

## **ELEMENT 4 – WORK EQUIPMENT HAZARDS AND RISK CONTROLS**

- 4.1** Outline general requirements for work equipment.
- 4.2** Explain the hazards and controls for hand-held tools.
- 4.3** Describe the main mechanical and non-mechanical hazards of machinery.
- 4.4** Explain the main control measures for reducing risk from machinery hazards.

### **4.1 THE SELECTION OF WORK EQUIPMENT AND MACHINERY**

Manufacturers and suppliers of new machinery have to ensure that machinery and equipment meets certain standards as required by the Supply of Machinery (Safety) Regulations 2009. These regulations require manufacturers and suppliers to ensure that machinery is safe when supplied, it is provided with suitable instructions, and is CE marked.

Once the equipment is in use within the workplace it is covered by the Provision and Use of Work Equipment Regulations 1998 (PUWER). Equipment put into use before 1/1/95 will not have the CE marking but must still meet the provisions of PUWER when used in any workplace or by employees.

#### **THE SUPPLY OF MACHINERY - THE EUROPEAN MACHINERY DIRECTIVE**

From 1 Jan 1995 all relevant machinery put into use in the European Union (EU) must bear the CE mark, this covers new machinery, imported items and modified machinery. It is illegal to supply new machinery in the EU without the CE mark, it is the passport for the free movement of goods within the EU.

#### **Supply of Machinery (Safety) Regs 2009**

**Relevant Machinery** - This includes:-

“An assembly of linked parts, at least one of which moves, includes power circuits joined together for a specific application.”

“An assembly of machines.... which are arranged and controlled so that they function as a whole”

The definition includes a vast amount of different machinery, it includes construction machinery, fork lift trucks and automated production lines within factory environments.

#### **Supply of Machinery (Safety) Regulations - The CE marking process**

Step 1: Ensure the machine fulfils “Essential Safety Requirements” e.g. meets all relevant BS and EU standards. Some standards cover different types of guarding or control types, other standards cover one specific type of equipment e.g. chain saws.

Step 2: Prepare Technical File – including diagrams, plans, details of guarding and a copy of the user instructions.

Step 3: Prepare Declaration of Conformity which must be signed by a senior person in the company.

Step 4: Affix CE Mark

The designated responsible person within the organisation must ensure machinery:

- satisfies H&S requirements
- undergoes a conformity assessment
- has EU declaration and CE mark or declaration of incorporation
- is safe when used correctly

There are general requirements which need to be met covering issues such as:-

- Markings and warnings
- Guarding
- Control systems
- Control of mechanical and non mechanical hazards
- Instructions for purchasers
- Specific requirements apply for specific hazards and specific machinery

### **Hazardous Machinery**

Certain machines are judged high risk; these are listed in Schedule 4 of the regulations. These require external verification that all essential safety requirements have been met; the equipment and its technical file must be viewed by a nominated body.

Examples: circular saws, sawing machines, planing machines, band saws, portable chain-saws, presses, plastic moulding machines, machinery for working underground, household refuse trucks and vehicle servicing lifts.

### **EMPLOYERS' RESPONSIBILITIES PRIOR TO USING EQUIPMENT**

When an employer places an order for machinery they must specify that the equipment is safe. When it arrives it should be checked to ensure it bears the CE mark and has a Declaration of Conformity. A set of instructions in English on how the machine works or operates should be provided, then the employer must check it is safe to use.

The employer's check should consider:-

- Are there any exposed mechanical hazards? e.g. exposed gear wheels or blades?
- Can the machine operate with the guards removed?
- Are the controls clear and easy to understand?
- Can dust or fumes escape from the machine?
- Is it excessively noisy or is there excessive vibration?
- Are any exposed parts likely to be extremely hot or cold?
- Are there any live electrical parts which are exposed or easy to get at?
- Are there any special features, e.g. slow running speed, for use when setting?
- Are the manufacturers' instructions clear and comprehensive?

**Do not assume just because the equipment has the CE mark that it is safe.**

### **USERS' RESPONSIBILITIES**

- Not to interfere with safety devices
- Not to remove guards
- To follow the training given
- To report faults
- To wear PPE as required
- To clean equipment and machinery after use
- To maintain and lubricate equipment
- Only to use equipment and machinery for the appropriate purpose

## 4.2 PROVISION AND USE OF WORK EQUIPMENT REGS 1998

Machinery and equipment used for work are covered by the Provision and Use of Work Equipment Regulations 1998.

*“any machinery, appliance, apparatus or tool for use at work”*

This wide ranging definition quite literally covers the pen you use at work as well as any automated plant and machinery. The Regulations set some basic standards for all equipment used at work. They were amended in 1998 and now cover power presses, abrasive wheels, wood working machines and lifting equipment. However lifting equipment is additionally covered by the Lifting Operations & Lifting Equipment Regulations 1998 (LOLER.)

Examples of work equipment: hammers, screw drivers, drilling machines, laboratory apparatus, hoists, fork lift trucks, ladders and knives.

### OVERVIEW OF THE REGULATIONS

**SUITABILITY** - All work equipment must be suitable for the task, the working conditions where it is being used and the user. Consideration should be given to the equipment's design and use.

**APPROPRIATE MAINTENANCE** - This could range from fault reporting to planned preventative maintenance. Where maintenance is carried out, records must be kept. Additionally arrangements must be made for maintenance to be carried out safely. All equipment must be maintained in a good condition and in safe working order to support the requirement of Section 2 HASAWA..

**INSPECTION** – Equipment should be inspected if there could be significant risks from incorrect installation or deterioration. Records of these inspections should be kept, e.g. for power presses or abrasive wheels.

**SPECIFIC RISKS** - Where the risk is high e.g. using a band saw, the use and maintenance must be restricted to trained competent people.

**INFORMATION & INSTRUCTION** – This may need to be for managers and employees and should include information on the hazards/risks, safe use, pre-use checks and emergency procedures.

**TRAINING** - For employees and others e.g. casual workers, this may include training in the safe system of work or permit to work.

**EU CONFORMANCE** – The requirement for CE marking of all equipment sold and used in the EU has been in place since 1995.

**DANGEROUS MACHINERY** - Access to moving parts, blades pulleys etc must be prevented. This will normally be achieved by guarding and safety devices.

**DANGEROUS PARTS OF MACHINERY** – The employer should follow a hierarchy of controls which begins with a fixed guard, if this is not possible other guards and protection devices should be used. In addition the provision of jigs and push sticks may need to be used, with training, information and instruction for staff provided to ensure safe use.

The requirement to guard dangerous parts was amended in 2002 to avoid employer's removing guards which the manufacturer had fitted. They can replace them with additional guarding but must not leave dangerous parts unprotected.

The employer must ensure that equipment complies with all essential safety requirements which were there when it was first supplied and covered by its CE mark.

### **Mechanical Hazard Hierarchy for Dangerous Parts**

Where practicable fit a **Fixed** guard – if not possible then ...

**Other guards** – (Interlocking/Automatic/Adjustable/Trip Devices ..if these are not feasible or extra protection is required .....then ...

**Jigs and push sticks** (to keep the operator away from the danger zone)

**Training, information, instruction and supervision** as necessary

**Personal Protective Equipment**

**SPECIFIED HAZARDS** e.g. OVER-HEATING or EJECTION - appropriate precautions must be taken to minimise the effects should over heating or ejection of particles or fluids occur.

**HIGH / LOW TEMPERATURES** - must be controlled to reduce risk of injury.

**CONTROLS** - These must be easily identifiable, in full working order, easily accessible, clearly visible and work in an appropriate manner. Suitable controls for starting, stopping and controlling speed should be fitted. Emergency stops will also be needed for machines where other safeguards do not prevent the risk of needing to stop the machine in an emergency.

**ISOLATION** - electrical plant must be able to be isolated from the power source to prevent it being turned on during maintenance. This may also apply to isolating pipelines.

**STABLE** - every piece of work equipment must be stable for use.

**LIGHTING** - adequate for the task and to use the equipment safely.

**MARKINGS & WARNINGS** - UNAMBIGUOUS following appropriate European or British standards.

**CARRYING EMPLOYEES ON MOBILE EQUIPMENT** – This should not be done unless the equipment is designed for this purpose.

**ROLLING OVER OF MOBILE EQUIPMENT** – Measures should be taken to reduce the risk of roll over which may be more of a risk in certain environments. Roll over protection must be fitted where necessary, i.e. cages or roll over bars.

**OVERTURNING OF FORK LIFT TRUCKS** – Measures to reduce the risk of the truck overturning, additionally restraining systems may be needed to protect the driver. (i.e. seat belts)

**SELF-PROPELLED WORK EQUIPMENT** – Measures should be taken to prevent unauthorised starting and to minimise collisions. All equipment should be fitted with a suitable and effective braking system.

**REMOTE CONTROLLED SELF-PROPELLED EQUIPMENT** – This type of equipment should stop if it leaves its control range. It should include devices to ensure the risks of crushing and impact are controlled.

**DRIVE SHAFTS** – These convey power from mobile equipment to any equipment connected to it. Measures should be taken to ensure the operating mechanism does not become blocked, and that the shaft is safely guarded.

### 4.3 HAND HELD TOOLS

There are a variety of non powered hand tools used which can be hazardous, they may be defective, create dust or ejected particles, have manual handling or ergonomic problems or present the risk of cutting, shearing or abrasion to the hands or body.

Issues to be considered in hand tool selection

- Is it suitable for the job, user and environment
- Quality – the discount shop special may not be suitable!
- Handles – shape, roughness, surface
- Cleanliness
- Cutting edges – sharp
- Repair and storage – some hand tools get damaged not in use but in storage or transportation.



A hazard is the condition with the potential to cause harm, the risk is the likelihood of injury and the possible severity, for the following tools list down the possible hazards, risks and typical precautions which could be taken to reduce the risk of injury.

- Screwdrivers
- Hammers
- Chisels
- Pliers
- Files
- Knives
- Spanners & Wrenches.



## 4.4 POWERED HAND TOOLS

Typical hand held power tools include drills, pneumatic chisels, disc cutters, sanders, cartridge and pneumatic nail guns and chain saws. An awareness of the key hazards, associated risks and typical safe guards and safety precautions is required. Many of the hazards and risks may be similar.

Remember powered tools and machinery may present a range of hazards physical, mechanical, ergonomic, chemical and biological.

Mechanical hazards are all associated with the movement of components or parts i.e. rotating blades or reciprocating belts.

Non mechanical hazards incorporate all the other hazards which may be encountered:

- Electricity - power and static
- Noise
- Vibration
- High/low temperature
- Pneumatic
- Compressed air
- Fire/Internal combustion
- Radiation
- Hazardous substances.

It is important to consider a range of issues when assessing the risks namely:

- Electrically operated tools – are they of suitable voltage? Are plugs and cables in good condition?
- Some power tools may need attachments - are they correctly attached?
- Petrol engines may generate fumes, dust and noise.
- Persons at risk - this could be the user and other people in the near vicinity.
- Severity of possible injury
- Probability of injury
- Need for access to moving parts.
- Duration of exposure
- Reliability of safeguards – fixed guards are the best but may not be suitable for every piece of equipment as they may render it unusable.
- Operating procedures – what procedures will be needed for safe use, cleaning and maintenance?

## 4.5 DANGERS FROM MACHINERY

### PRINCIPLES OF MACHINERY SAFEGUARDING

The fact that a company has not had an accident so far, is not an indication of its safety or compliance with statutory obligations, neither does it indicate how safe any moving / stationary part of a machine is!

Injury can result from:

- Coming into contact with or being trapped between the machine and any other fixed machine/structure/material.
- Being struck by any material in motion or being ejected from a machine.
- Being struck by any part of the machine.
- Becoming entangled in the machine.

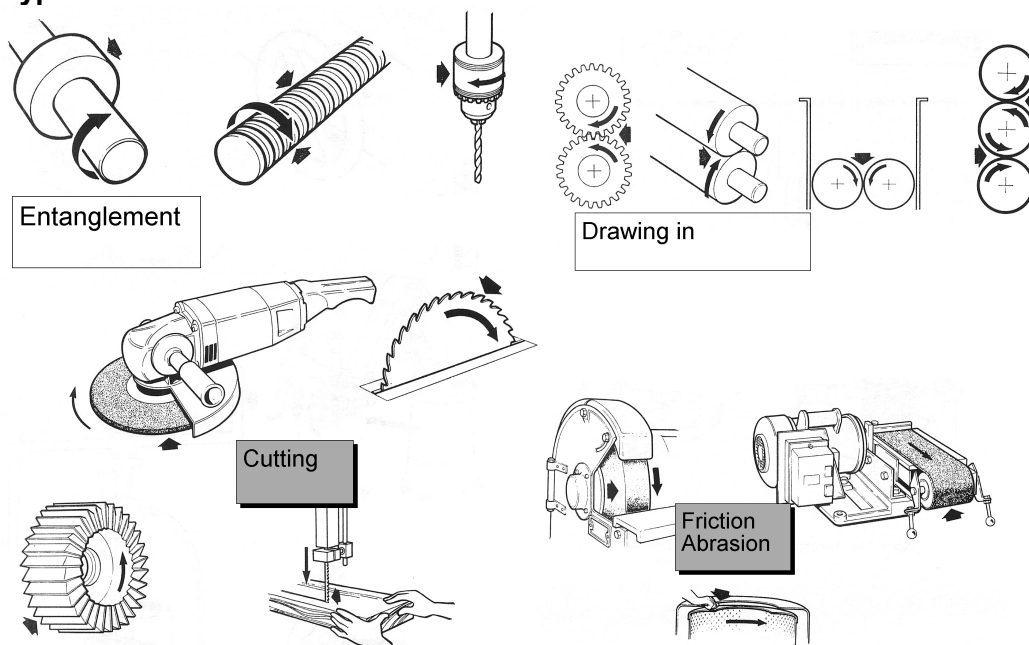
**Mechanical Hazards:** Entanglement, stabbing (puncture), impact, cutting, shearing, drawing in, crushing, abrasion, ejected particles, ejected fluids, being thrown, being run over, injection (of gas or liquid), suffocation and slips and trips (if associated with a machine). These are covered by the BS EN ISO standard 12100.

Each year there are an estimated 16,000 accidents involving machinery.

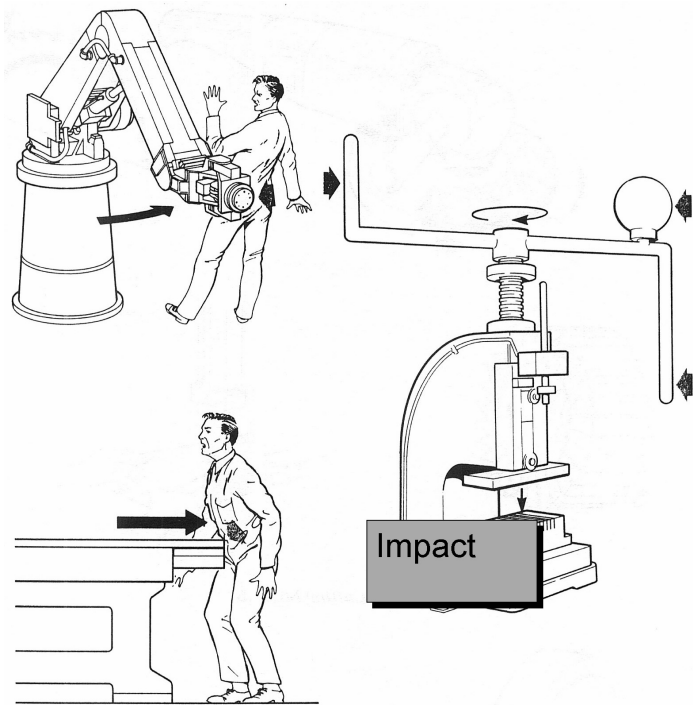
Accidents that occur through lack of, or inadequate, guards are with very few exceptions, serious, resulting in crushed or amputated limbs and on many occasions, death. Over 50% could have been avoided if the existing standards were implemented.

The standards in the UK regarding safeguarding of machinery: British Standard BS 5304 - BSI's Code of Practice on the "Safeguarding of Machinery", they have been updated on a number of occasions and are now covered by **BS EN ISO 12100** – Safety of Machinery.

### Typical Mechanical Hazards







### Typical Non Mechanical Hazards Associated with the Use of Machinery

- Electricity - power and static
- Noise
- Vibration
- High/low temperature
- Pneumatic
- Compressed air
- Biological
- Light
- Ionising Radiation
- Hazardous substances.
- MH
- Lack of space
- Access
- Fumes
- Dust

### 4.6 TYPICAL WORK EQUIPMENT

Review the following equipment and identify the mechanical and non mechanical hazards presented by each along with the guards and other measures which could be taken to reduce the risk of injury to the user.

**a. Strimmer**



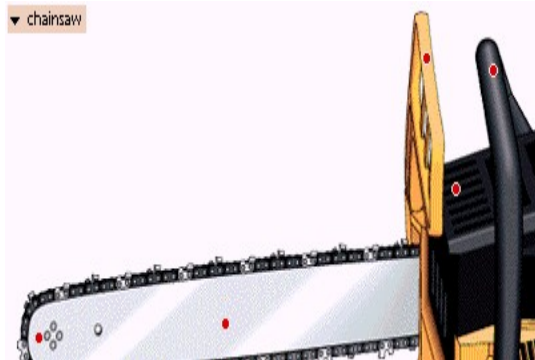
**b. Cement Mixer**



**c. Abrasive wheel**



**d. Chain saw**



**e. Two Bladed Circular Saw**



**f. Waste Compactor**



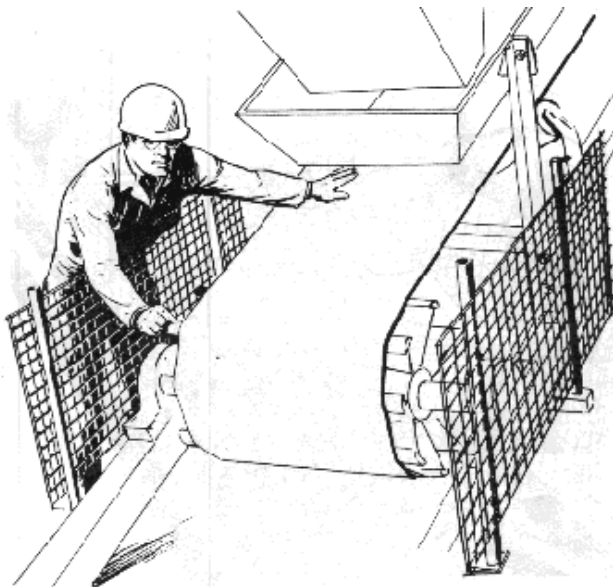
## 4.7 MECHANICAL HAZARDS - HIERARCHY OF CONTROL

### REGULATION 11

- **PUWER Reg 11 Dangerous Parts – hierarchy for mechanical hazards**
- "to prevent dangerous parts of machinery causing danger"
- Where practicable use a fixed guard
- If this is not practicable other guards and protection devices should be used.

**DANGEROUS MACHINERY** - Access to moving parts, blades, pulleys etc must be prevented. This will normally be achieved by guarding and safety devices.

**DANGEROUS PARTS OF MACHINERY** – The employer should follow a hierarchy of controls which begins with a fixed guard, if this is not possible other guards and protection devices should be used. In addition the provision of jigs and push sticks may need to be used, with training, information and instruction for staff provided to ensure safe use. You may use the acronym "FIAT" to assist in remembering the different types of guarding.



Effective guarding must prevent access to the danger area.

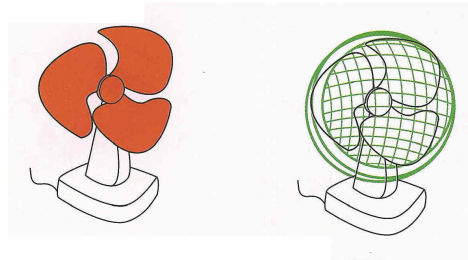
Any guarding fixed to a machine must not introduce further hazards such as trapping points, sharp edges or access problems. The guard must be made from suitable material, strong enough for the task and environmental conditions. It must also be able to withstand day to day use and possible misuse and interference.

#### General requirements for guarding:

- Strength, stiffness, durability
- Effects on the machine - will it make it difficult to use?
- Visibility
- Will it create more hazards e.g. noise or trapping points etc?

**SAFEGUARD** - A guard or device designed to protect persons from danger.

**FIXED** - A guard which has no moving parts, it prevents access to the danger and is in place all the time. It should not be easily removable. e.g. Cage around pulley & metal case around video recorder. Many will need a special tool to remove them. Large fixed guards may make it difficult to maintain the machine or may restrict visibility to the user. (A distance guard is usually a form of fixed guard – there to keep people and parts of their body away from the danger area as shown in the photo here)

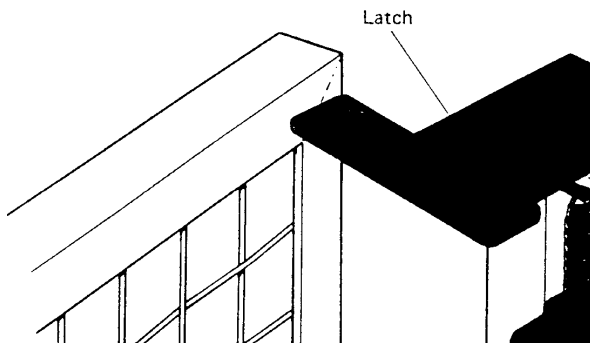


**INTERLOCKING** - A guard which has a movable part connected to the machinery so that the machine cannot be started if the guard is not in place. It allows easy access but in some cases can be easily overridden. e.g. microwave or lift door. The interlock can be mechanical, electronic or hydraulic. The machine **should not** allow access until it has stopped.



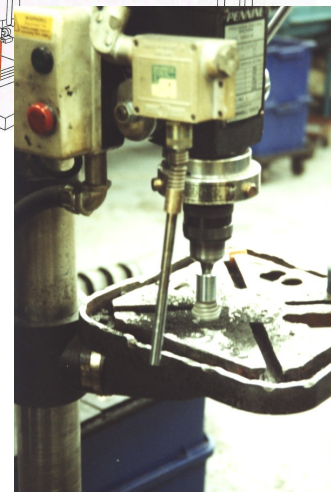
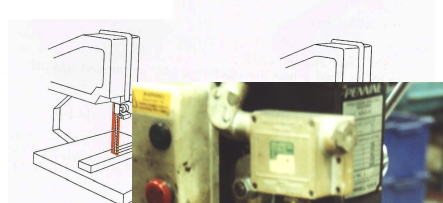
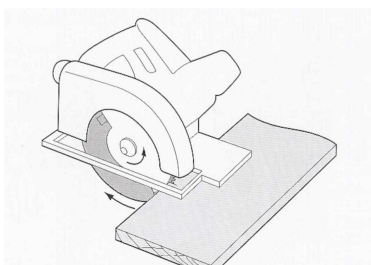
Above: a fixed distance guard.

Diagram of interlock latch.



**AUTOMATIC** - A guard which is dependent upon the machinery, when the machine is switched on the guard comes down and then automatically the machine process will begin. e.g. power press or guillotine. As the operator starts the process the guard comes into place pushing the person out of the danger zone, the machine process will then continue until the end.

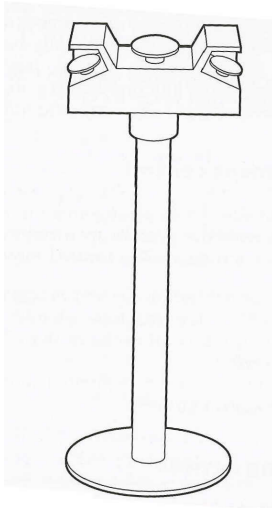
**ADJUSTABLE/SELF ADJUSTING** - The guard can be moved and adjusted depending on the material being worked upon. The aim is to have the smallest part of the blade exposed. e.g. circular saw, bacon slicer and drill. There are also self adjusting guards which as you move the equipment are sprung loaded to cover as much as possible of the blade.



**TRIP DEVICE** - A means whereby any approach by a person beyond the safe limit of working machinery causes the device to activate and stop the machinery or reverse its motion, thus preventing or minimising injury at the danger point. These can be in the form of light beams, pressure pads or probes. A trip device is not a guard as it is not a physical barrier.

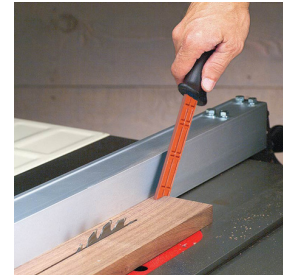
**TWO-HANDED CONTROL DEVICE** - A device which requires both hands to operate the machinery controls, thus affording a measure of protection from danger only to the machine operator. These are not ergonomically sound as some require the operator to press a button with each hand and at the same time operate a foot pedal.

### JIGS AND PUSH STICKS/ PROTECTIVE APPLIANCES



These allow materials to be moved into the danger area but keep the operators hands away from the danger zone.

**FAIL SAFE** - Any failure or interruption of power supply to a safeguard will result in the prompt stopping, or where appropriate the stopping and reversal before injury can occur.



#### Other controls include:-

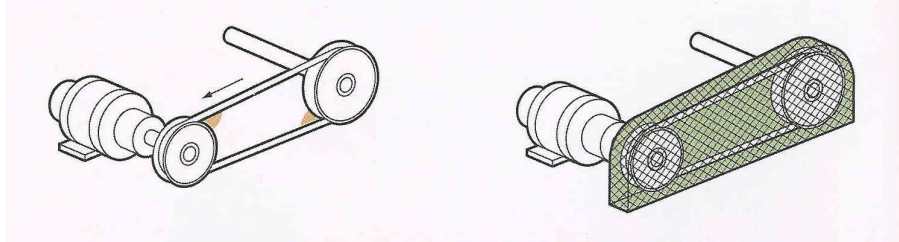
- Hold To Run Device (Deadman's Handle) – where the handle or button must be depressed, once pressure is removed power is removed as well.
- Emergency stop buttons or wires
- Time delays
- Warning signs
- Maintenance
- Safe Systems of Work
- Supervision
- Shrouded pedals

#### TYPICAL MANAGEMENT CONTROLS

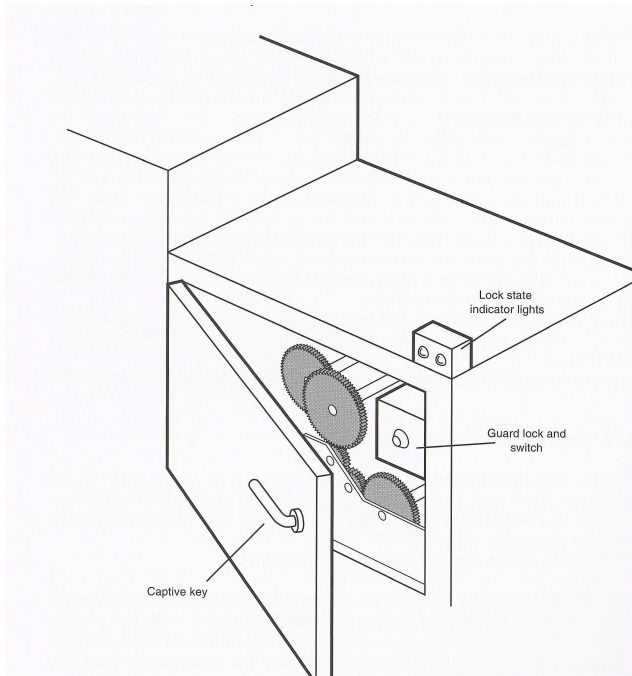
- Training
- No loose fitting clothing
- Supervision
- Good lighting and clear space
- PPE e.g. eye protection, ear defenders and signage

## Examples of Machinery Guarding

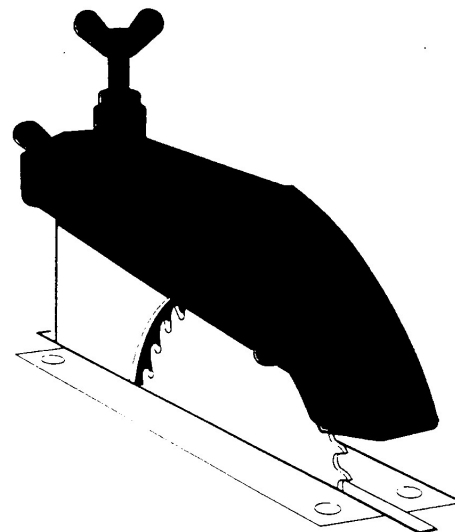
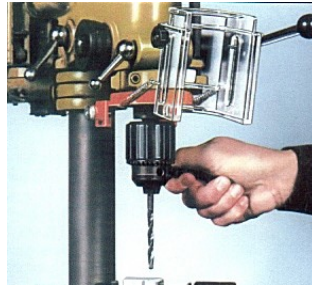
### Fixed Guards



### Interlocking Guards

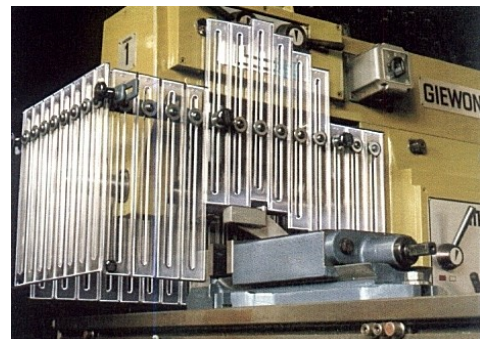
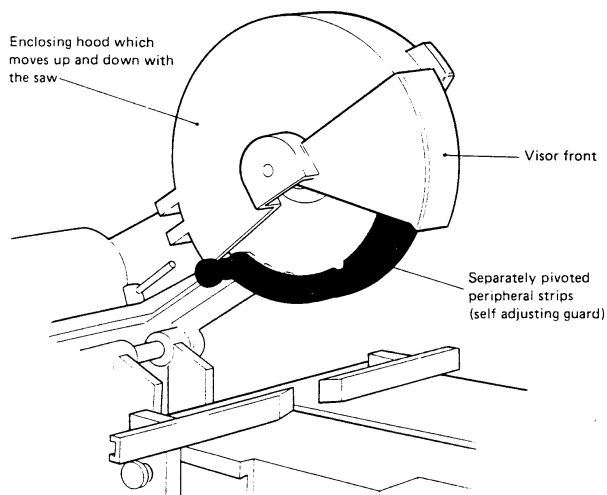


### Adjustable



Slots in the line of cut

### Self Adjusting



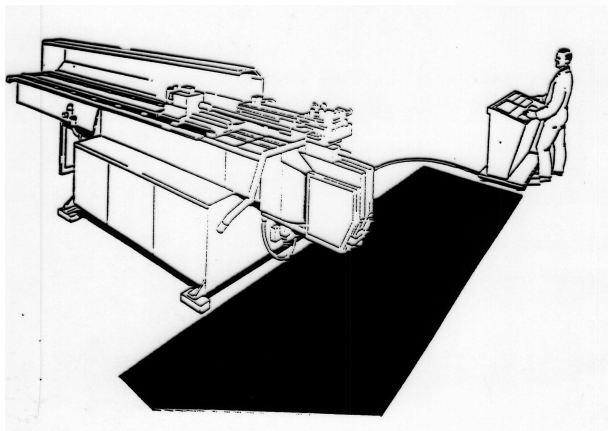
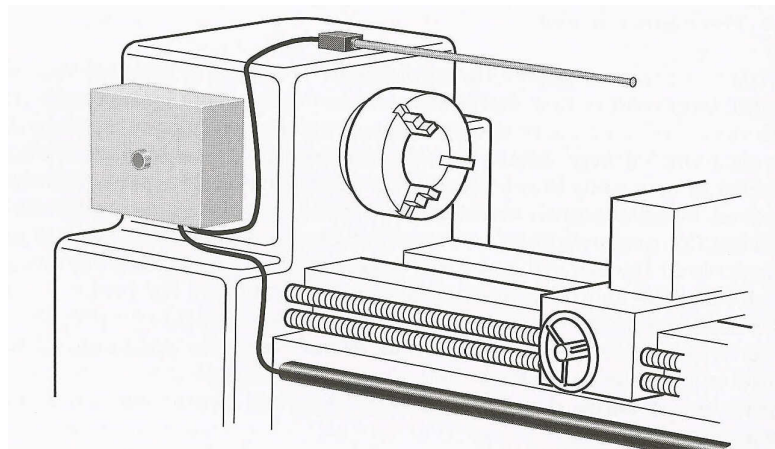
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## Automatic Guard



Self Adjusting on a saw

**Trip devices** – Light beams, probes and pressure mats.





## 4.8 MAINTENANCE WORK

Maintenance work encompasses a range of different activities including the maintenance of machinery, cleaning, repairs to buildings and general maintenance of outside areas. Rather than deal specifically with each aspect of maintenance, the general hazards and principles of control are considered below. As you will see a majority of these hazards are covered by the other elements of the GC2 syllabus. However when undertaking maintenance work, the risks may increase due to the nature of the work, the possibility of working on live or unguarded machinery and the working environment where the work is undertaken, which may range from on a roof, in a confined space or even inside a large machine.

### PRINCIPLE HAZARDS

#### PHYSICAL

**Mechanical** – Cutting, Entanglement, Contact, Ejection, Shearing, Crushing, Drawing in & Unexpected start-up.

**Electrical** - From coming into contact with live electricity which may present a risk of electrocution or electric shock.

**Pressure** - The unexpected release of stored pressure & explosion. This could be from pneumatics or hydraulics or even electricity.

**Other** - Extremes of Temperature, Noise & Vibration, Naked Flames - Fire & Explosion.

#### CHEMICAL

**Gases, Fogs, Mists, Fumes, Dust** may be encountered. Oils and greases may be used during maintenance work

Lack of oxygen e.g. in a confined space.

#### ERGONOMIC

**MH** - Awkward Lifting / Pulling / Pushing / Carrying positions.

**Access issues** - Obstructions, Floor openings, Sloping surfaces, Work at height & Confined spaces.

#### BIOLOGICAL

Places/machines where the engineer may disturb old decaying debris.

### PRECAUTIONS (both general and specific)

- Safe Systems of Work/Permits to Work
- Defined Competent People for high risk operations
- Method Statements for contractors - how they intend to carry out the task
- Supervision/Enforcement of Contractor Rules
- Limit access where maintenance is being carried out and barriers to protect the rest of the workforce

- Training, Supervision, Information and Instruction
- Signs, marking and labelling
- P.P.E - gloves, face masks, safety shoes
- Lock Off Procedures for pipelines and electrical energy (isolation)
- Adequate ventilation and lighting (may need to be intrinsically safe where there are flammable vapours)
- Provide safe access e.g. ladders & scaffold.
- Allow hot surfaces to cool prior to work or work nearby
- Suitable tools to complete the task e.g. intrinsically safety electrical equipment in flammable atmospheres.

#### **4.9 STATUTORY EXAMINATIONS SUMMARY**

- Lifting equipment used to lift people i.e. hoists every 6 months
- Lifting equipment used to lift materials. i.e. FLT or crane every 12 months
- Lifting tackle e.g. slings and chains every 6 months
- Power presses Daily checks /6 months for non fixed guards
- Pressure Vessels – written scheme to determine frequency
- Local exhaust ventilation units – every 14 months

#### **4.10 MECHANICAL HAZARD HIERARCHY OF CONTROL**

- F – Fixed
- I – Interlocking
- A – Adjustable (Self Adjusting/ Automatic
- T – Trip devices
- 2 handed – controls
- Jigs/Push Sticks
- Other devices : hold to run devices
- Mgt Controls
  - Training
  - No loose fitting clothing
  - Supervision
  - Good lighting and clear space
  - PPE e.g. eye protection, ear defenders and signage