on to the blade or guard very quickly.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
  - Being caught by a workpiece snagging and then being dragged across the blade.

Flying chips and dust
- Wood shavings and splinters can be thrown up into the operator’s face by the action of the blade.
- Certain timber may cause an allergic reaction in people especially when exposed to fine dust.
  - Certain types of wood dust may cause allergic reactions.
    - Saw dust has been determined to be a group A carcinogen by the International Agency for Research on Cancer (IARC).
    - Hardwoods in general such as beech, oak and mahogany and native hardwoods (eucalypts) generate fine particles of dust and this has a prime link with nasal cancers. Softwood timbers from coniferous trees such as pines are less of a risk.
    - Workers exposed to wood dusts have experienced a variety of adverse health effects such as eye and skin irritation, allergy, and reduced lung function, asthma and nasal cancer.
  - Dust extraction must operate efficiently.
Surface Planer maintenance

A documented Surface Planer maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.

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- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Surface Planer is a high maintenance machine.

- Using sharp knives contributes significantly to the safe operation of a Surface Planer.
  - A good maintenance procedure is to hone the knives to keep them in top condition so that they will cut freely without having to force the work piece against the blade.
  - A knife hone will polish and finely sharpen knives quickly and easily without removing them.
  - For damaged or extra dull knives, have them re-sharpened by a professional grinder.
  - To avoid downtime from re-sharpening, it is recommended having an extra set of knives on hand.
  - It is essential to keep the knives in sets with each knife having equal mass so that the cutter head is balanced.
  - Never install or adjust the blades so that they protrude more than 3mm beyond the cylindrical cutter head.
  - Ensure cutting head is free from vibration.

- Check the outfeed table adjustment.
  - If the outfeed table is set correctly, a straightedge will lie across the table and barely touch the knife when it is at top dead centre.
  - Check that the infeed table is exactly the same height as the outfeed table.
    - Place a straightedge half way on the outfeed table and halfway over the infeed table.
    - Adjust the infeed table so that it is flush with the outfeed table.
  - Set the pointer to 0 on the depth indicator scale.
  - Test the cutter head guard and adjust if required.
    - Move it toward the front of the surface planer and then release it.
    - The guard should return back to its original position against the fence and over the cutter head.

Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.

Take care to avoid lacerations when carrying and installing Surface Planer knives.

Keep knives clean, sharp and properly set so that they cut freely without undue force.

Guidelines for the Safe Use of Machinery
Decommissioning a Surface Planer

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Surface Planer the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment such as spanners, blade adjusters etc. to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Protect cutting knives to prevent lacerations.
8. Any belt drives should be freed from tension.
9. Disconnect the machine from dust collection unit and seal dust collection point.
10. Protect any machined surface with a suitable corrosive preventative.
11. Carefully move the Surface Planer so that the machine does not create a hazard.
    - Observe manual handling procedures when moving the machine.
12. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
13. School records and electrical testing databases must be amended.

**WARNING**

Because of the size and weight of a Surface Planer it is strongly recommended that only properly equipped and experienced personnel attempt the removal or relocation of the machine.
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<td><strong>Danger zone</strong></td>
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<td><strong>Defect</strong></td>
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<td><strong>Fence</strong></td>
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<td><strong>Guard</strong></td>
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<td><strong>Infeed Table</strong></td>
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<td><strong>Kickback</strong></td>
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<td><strong>Outfeed Table</strong></td>
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**Thickness Planer**

A Thickness Planer is used in Design and Technology to plane timber to a uniform thickness. Two adjacent surfaces are straightened and squared on a Surface Planer before using the Thickness Planer to bring the timber to size.

Material passes under cylindrical cutter heads with multiple knives. An operator adjusts the depth of cut and then feeds the material into the infeed side of the machine. The surfaced board is retrieved from the outfeed side of the machine.

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**WARNING**

The main types of injury are cuts or amputations to arms and hands, from contact with the knives.
- Operators need to be aware of kickbacks and flying wood chips.
Thickness Planer Guarding
Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

The danger presented by a Thickness Planer is not entirely due to contact with a revolving blade. There is significant danger of timber being violently ejected at high speeds from the machine.

Thickness Planers must be guarded in these ways:
1. The cutter head must be enclosed or otherwise guarded to minimize the chance of contact from the cutter block and cutting knives
   • A dust extraction outlet is often incorporated into this guard
2. Thickness Planers must be power fed.
3. Power feed rollers must be guarded so as to prevent the fingers reaching the nip-point between the rollers and the material being fed.
   • The clearance between the edge of the guard and the material must be as small as practicable.
   • The guards must be effective for all sizes of material.
4. Power feed rollers must be provided with anti-kickback devices placed in front of the feed rollers.
5. Fixed or interlocked guards to prevent bodily contact with moving parts of the power transmission apparatus during maintenance and cleaning procedures.

Thickness Planer Guards should:
• Be strong and rigid
• Be rigid to prevent them touching the revolving blades
• Be robust so those accidental knocks will not displace or bend them.
• Constructed so that it is not easily deflected, which would expose the blade.
• Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
• Be difficult to by-pass or disable.
• Cause minimum obstruction to the view of the process.
• Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
• Be easy to adjust so that they can be set correctly.
• Be regularly maintained to keep them easy to adjust.
• Not introduce any other risks.
• Cover dangerous moving parts such as motor, belts, gear trains, pulleys and shafts.
• Have provision for connection to an extraction system.
Purchasing a Thickness Planer

General
A Thickness Planer should:
• Meet DECS Standards for Plant and Equipment: Part A
• Have spare parts available through a local distributor.
• Be supplied with detailed instruction/parts manual and all tools required for the operation of the machine.
• Be of robust construction and suitable for continuous use, similar to that found in industry.
• Produce less than 85 dB(A) at the point of operation.
• Meet the provisions of the OHS&W Act and OHS&W Regulations 1995 Part 3.
• Meet the safety requirements of Australian Standard AS4024.1 – 1995 Safeguarding of machinery Part 1: General principles.
• Supplied with a risk assessment.

Parameters
A Thickness Planer should:
• Have a stand sufficiently rigid for the Thickness Planer to be vibration free and stable when used
• Have a dust extraction outlet incorporated into the fixed hood guard
• Have switching controls in an easy to reach location
• Produce less than 85 dB(A) at the operator's ear.

Technical Details
A Thickness Planer should:
• Have guarding to enclose the cutter head to minimize the chance of contact from the cutter block and cutting knives.
• Have a dust extraction outlet incorporated into this guard
• Be power fed.
• Have guarding on the power feed rollers so as to prevent the fingers reaching the nip-point between the rollers and the material being fed.
  ♦ The clearance between the edge of the guard and the material must be as small as practicable.
• Have effective guarding for all sizes of material.
• Have power feed rollers with anti-kickback devices placed in front of the feed rollers.
• Have fixed or interlocked guards to prevent bodily contact with moving parts of the power transmission apparatus during maintenance and cleaning procedures.
• Have either a 3-phase motor: 415V/3/50, 3.7 kW minimum capacity, or a single-phase motor: 240V/1/50, 3.7 kW minimum capacity.
• Have a circular, 2 or 4 knife balanced cutter block.
Positioning a Thickness Planer

A Thickness Planer depending on the brand and model weighs approximately 500 Kg.

Most workshop floors should be sufficient to carry the weight of a Thickness Planer. The machine may be located on wooden or concrete floors provided they are in sound condition.

- Before moving a Thickness Planer onto a workshop floor, inspect it carefully to determine that it will be sufficient to carry the load of the machine, the device for moving it and its operators.

Ensure a Thickness Planer rests on a suitable foundation.

- On a floor or other support that ensures the plant is stable and secure against movement.
- A Thickness Planer must be securely fixed into position using 'Dynabolts' or similar for concrete floors or coach screws for wooden floors.
- Where a Thickness Planer is fixed to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

It is recommended that a Thickness Planer form part of the materials handling infrastructure and, as such, be best positioned in the materials store.

- Extraction plant must be used with a Thickness Planer and this may well affect the options when siting this machine.

The installation, spacing, services and foothold around a Thickness Planer must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.

WARNING

A Thickness Planer is a heavy machine. DO NOT move the machine by yourself. Assistance and lifting equipment will be required. Serious personal injury may occur if safe moving methods are not followed.
Spatial allowances for a Thickness Planer

The following graphic indicates the recommended spatial allowances for a Thickness Planer and operator.

- Only a single operator may use a Thickness Planer.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

WARNING

ONE PERSON ONLY MAY OPERATE THIS MACHINE

THICKNESS PLANER
Commissioning a Thickness Planer

A Thickness Planer must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
   - The unpainted surfaces are coated with a waxy oil to protect them from corrosion during shipment.
   - Remove this protective coating with a solvent cleaner or citrus-based degreaser.
   - To clean thoroughly, some parts may need to be removed.
   - For optimum machine performance, clean all moving parts or sliding contact surfaces that are coated.
   - Avoid chlorine-based solvents as they may damage painted surfaces should they come in contact.

2. A Thickness Planer must be securely fixed to the floor.
   - Under no circumstances must a machine be left to stand unsecured.

3. All nuts, bolts and grub screws must be in place and tight.

4. Belt drives must be checked for pulley alignment, serviceability and correct tensioning.
   - Ensure the belt profiles match the pulley type.

5. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.

6. A licensed electrician must install hard-wired equipment.

7. When electrical connection has been made, an authorised person must confirm the direction of cutter block rotation.
   - Select neutral position for feed selector lever.
   - Switch on and at the same time switch off to view direction.
   - The cutter block must run in an anti-clockwise direction when viewed from the left side of the machine.
   - If required an electrician must make any alterations to correct the direction of rotation.
   - Failure to carry out a cutter block direction test may result in serious operator injury and damage to the machine.

8. Lubrication points should be serviced and all moving parts should move freely.


10. Erect a sign indicating the minimum sizes for material that may be planed.

11. Mark in Machine and Operator zone.

12. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.

13. Housekeeping equipment should be installed in a suitable nearby location.

14. File machine documentation supplied from manufacturer/supplier to ensure ready availability.

15. Warranties must be processed and forwarded to the appropriate parties.

16. The details of the machine must be entered in the school’s record and in the Thickness Planer Maintenance Schedule.

17. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.

Guidelines for the Safe Use of Machinery
**Thickness Planer safe work practices**

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of the Thickness Planer.

- Operators must be **properly instructed** in the **safe operation** and the characteristics of the machine and materials involved.
  - The **safe handling** of the workpiece when thicknessing and the **position of the hands** relative to the workpiece.
  - This machine has the capacity to throw workpiece back toward the operator.
- Ensure the cutting knives meet with and are operated according to the manufacturer’s recommendation.
- Knives must be kept sharp.
  - Blunt knives require more feeding pressure, which may increase the potential for kickback and increases noise levels.
- The take-off table must be maintained at the same height as the infeed table.
- Good hearing protection must be worn.
  - The machine is capable of producing noise levels in excess of 100dB(A). This can rapidly cause hearing loss if the ears are unprotected.
- Gloves must not be worn whilst operating this machine.
- Do not feed more than two pieces of material at one time through a machine fitted with one section feed rolls.
- Avoid looking through the machine while the material is being passed through.
- Do not stand in line and behind of material that is being fed through the machine in case of kickback.
- Do not feed material equal to or shorter than the distance between the centres of the feed roller.
- The machine must not be used to thickness branches or second hand timber.
- Do not feed boards of different thicknesses.
  - Thinner boards will be kicked back.
- The removal of shavings must only occur when the machine is in a safe rest position and the cutter block has stopped rotating.
  - It is good practice to use a stick rather than hands to remove shavings.
- Ensure that any body parts do not get near the cutting block and knives when loading, moving or unloading timber.
- Beware of the cutting knives, which can cause cuts or amputations.
- Do not use hands or compressed air to remove dust or off cuts from the machine.
**Thickness Planer safe operation**

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. A Thickness Planer must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
   - Dust mask must be worn in an extremely contaminated or dusty environment.
   - Hearing protection is required.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn. Medic alert identity (if worn) must be taped.
8. Waste extraction must be used for this machine.
9. Check condition of the blade.
10. Ensure all locks are securely tightened before operating.
11. Allow the machine to develop full speed before thicknessing.
12. Feed only one piece of material through at a time.
13. Do not stand behind material as it is being passed through the machine.
14. Avoid the accumulation of sawdust, waste or stock on the machine table or on the floor.
15. Ensure that long and heavy pieces of timber are properly supported.
   - Turn off the power and make sure the machine has stopped completely before leaving the area.
17. Bring the machine to a complete standstill and isolate the machine from power before cleaning or making adjustments.
Safety Hazards of a Thickness Planer

Safety hazards can cause immediate injury.

Point of operation
- Contact with the knives may occur.
  - Lacerations or amputations from rotating knives.

Kickbacks.
- Operators must be aware of the potential of being hit by pieces of the machine or workpiece being flung off.
  - A workpiece can be ejected from the machine after being caught by the knives.

In-running nip points.
- Clothing, hair or hands may be caught by and pulled into the automatic feed mechanism.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
  - The operator must be aware of the position of their hands and fingers in relation to the feed rolls and cutters at all times.

Flying debris and dust
- Wood shavings, splinters and dust, can be thrown up into the operator’s face by the action of the blade.
- Certain timber may cause an allergic reaction in people especially when exposed to fine dust.
  - Certain types of wood dust may cause allergic reactions.
  - Saw dust has been determined to be a group A carcinogen by the International Agency for Research on Cancer (IARC).
  - Hardwoods in general such as beech, oak and mahogany and native hardwoods (eucalypts) generate fine particles of dust and this has a prime link with nasal cancers. Softwood timbers from coniferous trees such as pines are less of a risk.
  - Workers exposed to wood dusts have experienced a variety of adverse health effects such as eye and skin irritation, allergy, and reduced lung function, asthma and nasal cancer.
  - Dust extraction must operate efficiently.
**Thickness Planer maintenance**

A documented *Thickness Planer Maintenance Schedule* must be developed and time should be allocated specifically for maintenance purposes.

The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer's recommendations for the specific machine.

- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Thicknesser Planer is a reasonably high maintenance machine in that the blades require constant attention.

- Using sharp knives contributes significantly to the safe operation of a Thickness Planer.
  - A good maintenance procedure is to hone the knives to keep them in top condition so that they will cut freely without having to force the work piece against the blade.
  - A knife hone will polish and finely sharpen knives quickly and easily without removing them.
  - For damaged or extra dull knives, have them re-sharpened by a professional grinder.
  - To avoid downtime from re-sharpening, it is recommended having an extra set of knives on hand.
  - It is essential to keep the knives in sets with each knife having equal mass so that the cutter head is balanced.
  - Never install or adjust the blades so that they protrude more than 3mm beyond the cylindrical cutter head.
- Feeding of timber is difficult if the infeed roll is clogged or the table are gummed or the anti-friction rolls are set too low.
  - Clean with non-caustic oven cleaner.
- If a ridge is left across the planed surface of the material, the pressure bars require adjusting or the anti-friction rolls are set too high.
- Routine maintenance, cleaning and lubrication is required to ensure the Thickness planer and its safeguards operate properly.
  - The slides and runways often become dusty, which impedes free running.
Decommissioning a Thickness Planer

A risk assessment using the Risk Assessment Process Part A and Part B pro formas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Thickness Planer the following processes must be completed:

1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment such as spanners, etc. to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Disconnect the machine from dust collection unit and seal dust collection point.
8. Any belt drives should be freed from tension.
9. Protect any machined surface with a suitable corrosive preventative.
10. Carefully move the Thickness Planer so that the machine does not create a hazard.
    - Observe manual handling procedures when moving the machine.
11. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
12. School records and electrical testing databases must be amended.

WARNING

Because of the size and weight of a Thickness Planer it is strongly recommended that only properly equipped and experienced personnel attempts the removal or relocation of the machine.
**Thickness Planer glossary**

**Anti-friction rolls**
Mounted in the table to reduce friction between the table and the timber.

**Anti-kickback device**
In the case of a Thicknesser Planer consist of a screen of fingers or stepped pawls to reduce the risk of timber being ejected.

**Belt Profile**
The shape of the cross-section of a power transmission belt. Common examples are 'v', multi-'v', flat and round belts. The belt profile must suit the pulley type.

**Chip Breaker**
spring-loaded device mounted between the infeed roll and cutter block that holds the timber firmly against the table thus prevents timber splintering.

**Cutter Block**
a solid cylindrical steel bar with machined slots to accommodate the knives.

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

**Defect**
A flaw in timber such as a knot, split; etc that can seriously weaken the timber.

**Guard**
A physical barrier that prevents or reduces access to a danger point or area.

**Hazard**
A situation at the workplace capable of potential harm.

**Infeed roll**
Located in front of the cutter block and is grooved to provide traction on the timber.

**Kickback**
Unexpected movement of the work piece opposite to the direction of feed.

**Knot**
A disturbance or inclusion in the grain of the wood, caused by the growth of a branch.

**Lux**
A unit of measurement relating to light

**Lock**
A **keyed padlock**, which will secure a control device in the "off" position and prevent it from being reactivated. Combination locks or locks using magnetic keys or bars are not acceptable.

**Pressure Bar**
Similar to a chip breaker but is fixed behind the cutter block to hold the timber against the table as it passes from the cutter block.

**Risk**
The probability that the potential harm may become a reality.

**Three Phase Power**
A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery
Wood Lathe

Wood lathes are used in Design and Technology to shape round parts either by turning between centres or faceplate turning.

**Turning between centres**
The material, mounted between two centres, rotates rapidly while the operator applies a lathe tool to the material. The operator holds the tool on a tool rest and advances it along the length of the tool rest to achieve the desired shape.

**Faceplate turning**
The material is screwed directly to a faceplate, which in turn is attached to the headstock spindle.

The operator holds the tool on a tool rest and advances it along the length of the tool rest to achieve the desired shape.

Various adaptations of faceplate turning have emerged. In essence all of these methods rely on a chuck, which is tightened on the headstock spindle. A variety of less obtrusive methods are then employed to hold the work piece to the chuck.

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**WARNING**

The primary hazards of Wood Lathes are contact with and contact at the point of operation.

- Contact with rotating parts at the point of operation occurs because the operator’s hands may become too close to the rotating parts during turning.
- Workpiece may be ejected if incorrectly fixed and inappropriate speeds are used.
- Wood Lathes produce large amounts of dust particularly during sanding and must be used in conjunction with dust extraction plant.
Wood Lathe Guarding
Machinery must have in place guarding which isolates moving parts and the point of operation from direct contact with the operator.

A Wood Lathe must be guarded in the following ways:

- The motor, pulleys and all drive belts must be totally enclosed with an electrically interlocked guard.
- As speed changes are essential operations performed in normal use the pulley covers should be fitted with an electrical interlock.
- The rear headstock spindle must have a fixed guard fitted so that the spindle is covered whilst allowing for the centre drift bar to be used.

Wood Lathe Guards should:
- Be strong and rigid.
- Be rigid to prevent them touching the revolving parts.
- Be robust so those accidental knocks will not displace or bend them.
- Be designed so that access to moving parts that may still be moving after the power is turned off, is prevented until motion ceases.
- Be difficult to by-pass or disable.
- Cause minimum obstruction to the view of the process
- Restrict access during normal operation yet allow for servicing, maintenance, installation and repair of moving parts to be undertaken only with the aid of a tool or key.
- Be easy to adjust so that they can be set correctly.
- Be regularly maintained to keep them easy to adjust.
- Not introduce any other risks.
- Cover dangerous moving parts such as motor, belts, gear trains, pulleys and shafts.
- Have provision for connection to an extraction system.
Purchasing a Wood Lathe

General
A Wood Lathe should:
- Meet DECS Standards for Plant and Equipment: Part A
- Have spare parts available through a local distributor.
- Be supplied with all tools required for the operation of the machine.
- Be supplied with detailed instruction/parts manual.
- Be of robust construction.
- Be suitable for continuous use, similar to that found in industry.
- Produce less than 85 dB(A) at the point of operation.
- Be supplied with a risk assessment.

Parameters
A Wood Lathe should:
- Be mounted on a robust cabinet
- Have a stand sufficiently rigid for the lathe to be vibration free and stable when used
- Have a lathe bed that is of rigid cast iron construction, providing firm support for the cast iron tail stock and tool rest
- Have a fully enclosed cast iron headstock with provision for readily accessible speed changing
- Have provision for rear turning to 600 diameters with tool rests.
- Have indexing as standard.
- Have a tool rest and tool post firmly connected and made from material, which ensures the rest is rigid, and vibration free when used.
- Be supplied with track and slider mechanisms for dust extraction.
- Be supplied with tools and accessories listed below in Technical Details.
Technical Details
A Wood Lathe should have:
- A working height of floor to spindle of approximately 1100mm.
- Have an alloy steel spindle with a M30 x 3.5 thread on the spindle nose.
- Have a 400mm (approx) centre height.
- Have 900 –1000mm between centres.
- Have a headstock and tailstock fitted with No.2 Morse tapers.
- Have a minimum of four speeds at the following (approx) RPM 400, 700, 1200 and 2000.
- Either a 3-phase motor: 415V/3/50, 0.75 kW, or a single-phase motor: 240V/1/50, 0.75kW.

The following tools and accessories should be supplied:
- 200mm RH Face Plate.
- Tool bracket and spanner (unless cam locking device used).
- 25mm spur centre.
- HSS Spindle Gouge – 6mm (approx).
- HSS Spindle Gouge – 12mm (approx).
- HSS Spindle Gouge – 19mm (approx).
- HSS Bowl Gouge – 10mm (approx).
- HSS Round Nose Scraper – 12mm.
- HSS Square Scraper – 25mm.
- HSS Parting Tool – 6mm (approx).
- HSS Skew Chisel – 12mm.
- HSS Skew Chisel – 25mm.
- Centre Drift Bar.
- 16mm Revolving Cup Centre.
- 4-Jaw Self Centring Chuck.
- 50mm Screw Cup chuck.
- 300mm straight tool rest.
- 150mm straight tool rest.
- Curved tool rest.
- 2 spanners to fit faceplate and spindle.
Positioning a Wood Lathe

A Wood Lathe depending on the brand and model can weigh as much as 200 Kg.

A Wood Lathe may be located on most wooden or concrete floors provided they are in sound condition.

- Ensure the machine rests on a suitable foundation, for example, on a floor or other support that ensures the plant is stable and secure against movement.

A Wood Lathe must be securely fixed into position using ‘Dynabolts’ or similar for concrete floors or coach screws for wooden floors.

- Where a Wood Lathe is fixed to wooden floors, consider either securing the machine on a concrete plinth or fit anti-vibration rubber mounts to the base of the machine.

Extraction plant must be used with this machine and this may well affect the options when siting this machine.

The installation, spacing, services and foothold around a Wood Lathe must be such as to ensure:

- Sufficient space for safe access to the machine for supervision, operation, cleaning, maintenance, inspection and emergency evacuation.
- Greater access to the headstock end of the machine if a disc sander is fitted,
  - In this case the distance from the faceplate to the limit of the machine zone would be increased.
  - It should also be noted that additional room might be required at the back of the machine to allow for optional copy turning type accessories.
- The installation is plumb.
- The plane of operation is not in line with doorways, passageways, entrances or where students regularly work.
- There is adequate space for handling materials and parts to and from the machine and for work in progress.
- All operators are afforded a good view of the point of operation of the equipment.
**Spatial allowances for a Wood Lathe**

The following graphic indicates the recommended spatial allowances for a Long Bed and Short Bed Wood Lathe and operator.

- Only a single operator may use a Wood Lathe.
- The measurements displayed are considered minimum requirements.
- Sufficient space should be provided around machines to handle the material with the least possible interference from or to other operators.
- Operator zones must be clearly marked with 50mm. wide yellow or yellow/black line.

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**Alternative Layout**

**Lathe, Wood, Longbed**

(GC: 455–108292, Woodfast MC 9083)

**Lathe, Wood, Shortbed**

(GC: 455–108293, Woodfast MC 4085)
Commissioning a Wood Lathe
A Wood Lathe must not be used until the following checks have been completed according to the manufacturer’s recommendation and necessary adjustments have been made.

1. Ensure the machine is in a clean condition.
2. A Wood Lathe must be securely fixed to the floor.
   • Under no circumstances must a machine be left to stand unsecured.
3. All nuts, bolts and grub screws must be in place and tight.
4. Belt drives must be checked for pulley alignment, serviceability and correct tensioning.
   • Ensure the belt profiles match the pulley type.
5. The mains cable and plug (if any) should be visually checked for flaws and then electrically tested.
6. A licensed electrician must install hard-wired equipment.
7. When electrical connection has been made, an authorised person must confirm the direction of spindle rotation.
   • Switch on and at the same time switch off to view direction.
   • The spindle must run in a clockwise direction when viewed from the headstock end of the machine in the direction of the tailstock end of the Wood Lathe.
   • If required an electrician must make any alterations to correct the direction of rotation.
   • Failure to carry out a direction test may result in serious operator injury and damage to the machine.
8. Guarding must be in place and function correctly.
9. Lubrication points should be serviced and all moving parts should move freely but with little slop or backlash.
10. Attach Wood Lathe Safety Operating Procedures.
11. Ancillary equipment such as lathe tools and accessories should be located in close proximity to the machine.
12. Appropriate Personal Protective Equipment must be sited in close proximity to the machine.
13. Associated housekeeping equipment should be installed in a suitable nearby location.
14. File machine documentation supplied from manufacturer/supplier to ensure ready availability.
15. Warranties must be processed and forwarded to the appropriate parties.
16. The details of the machine must be entered in the school’s record and in the Wood Lathe Maintenance Schedule.
17. Conduct a risk assessment using the Risk Assessment Process Part A and Part B proformas to ensure that there is no likely health and safety risk to personnel.

WARNING
A Thickness Planer is a heavy machine.
DO NOT move the machine by yourself.
Assistance and lifting equipment will be required.
Serious personal injury may occur if safe moving methods are not followed.

WARNING
Use care when disposing of cleaning cloth/rag to be sure they do not create fire or environmental hazards.

WARNING
Guards must be in place and function correctly.

WARNING
The Wood Lathe should run smoothly, with little or no vibration or rubbing noises. Strange or unnatural noises should be investigated and corrected before operating machine further.
Wood Lathe safe work practices

Complementary equipment and the application of appropriate work procedures and practices are fundamental to the safe operation of a Wood lathe.

- Operators must be properly instructed in the safe operation and the characteristics of the machine and materials involved.
  - The safe handling of the work piece when turning and the position of the hands relative to the work piece.
  - This machine has the capacity to grab lathe tool if incorrectly presented to the work piece.
  - Beware of moving machinery parts that cause entanglements.
  - Wood Lathes generate significant quantities of airborne particulates, which may create health problems.
- Ensure the Wood Lathe is operated according to the manufacturer’s recommendation.
- Dust extraction must work efficiently.
- Turning tools must be sharp and kept in good condition.
  - Handles must be a secure fit and be serviceable.
  - Operators must wear the appropriate Personal Protective Equipment.
  - Care must be exercised to detect defects in timber and weaknesses in joints.
Wood Lathe safe operation

1. Only operators who have been authorized as properly trained and competent are allowed to operate machines.
2. Adequate instruction and supervision are essential.
3. The Wood Lathe must not be used to perform tasks beyond its design specification.
4. Ensure workspace is clear before operating the machine.
   - Foreign materials may cause poor footing.
5. Operators must wear the appropriate Personal Protective Equipment.
   - Eye protection is mandatory.
   - Operators must wear close fitting protective clothing.
     - Ties, shirtsleeves and other loose items of clothing may become entangled in moving machine parts.
   - Dust mask may be worn as additional protection.
   - Sturdy Footwear to be worn at all times in work areas.
6. Long and loose hair must be contained.
7. Rings, watches, jewellery must not be worn.
   - Medic alert identity (if worn) must be taped.
8. Dust extraction must be used for this machine.
   - If the faceplate allows an expanded function e.g. disc sanding or bowl turning then the dust collection system must be extended to accommodate the extra function.
9. Gouges, chisels, parting tools and any other cutting tools must be sharp and in good condition.
10. All wood turning operations should be performed on timber that is in good condition.
11. Adjust lathe speed as appropriate for wood being turned.
12. The work piece must be suitably prepared.
   - A circular shape for faceplate turning or octagonal shape for between centres turning.
13. The work piece must be safely secured between centres or to a face plate using established methods.
14. The tool rest must be adjusted as close as possible to the work piece.
15. The free turning of the lathe must be checked before the machine is started.
16. Allow the machine to develop full speed before turning.
17. Never attempt to remove an excessive amount of material at any one time.
18. Do not allow the machine to run unattended.
19. Tool rest must be removed prior to sanding.
20. Bring the machine to a complete standstill and Isolate the machine from power before cleaning or making adjustments.

<table>
<thead>
<tr>
<th>Dia. of wood (mm)</th>
<th>Speed (r/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>3000</td>
</tr>
<tr>
<td>50</td>
<td>2500</td>
</tr>
<tr>
<td>75</td>
<td>1500</td>
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<td>125</td>
<td>1000</td>
</tr>
<tr>
<td>200</td>
<td>650</td>
</tr>
<tr>
<td>300</td>
<td>570</td>
</tr>
</tbody>
</table>

The following Speeds are recommended for diameter of wood being turned:

**WARNING**
Guards must be in place and function correctly.

**WARNING**
Maintain tool rest as close as practicable to workpiece at all times.

**WARNING**
Remove the tool rest before sanding.
Safety Hazards of a Wood Lathe

Point of operation
- Contact with the rotating workpiece may occur during operation.
  - Under no circumstances should an operator bend down near this machine whilst it is operating.
  - The danger is significant because the operator works in close proximity to the rotating workpiece and the lathe tool.
  - The operator must be aware of the position of their hands and fingers in relation to the workpiece at all times.

In-running nip points.
- Hands may be caught between tool rest and workpiece.

Rotating parts
- Clothing, hair or hands may be caught by and pulled into rotating workpiece or spindles.

Kickback
- The workpiece may be thrown out.
- Operators must be aware of the machine’s capacity to grab lathe tool if improperly presented to the workpiece or if tool rest is incorrectly set.

Flying chips and material
- Dust and splinters, can be thrown up into the operator’s face by the action of the disc leading to eye injuries.
- Wood turning operations produce copious amounts of dust, including pieces of debris, swarf etc.
  - Certain types of wood dust may cause allergic reactions.
  - Wood dust has been determined to be a group A carcinogen by the International Agency for Research on Cancer (IARC).
  - Hardwoods in general such as beech, oak and mahogany and native hardwoods (eucalypts) generate fine particles of dust and this has a prime link with nasal cancers. Softwood timbers from coniferous trees such as pines are less of a risk.
  - Workers exposed to wood dusts have experienced a variety of adverse health effects such as eye and skin irritation, allergy, and reduced lung function, asthma and nasal cancer.
  - Dust extraction must operate efficiently.
Wood Lathe maintenance

A documented Wood Lathe maintenance schedule must be developed and time should be allocated specifically for maintenance purposes.

- The procedure outlined in the maintenance schedule is indicative and may require changes to meet the needs of the school and manufacturer’s recommendations for the specific machine.
- The only criteria being that regular maintenance requirements are identified, actioned and documented along with any repair work undertaken.
- Refer to information supplied with the machine for specific maintenance requirements for this machine.
- Manufacturers and suppliers must supply adequate information for the correct maintenance of the machine including tool changing, adjustment, cleaning and lubrication instructions.

A Wood Lathe is a low maintenance machine.

- Lathe tools must be kept sharp and in sound condition.
- Guarding must be maintained in effective working order.

Where a Disc Sander is fitted to a Wood Lathe the maintenance requirements will increase due to the nature of the abrasive media.

- Where a Disc Sander is fitted replacement discs must be fitted before wear and tear failures occur.
- Ensure abrasive discs are securely attached to the metal disc before operating.
- The Disc Sander work support table must be adjusted to within 2mm of the abrasive disc at all times.

WARNING

Isolation procedures must be implemented when cleaning and when maintenance tasks are carried out on machinery.
Decommissioning a Wood Lathe

A risk assessment using the Risk Assessment Process Part A and Part B proformas must be undertaken before decommissioning to ensure that there is no likely health and safety risk to personnel carrying out the decommissioning of the machine.

- Retain risk assessment as a record.

Where plant is to be dismantled and/or stored as part of decommissioning:

- Ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who dismantles or stores the machine.
- A competent person must carry out dismantling.
- Ensure steps are in place to minimize the potential for injury due to corrosion, machinery fatigue or hazardous substances.

Prior to the removal or relocation of a Wood Lathe the following processes must be completed:
1. The machine must be tagged barring use.
2. A licensed electrician must disconnect hard-wired equipment.
3. Tape the mains cable/plug to the machine.
4. The machine should be in a clean condition.
5. Secure any ancillary equipment such as spanners, tool post, tailstock, tool rests etc. to the machine.
6. Any fixings securing the equipment to its bed should be removed.
7. Any belt drives should be freed from tension.
8. Disconnect the machine from dust collection unit and seal dust collection point.
9. Protect any machined surface with a suitable corrosive preventative.
10. Carefully move the Wood Lathe so that the machine does not create a hazard.
   - Observe manual handling procedures when moving the machine.
11. All original documentation should be placed in a plastic bag, which is then securely taped to the unit.
12. School records and electrical testing databases must be amended.
Wood Lathe glossary

Bed
This runs across the full width of the machine and supports the headstock, tailstock and tool rest bracket.

Belt Profile
The shape of the cross-section of a power transmission belt. Common examples are 'v', multi-'v', flat and round belts. The belt profile must suit the pulley type.

Chuck
A device for holding the work piece to the headstock spindle.

Face Plate
Work that is fixed to a faceplate, which in turn is screwed to the headstock spindle.

Head Stock
The "heart" of the machine. The head stock houses the drive belt(s), the pulleys and the rotating spindle. All the moving parts are safely concealed behind the casing of the machine.

Lux
A unit of measurement relating to light.

Morse Taper
A standard taper much used in engineering. Lathe centres and drill chucks fit very accurately into tapered holes formed in the driving shaft (or the tailstock). The fit is so good that friction alone transmits the power.

Motor Release
This releases the motor to slacken the belts and assists in changing the speed.

Rest
The rest, sometimes called the fence, is attached to the bed by means of a tool rest bracket. The rest provides a horizontal surface to support the turning tool.

Spindle
The spindle is the actual moving part of the machine and is powered from the motor. It consists of a screw thread with a hollow Morse tapered hole allowing a wide variety of attachments to be fitted.

Tailstock
The tailstock is always mounted on the right hand side of the bed as the operator looks at it. Using a lever/nut assembly it can also be moved and locked along the full length of the bed. It has two levers or knobs on it as well as the locking lever. One is to lock the tailstock's spindle in position. The other is to move the tailstock's spindle backwards and forwards.

Three Phase Power
A system of electrical generation and distribution which enables significant economies in industrial applications. Most commonly used in heavy-duty machinery.

Turning between centres
Process of turning work that is held between the headstock and tailstock centres.
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