

Managing Physical Hazards

Lecture Title: Machinery, Mechanical Hazards & Machine Safeguarding

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**Undergraduate Diploma in
Occupational Health and Safety**

Welcome and Objectives

Students examine mechanical hazards including entanglement, crushing, cutting, impact, shearing, and drawing-in. Safeguarding methods—guards, interlocks, presence-sensing devices—are introduced. Lockout/tagout (LOTO) principles and safe isolation procedures are reviewed. Real case studies highlight common incident mechanisms.



Welcome, Module Roadmap & Transition from Risk Management

Lecture 1 — Introduction to Physical Hazards & Regulatory Frameworks

Lecture 2 — Measurement & Monitoring Techniques for Physical Hazards

Lecture 3 — Noise & Vibration Hazards: Exposure, Measurement & Control

Lecture 4 — Thermal Hazards: Heat Stress, Cold Stress, and Thermal Comfort

Lecture 5 — Radiation Hazards: Ionising and Non-Ionising

Lecture 6 — Lighting, Visibility, and Workplace Ergonomics

Lecture 7 — Machinery, Mechanical Hazards & Machine Safeguarding

Lecture 8 — Workplace Environment Hazards: Slips, Trips, Falls, and Confined Spaces

Lecture 9 — Integrated Physical Hazard Management & Continuous Improvement

Lecture 10 — Physical Hazard Control Strategies: Engineering, Administrative & PPE

18th May

This module focuses on physical agents and their technical, physiological, and legal considerations



Why Machinery Safety Matters to Managing Physical Hazards

1. **Machinery** is a primary source of **physical harm** in the workplace, driven by:
 - Mechanical energy
 - Force and motion
 - Stored energy
2. Unlike many **physical hazards** that cause harm **over time**, machinery can cause:
 - Instant injury
 - Permanent disability &
 - Fatal outcomes



Why Machinery Safety Matters to Managing Physical Hazards

3. Machinery hazards act directly on the human body through:
 - Entanglement
 - Crushing
 - Cutting and Shearing
 - Impact and trapping
4. Effective control of machinery hazards requires:
 - Engineering design
 - Machine safeguarding
 - Safe systems of work
 - Anticipation of human error

Why Focus on Machinery?

1. Machinery remains one of the leading causes of serious and fatal workplace accidents.
2. Typical outcomes include:
 - Amputations
 - Crushing injuries
 - Permanent disability
 - Fatal incidents

Most machinery accidents are predictable and preventable.



Why Are Machinery Accidents So Severe?

1. Machinery accidents are often:
 - High-energy
 - Involving moving or rotating parts
 - Rapid in escalation
 - Unforgiving of mistakes

Once contact occurs:

- There is little or no time to react
- Injuries escalate very quickly



Machinery Hazards vs Other Hazards

1. Unlike many workplace hazards:
 - Machinery hazards are always present
 - Energy is often continuous or stored
 - Human error can have immediate consequences
2. This makes:
 - Design
 - Safeguarding
 - Safe systems of work
 - Critical controls



Maintenance: A Hidden High-Risk Activity

1. Many serious machinery accidents occur during:

- Cleaning
- Adjustment
- Set-Up
- Maintenance

2. Reasons include:

- Guards removed
- Unexpected start-up
- Exposure to dangerous parts



What We Mean by "Machinery"

1. For safety purposes, machinery includes:

- Fixed machines
- Mobile machinery
- Powered hand tools
- Automated and semi-automated systems

2. Hazards exist:

- During normal operation
- During non-routine tasks



What Is “Machinery”?

1. Machinery refers to any equipment with moving parts that performs work and can expose people to mechanical hazards.
2. In occupational health and safety, machinery is interpreted:
 - **Broadly** – not limited to large industrial machines
 - **Practically** – based on how work is actually carried out
 - **Based on risk** – not on size, complexity, or appearance



Machinery as a Source of Physical Hazards

1. In the context of Managing Physical Hazards, machinery is a major source of:
 - Mechanical energy
 - Moving parts
 - Forces capable of causing injury on contact
2. These characteristics mean machinery presents physical hazards that act directly on the body.



Linking Machinery to Physical Hazards

1. Machinery creates physical hazards through:
 - Motion (rotating, sliding, reciprocating parts)
 - Force (crushing, shearing, impact)
 - Energy transfer (mechanical, electrical, hydraulic)
2. Injury occurs when the body comes into direct contact with these hazards.



Why Machinery Fits Within Physical Hazards

1. Machinery hazards are classified as physical hazards because:
 - They arise from physical interaction
 - They do not rely on chemical or biological exposure
 - Harm occurs through direct mechanical action
 - Injuries are immediate and observable
2. Examples include:
 - Entanglement, Crushing, Cutting, Impact



Accident Statistics & Lessons Learned

Machinery Accidents: The Reality

1. Accidents involving machinery are among the most serious workplace incidents.
2. They frequently result in:
 - Life-changing injuries
 - Permanent disability
 - Fatal outcomes
3. Severity is a defining feature of machinery accidents.



Typical Injury Outcomes

1. Common injury outcomes from machinery accidents include:

- Amputations
- Crushing injuries
- Entanglement injuries
- Fatalities

2. These injuries often involve:

- Hands and fingers
- Arms and limbs
- Whole-body trauma



Amputations

1. Machinery-related amputations commonly occur due to:
 - Contact with rotating parts
 - Cutting or shearing movements
 - Drawing-in to rollers or conveyors
2. Key characteristics:
 - Often instantaneous
 - Permanent
 - Frequently preventable with guarding



Crushing Injuries

1. Crushing injuries arise when a person is caught:
 - Between moving parts
 - Between moving and fixed parts
2. Typical consequences include:
 - Fractures
 - Internal organ damage
 - Long-term disability
 - Fatal injuries in severe cases



Entanglement Injuries

1. Entanglement occurs when:

- Clothing, hair, gloves or body parts
- Are caught in rotating machinery

2. These incidents:

- Escalate extremely quickly
- Leave little or no time to react
- Often result in severe trauma or death



Fatalities Involving Machinery

1. Machinery fatalities often involve:
 - Entanglement in rotating equipment
 - Crushing during maintenance
 - Unexpected start-up of machinery
 - Inadequate safeguarding or isolation
2. Many fatalities occur during non-routine tasks.

Why Are Machinery Accidents Preventable?

Most machinery accidents are preventable because:

- Hazards are known and well-documented
- Injury mechanisms are predictable
- Proven safeguards already exist
- Safe systems of work can be implemented



Lessons Learned from Machinery Accidents

1. Key lessons from accident data:

- Guards are often missing or bypassed
- Maintenance is a high-risk activity
- Human behaviour must be anticipated
- Design and safeguarding save lives



Mechanical Hazards & Injury Mechanisms

Types of Mechanical Hazards

1. Entanglement (rotating shafts, belts, chains)
2. Crushing (moving vs fixed parts)
3. Shearing (sliding or reciprocating parts)
4. Cutting / Severing (blades, saws)
5. Impact (moving machine parts)
6. Drawing-in / Trapping points

Entanglement

1. Entanglement hazards occur when rotating or moving parts catch clothing, hair, gloves, or body parts.
2. Common sources include: Rotating shafts, Belts and pulleys, Chains and sprockets
3. Injury mechanism:
 - Initial contact with a rotating part
 - Material or body wraps around the component
 - Person is pulled rapidly into the machinery

Extremely fast escalation, Little or no time to react, High likelihood of severe or fatal injury



Crushing

1. Crushing hazards occur when a person or body part is caught between moving and fixed parts, or two moving parts
2. Typical examples: Mechanical presses, Hydraulic systems, Moving tables, rams, or platforms
3. Injury mechanism:
 - Person enters a danger zone
 - Machine movement applies force
 - Body is trapped and compressed
4. Common injury outcomes: Fractures, Internal organ damage
Amputations or fatalities



Shearing

1. Shearing hazards arise when two machine parts move across each other in a sliding or reciprocating motion.
2. Common situations include: Guillotines, Press brakes, Reciprocating machinery
3. Injury mechanism:
 - Body part enters shear point
 - Opposing movements cut or sever tissue

Scissor-like action, High force over short distance Hands and fingers most commonly affected

Cutting / Severing

1. Cutting and severing hazards result from sharp or rotating cutting elements.
2. Typical machinery includes: Circular saws, Band saws, Blades and knives
3. Injury mechanism:
 - Direct contact with sharp or rotating edge
 - Immediate and severe tissue damage
4. Typical injuries: Deep lacerations, Partial or complete amputations

Impact

1. Impact hazards occur when a person is struck by moving machinery or moving machine parts.
2. Common sources include: Moving machine arms, Automated or robotic systems Ejected materials or components
3. Injury mechanism:
 - Machine or object strikes the body
 - Energy is transferred on impact

Risk increases when: Movement is unexpected, Visibility is limited & Automation is involved



Drawing-In / Trapping Points

1. Drawing-in hazards occur when machinery pulls material — and body parts — into a dangerous area.
2. Typical locations include: Conveyors, Rollers Feed mechanisms
3. Injury mechanism:
 - Contact with moving surface
 - Machine actively pulls body toward hazard
 - Often combined with crushing or entanglement
4. Machine power creates the pulling force

Danger Zones

1. A danger zone is any area where a person may be exposed to a mechanical hazard due to machine movement.
2. Danger zones may exist:
 - Around moving parts
 - During normal operation
 - During cleaning, maintenance, or set-up
3. Danger zones can change depending on the task being performed.



Point of Operation

1. The point of operation is where the machine performs its intended work.
2. Examples: Cutting, Pressing, Shaping, Forming material
3. This area often presents the highest mechanical risk.



Transmission Parts

1. Transmission parts are components that transmit power or motion within a machine.
2. Examples include: Belts, Gears, Pulleys, Chains & Shafts
3. These parts are frequently involved in:
 - Entanglement
 - Drawing-in injuries



Key Emphasis

1. Mechanical hazards are predictable
2. Injury mechanisms are well understood
3. Most injuries occur when people enter danger zones
4. Safeguarding must prevent access to points of operation and transmission parts

Every mechanical hazard has three elements: movement, force, and access. Remove access, and the injury cannot happen.

How Injuries Occur – Accident Causation

How Machinery Injuries Occur

Machinery injuries usually occur when:

- A person interacts with a mechanical hazard
- Existing controls are missing, bypassed, or ineffective
- Unsafe behaviours combine with unsafe condition

Injuries are the result of cause-and-effect, not chance.



How Injuries Occur – Accident Causation

Bypassing Guards

1. Bypassing or removing guards is a major contributor to machinery accidents.
2. Common reasons include:
 - Increasing speed or productivity
 - Clearing blockages or jams
 - Easier access during maintenance
 - Over-familiarity with the machine
3. Result:
 - Direct exposure to danger zones
 - Increased likelihood of entanglement, crushing, or cutting



How Injuries Occur – Accident Causation

Working Too Close to Dangerous Parts

1. Injuries occur when workers:
 - Place hands near moving parts
 - Reach into operating machinery
 - Enter danger zones during operation
2. This often happens during: Set-up Adjustment, Fault-finding
Cleaning

Proximity increases risk even if the task feels routine.

Loose Clothing, Hair and Personal Items

1. Loose items significantly increase entanglement risk, including:
 - Loose clothing
 - Long hair
 - Gloves
 - Jewellery
2. Injury mechanism:
 - Item contacts rotating part
 - Material wraps around component
 - Person is pulled into the machine

These risks are often underestimated until an incident occurs.

Poor Housekeeping

1. Poor housekeeping contributes indirectly to machinery accidents by:
 - Causing slips or loss of balance near machines
 - Obstructing safe access and egress
 - Encouraging unsafe reach or awkward positioning

Housekeeping is a **preventive control**, not a cosmetic issue.

Fatigue and Time Pressure

Fatigue and time pressure increase accident likelihood by:

- Reducing concentration
- Increasing shortcuts
- Encouraging guard bypass
- Impairing risk perception

These factors are commonly present:

- At the end of shifts
- During breakdowns
- Under production deadlines



Unsafe Acts vs Unsafe Conditions

Unsafe Acts

- Actions taken by people
- Examples: bypassing guards, reaching into machinery

Unsafe Conditions

- Workplace or equipment deficiencies
- Examples: missing guards, poor design, faulty interlocks

Most accidents involve both, not one alone.



Why Focusing Only on Behaviour Is Not Enough

Blaming unsafe acts alone:

1. Ignores workplace design
2. Ignores organisational pressures
3. Does not address root causes

Effective prevention requires:

1. Engineering controls
2. Safe systems of work
3. Training and supervision

Predictable Misuse of Machinery

Machinery is often misused in ways that are:

- Foreseeable
- Repeated
- Driven by real work demands

Examples: Bypassing guards to meet targets
Using machines for unintended tasks
Working inside danger zones to save time

Safe design must anticipate misuse.



Key Learning Points

1. Machinery injuries follow predictable patterns
2. Human behaviour is influenced by environment and pressure
3. Unsafe acts and unsafe conditions interact
4. Machinery safety must be designed for real-world use



What is Machine Safeguarding

1. Machine safeguarding refers to the **use of engineering measures, devices, and systems** designed to protect people from injury by preventing contact with hazardous machine parts or operating conditions.
2. Safeguards aim to protect workers during:
 - Normal machine operation, Set-up and adjustment,
 - Cleaning and maintenance, Faults &
 - foreseeable misuse.

Prevent injury without relying solely on worker behaviour.



Why Is Machine Safeguarding Necessary?

Machines can create hazards through:

- Moving parts (rotation, reciprocation, cutting)
- In-running nip points
- Crushing, shearing, or entanglement
- Ejected materials or broken parts
- Unexpected start-up or stored energy

Without safeguards, even **experienced** workers are exposed to serious injury risks such as:

Amputations, Crush injuries, Lacerations, Fatal entanglement



Core Principles of Machine Safeguarding

Effective safeguarding is based on four fundamental principles.

1. Prevent Access to Hazardous Areas
2. Stop Motion Before Contact
3. Minimise the Severity of Injury
4. Fail-Safe Design

Prevent Access to Hazardous Areas

1. Safeguards must physically prevent people from reaching dangerous machine parts.
2. This can be achieved by:
 - Fixed guards
 - Interlocked guards
 - Distance guarding
 - Enclosures or barriers

If a body part cannot reach the hazard, injury cannot occur



Stop Motion Before Contact

1. Where access is required (e.g. loading, clearing jams), safeguards must:
 - Stop machine movement automatically before contact is possible

Examples include:

- Interlocked guards
- Light curtains
- Pressure-sensitive mats
- Two-hand control devices

The machine must stop before a person can be harmed.



Minimise the Severity of Injury

1. Where hazards cannot be fully eliminated, safeguarding should:

- Reduce the force, speed, or energy involved
- Limit the seriousness of injury if contact occurs

Examples:

- Reduced-speed modes during set-up
- Torque limiting devices
- Cushioned or rounded surfaces

If contact occurs, the injury should be minor, not catastrophic.



Fail-Safe Design

1. Safeguards must be designed so that:
 - Failure of a component leads to a safe condition
 - The machine stops or remains stopped if a fault occurs

This includes:

- Loss of power
- Broken sensors
- Wiring faults
- Control system failures

A safeguarding system should never fail dangerously.



Types of Machine Safeguards

Overview: Types of Machine Safeguarding

1. Machine safeguarding can be divided into two main categories:
 - **Guards (Physical Barriers)**
 - **Safeguarding Devices (Active Protection Systems)**

Both aim to protect workers from mechanical hazards but operate in different ways and are suitable for different situations.

Guards (Physical Barriers)

1. Guards are physical barriers installed on machines to prevent access to hazardous moving parts.
2. They are the most basic and preferred form of machine safeguarding where practical.

Types of Guards:

- Fixed guards
- Interlocking guards
- Adjustable guards
- Self-adjusting guards

Fixed Guards

1. Fixed guards are permanently attached barriers that completely enclose dangerous parts of a machine.
2. They can only be removed using tools.
3. Typical examples:
 - Covers over gears, belts, and pulleys
 - Enclosures around rotating shafts





Fixed Guards – Pros and Limitations

○ Advantages

1. Very reliable
2. No moving parts or sensors
3. Low maintenance
4. High level of protection

○ Limitations

1. Not suitable where frequent access is required
2. Removal for maintenance may introduce risk
3. May be bypassed if improperly designed

The hazard does not require regular access during normal operation.

Interlocking Guards

1. Interlocking guards are connected to the machine's control system.
2. When the guard is opened or removed:
 - The machine automatically stops
 - The machine cannot restart until the guard is properly closed



Interlocking Guards – Pros and Limitations

○ Advantages

1. Allows access without exposing workers to moving parts
2. Reduces reliance on administrative controls
3. Suitable for frequent access task

○ Limitations

1. More complex than fixed guards
2. Can be defeated or bypassed if not properly designed
3. Requires inspection and maintenance

Operators need routine access for loading, clearing jams, or adjustments

Adjustable Guards

1. Adjustable guards allow the opening to be manually adjusted to suit different sizes of material or tools.
2. Commonly used on:
 - Drills
 - Milling machines
 - Bench grinders





Adjustable Guards – Pros and Limitations

○ Advantages

1. Flexible for different tasks
2. Simple design
3. Better than no guard at all

○ Limitations

1. Relies heavily on correct worker adjustment
2. Can be left open or incorrectly positioned
3. Offers lower protection compared to fixed or interlocked guards

Heavily dependent on operator behaviour.

Self-Adjusting Guards

1. Self-adjusting guards move automatically as material is fed into the machine.
2. The guard returns to a closed position when material is withdrawn.
3. Examples:
 - Circular saw blade guards
 - Wood-working machines



Self-Adjusting Guards – Pros and Limitations

○ Advantages

1. Adjusts automatically to material size
2. Avoids need for manual setting
3. Provides continuous protection

○ Limitations

1. Moving parts may fail if poorly maintained
2. Protection is limited during feeding
3. Less effective for very small workpieces

Heavily dependent on operator behaviour.

Summary: Guards (Physical Barriers)

1. Guards provide passive protection
2. Fixed and interlocking guards offer the highest level of safety
3. Adjustable and self-adjusting guards require greater user awareness
4. Guards should not create new hazards or interfere with visibility

Safeguarding Devices

Safeguarding devices **do not physically** block access but instead detect the presence of a person and automatically stop or prevent machine operation.

They are used when guards are impractical or interfere with production.

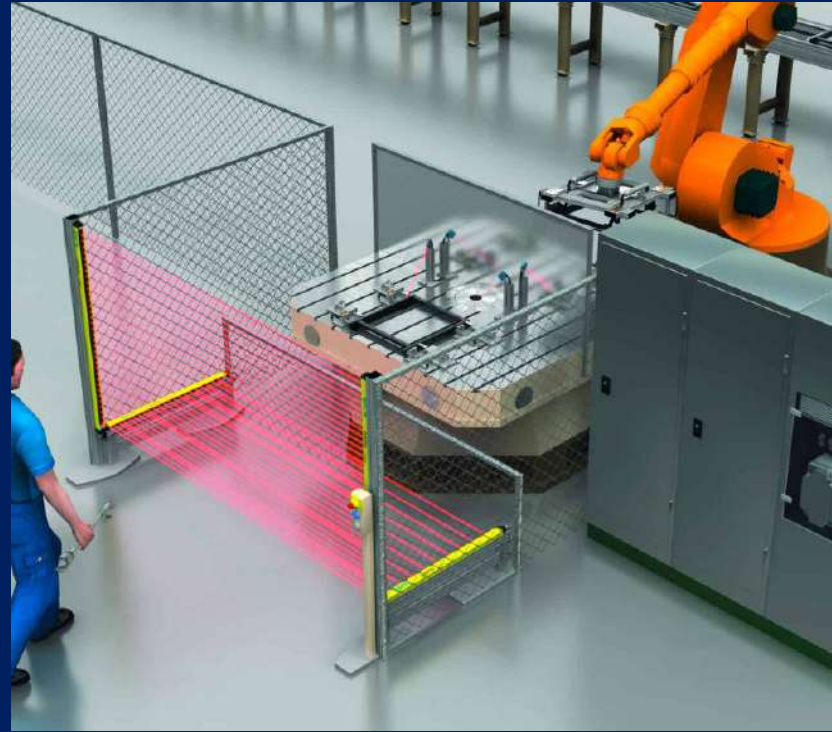
Common Types of Safeguarding Devices

- Light curtains
- Pressure-sensitive mats
- Two-hand control devices
- Presence-sensing devices



Light Curtains

- ❖ Light curtains consist of a beam of infrared light across a hazardous area. If the beam is interrupted:
 - The machine stops immediately
 - Commonly used on:
 - Presses
 - Robotic cells
 - Automated production lines



Light Curtains – Pros and Limitations

○ Advantages

1. No physical barrier
2. Allows visibility and access
3. Suitable for high-speed automated machinery

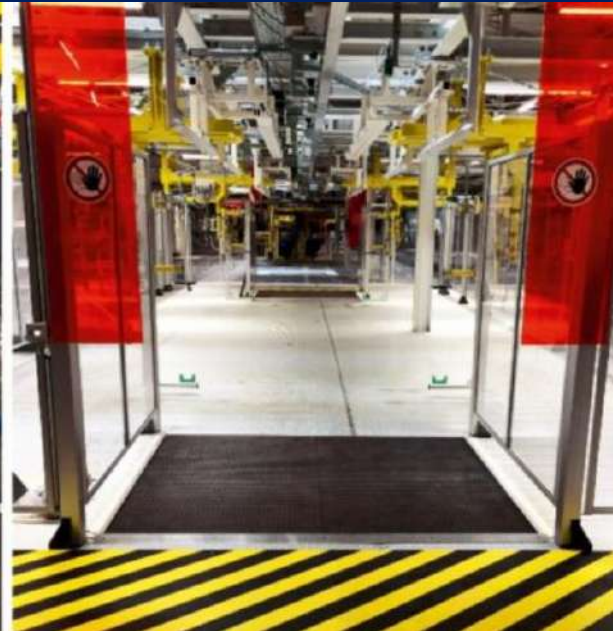
○ Limitations

1. Cannot protect against ejected materials
2. Must be correctly positioned and maintained
3. Does not prevent reaching around or over if poorly designed

Pressure-Sensitive Mats

1. Pressure-sensitive mats detect a person stepping into a hazardous area.
2. Upon activation:
 - The machine stops or prevents start-up
 - Often used around:
 - Robotic work cells
 - Large automated machines





Pressure-Sensitive Mats – Pros and Limitations

○ Advantages

1. Covers large areas
2. Allows flexible worker movement
3. Invisible to normal operations

○ Limitations

1. Can be damaged or worn
2. May trip unintentionally
3. Requires regular testing and inspection



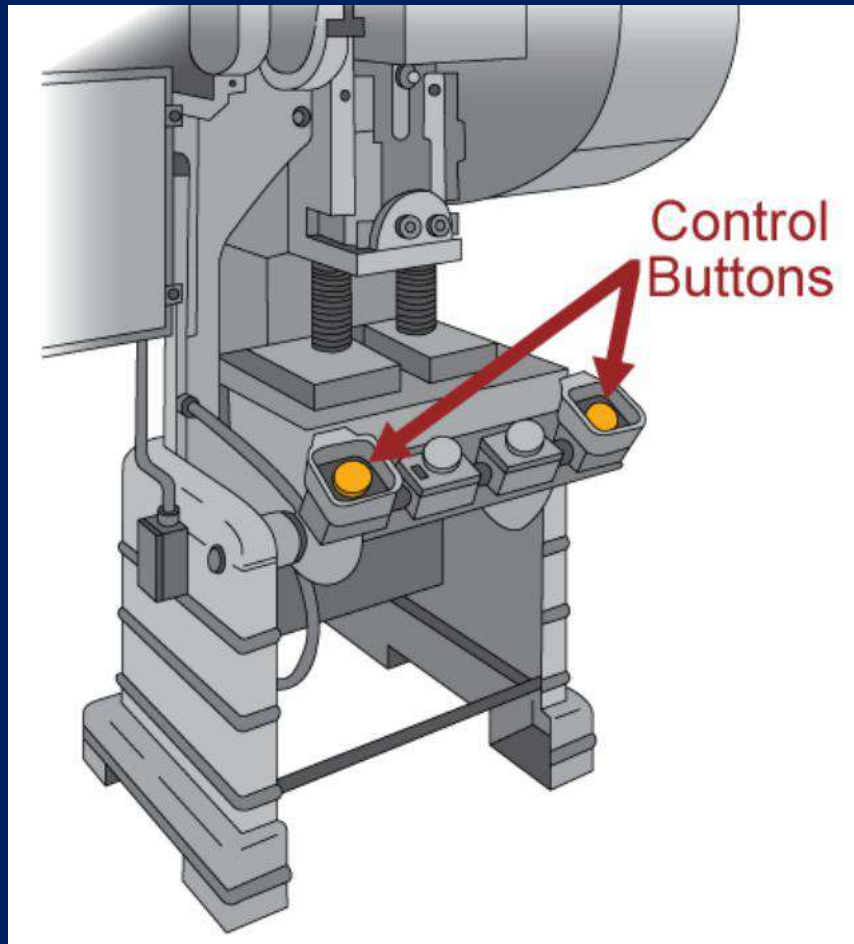
Two-Hand Control Devices

1. Two-hand controls require the operator to use both hands simultaneously to activate a machine.
2. This ensures:
 - Hands are away from the danger zone during operation

Commonly used on:

- Press brakes
- Punch presses





Two-Hand Controls – Pros and Limitations

○ Advantages

1. Simple and effective
2. Prevents hand-in-danger-zone injuries
3. Easy to understand and use

○ Limitations

1. Protects only the operator
2. Does not protect others nearby
3. Can be defeated if poorly designed



Presence-Sensing Devices

1. Presence-sensing devices detect the presence of a person within a defined hazardous area.
2. Includes:
 - Laser scanners
 - Radar-based sensors
 - Vision systems
 - Widely used with:
 - Robots and automated systems



Presence-Sensing Devices – Pros and Limitations

○ Advantages

1. High level of flexibility
2. Suitable for complex automated systems
3. Can adapt to different operating modes

○ Limitations

1. Technically complex
2. Requires specialist setup
3. Sensitive to environmental conditions



When Are Safeguarding Devices More Appropriate Than Guards?

1. Safeguarding devices are preferred when:
 - Physical guarding is impractical
 - Frequent access is required
 - Production speed must be maintained
 - Automated or robotic systems are used

Devices should never replace guards if a fixed guard can reasonably be used.

Reliability and Limitations of Safeguarding Devices

1. Devices rely on electrical, electronic, or software systems
2. They require:
 - Regular testing
 - Preventive maintenance
 - Competent inspection
3. Poor design or bypassing can lead to serious accidents

Active devices must be fail-safe and subject to rigorous management.

Complementary Protective Measures

Safeguarding Is Not Only Guards

1. Machine safety does not rely on a single measure.
2. While guards and safeguarding devices are essential, additional protective measures are required to:
 - Control residual risk
 - Manage non-routine activities
 - Protect during maintenance, faults, and emergencies
3. Effective machine safety = multiple layers of protection



Emergency Stop Devices

1. Emergency stop devices allow workers to quickly stop machinery in an emergency.
2. Characteristics:
 - Clearly visible and easily accessible
 - Red, mushroom-type push buttons
 - Must stop the machine as quickly as possible

Emergency stops do not replace safeguarding:
they only reduce harm once danger exists.





Lockout / Tagout (LOTO)

1. Lockout/Tagout (LOTO) is a procedure used to:
 - Isolate machinery from all energy sources
 - Prevent unexpected start-up during maintenance or repair
 - Energy sources include:
 - Electrical
 - Mechanical
 - Hydraulic, Pneumatic
 - Stored energy (springs, pressure, gravity)

A machine must be dead, isolated, and secured before work begins





Why LOTO Is Critical

1. LOTO is essential during:
 - Maintenance work
 - Cleaning and clearing blockages
 - Adjustments and repairs
2. Many serious accidents occur when:
 - Machines restart unexpectedly
 - Stored energy is released

LOTO saves lives, especially during non-routine tasks.



Safe Systems of Work (SSoW)

1. A Safe System of Work is a formal procedure that defines:
 - How a task should be done safely
 - Who is authorised to perform it
 - What controls must be in place

2. Systems must be:
 - Documented
 - Communicated
 - Regularly reviewed



Training and Supervision

1. Even the best safeguards can fail if workers:
 - Do not understand the risks
 - Are not trained to use machines correctly
2. Training should cover:
 - Machine hazards
 - Correct use of guards and devices
 - Emergency procedures
 - Prohibited behaviours (e.g. bypassing guards)

Supervision ensures safeguards are used as intended.



Warning Signs and Markings

1. Warning signs and markings provide visual alerts to hazards.
2. Examples:
 - Hazard warning signs
 - Moving parts labels
 - Floor markings and exclusion zones

3. Limitation:

Signs do not physically prevent injury — they only warn.

Personal Protective Equipment (PPE)

1. PPE includes:

- Gloves
- Safety footwear
- Eye and face protection
- Hearing protection

1. PPE is The last line of defence
2. Dependent on correct use by workers
3. Ineffective if chosen incorrectly

PPE should only be used after
higher-level controls are applied

Reinforcing the Hierarchy of Control

1. Machine safety controls must follow the Hierarchy of Control:
 - Elimination
 - Substitution
 - Engineering controls (guards, devices)
 - Administrative controls (SSoW, training, signs)
 - PPE

The lower you go in the hierarchy, the greater the reliance on human behaviour.



Legal Duties & Practical Application

Main Maltese Legislation Governing Machinery Safety

1. Machine safety in Malta is primarily governed by:
 - Health and Safety at Work Act, 2024
(Chapter 646 of the Laws of Malta)
2. Work Equipment (Minimum Safety and Health Requirements) Regulations (Subsidiary Legislation S.L. 646.24)

Health and Safety at Work Act – Chapter 646

Employer Duties – Risk Assessment

1. Employers must:

- Carry out suitable and sufficient risk assessments
- Identify hazards arising from machinery and work equipment
- Evaluate risks during:
 - Operation
 - Maintenance
 - Cleaning
 - Repairs

Safeguarding measures must be justified by risk assessment findings



Work Equipment (Minimum Safety and Health Requirements) RegS (S.L. 646.24) *Employer Duties – Provision of Safe Work Equipment*

1. Require employers to ensure that:
 - Work equipment is suitable for the work
 - Machinery can be used without risk to health and safety
 - If risks cannot be eliminated, they must be minimized

“The employer shall take the measures necessary to ensure that the work equipment made available to workers... may be used by workers without impairment to their safety or health.”

Work Equipment (Minimum Safety and Health Requirements) Regs (S.L. 646.24) *Employer Duties – Maintenance and Inspection*

1. Requires employers to ensure that machinery is:
 - Properly maintained
 - Inspected at regular intervals
 - Kept in an efficient and safe condition
 - This includes: Guards, Interlocks, Emergency stop devices, Control systems

A guard that is damaged or bypassed is a legal non-compliance, not just poor practice

Prohibition of Tampering with Safeguards

1. Workers must not remove or interfere with safeguards
2. Tampering is a legal and disciplinary issue
3. Defects must be reported immediately
4. This bridges well into employee duties.



CE Marking – Malta Context (High-Level)

<https://www.mccaa.org.mt/Section/Content?contentId=1132>

In Malta:

1. CE marking indicates machinery complied with safety requirements at supply
 2. It does not remove employer responsibility
 3. Employers must still:
 - Assess risks
 - Maintain safeguards
 - Control use conditions
4. CE marking does not guarantee ongoing workplace safety
 5. CE marking relates to conformity at the point of supply — it does not remove employer duties during use.

Case Scenario 1 – Mechanical Power Press

(Amputation): Source: U.S. OSHA – Department of Labor (Dec 2024)

1. What Was the Case?

OSHA investigated a metal manufacturing company after two separate amputation incidents involving a mechanical power press.

2. In both cases:

- The press lacked effective point-of-operation guarding
- Lockout/Tagout was not applied during servicing
- The press cycled unexpectedly while workers were near moving parts
- One worker was injured during servicing; another while clearing scrap material from the press

Case Scenario 1 – Mechanical Power Press

(Amputation): Source: U.S. OSHA – Department of Labor (Dec 2024)

Impact

1. Permanent finger amputations to two workers
2. OSHA cited the employer for:
 - Willful and serious machine-guarding violations
 - Failure to implement Lockout/Tagout
3. Proposed penalties: USD 182,293

Unexpected machine movement is one of the most common causes of amputations.

Case Scenario 2 – Press Brake Without Guarding

(Amputation): Source: Cal/OSHA Investigation (Feb 2026)

1. What Was the Case?

A sheet-metal company allowed a press brake to operate without required safeguarding. The operator was positioning material manually close to the dies when:

- The machine operated
- The worker's finger was caught at the point of operation
- This was not the first incident—a similar amputation had occurred the year before.



Case Scenario 2 – Press Brake Without Guarding

(Amputation): Source: Cal/OSHA Investigation (Feb 2026)

Impact

1. Finger amputation
2. Employer cited for:
 - Willful violation of machine-guarding requirements
 - Repeat serious violations
 - Penalties exceeding USD 212,000



Real Case Scenario 3 – Conveyor Entanglement During Maintenance (Fatal): Source: *OSHA Fatality Investigation – Feb 2024*

1. What Was the Case?

A worker was performing maintenance on a screw conveyor system at an industrial site. Although Lockout/Tagout was initially applied,

- the locks were temporarily removed to reposition equipment.
- The conveyor started unexpectedly, pulling the worker into rotating parts.



Real Case Scenario 3 – Conveyor Entanglement During Maintenance (Fatal): Source: *OSHA Fatality Investigation – Feb 2024*

Impact

1. Fatal injuries
2. OSHA cited two employers for:
 - Failure to control hazardous energy
 - Failure to guard moving conveyor parts
 - Poor coordination of safety procedures

1. Conveyors create severe in-running nip point hazards
2. Lockout/Tagout must never be partially applied
3. Contractors and host employers must coordinate safety controls



1. What makes machinery hazards different from other workplace hazards?
2. Why are machinery accidents often life changing rather than minor?
3. What is a “danger zone” in relation to machinery?
4. What is meant by the “point of operation”?
5. Which mechanical hazard is most associated with loose clothing or long hair?
6. Why are slow moving rollers often more dangerous than fast blades?
7. When are machines typically most dangerous?
8. Why do guards sometimes get removed in real workplaces?
9. Does training alone make machinery safe?
10. What is the main purpose of machine safeguarding?

11. Which safeguarding principle is strongest: warning, stopping motion, or preventing access?
12. Why must safeguarding systems be “fail safe”?
13. When are safeguarding devices used instead of physical guards?
14. Do emergency stop buttons replace machine guarding?
15. Why is Lockout / Tagout critical during maintenance?
16. Who has the primary legal responsibility for machinery safety at work?
17. Do workers have responsibilities related to machine safeguards?
18. Does CE marking guarantee a machine is always safe to use?



Next: Lecture 8: Workplace Environment Hazards: Slips, Trips, Falls, and Confined Spaces

This session covers physical hazards linked to workplace conditions—flooring, surfaces, obstacles, contamination, footwear, and poor housekeeping. Students explore friction requirements, environmental influences, and design factors. Confined space physical hazards (oxygen deficiency, mechanical energy, engulfment) and permit-to-work requirements are also reviewed.

