



# Machine Guarding

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- Risk Assessment
- Types of Guards
- Guard Designs
- Other Controls

Where there is a risk of exposure to dangerous parts during:

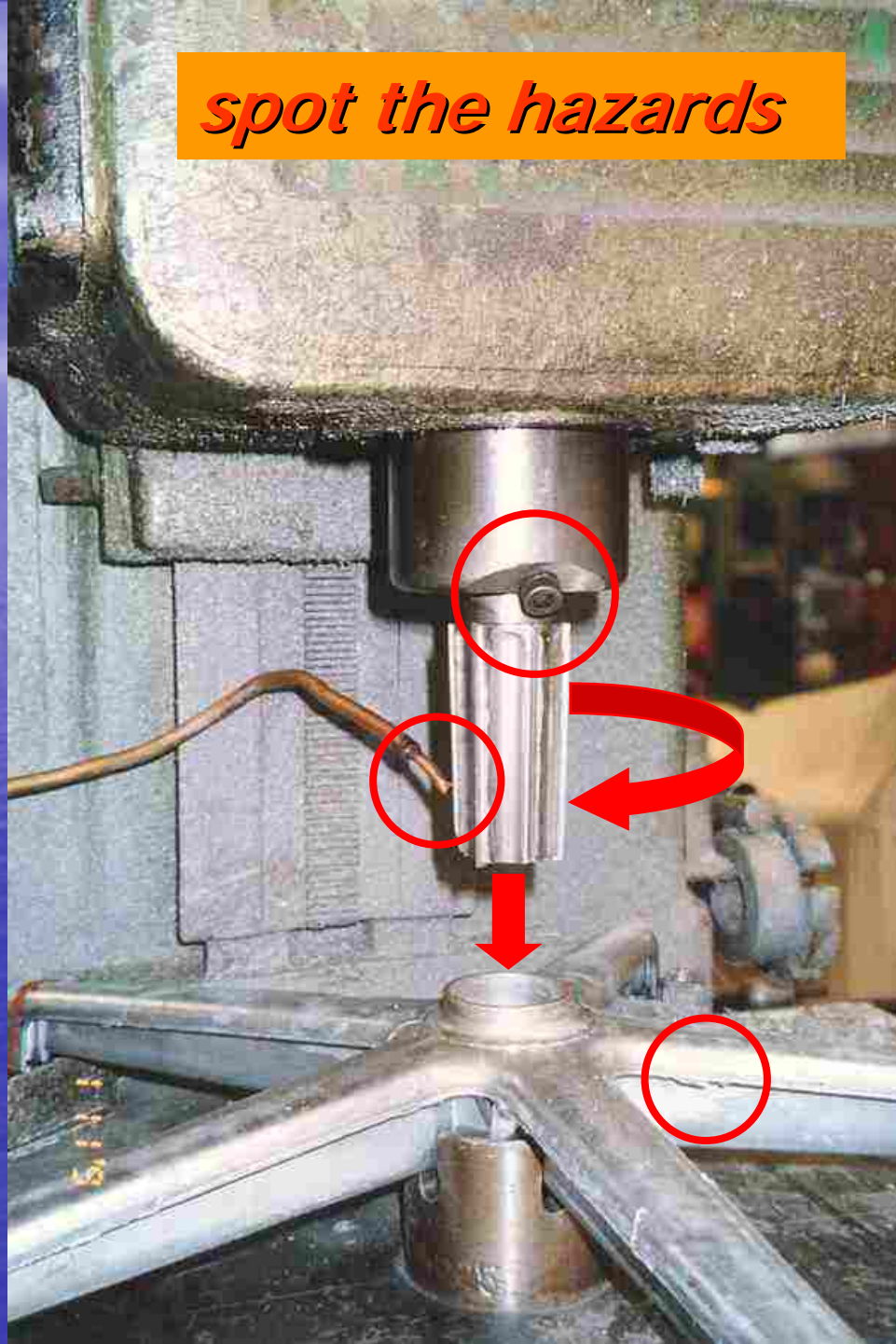
- operation
- examination
- lubrication
- adjustment
- maintenance,

that **risk** must be **eliminated**, or, where it cannot be eliminated, **minimised**.

# Hazard Identification

- a **Hazard** is something which could cause injury
- a **Risk** is the likelihood of the hazard causing an injury, and the likely severity of an injury
- what parts of a machine do you look at to find the **Danger Areas?**

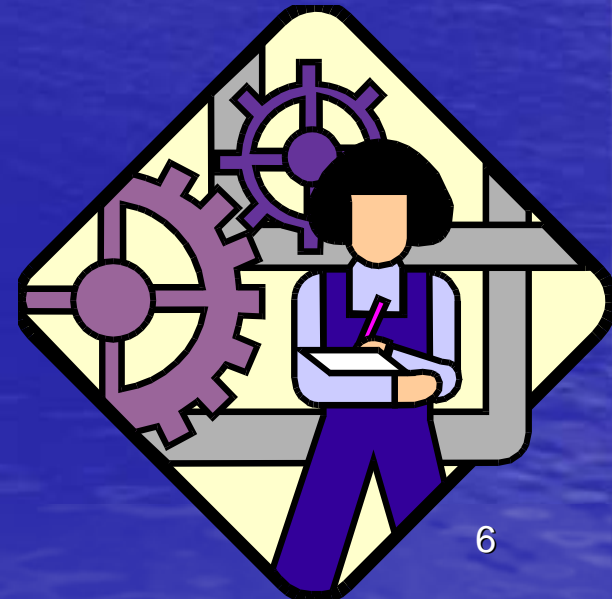
*spot the hazards*



# Danger Areas

Typically, the following 2 areas on machinery are dangerous, and can be a risk to anyone near the machine:

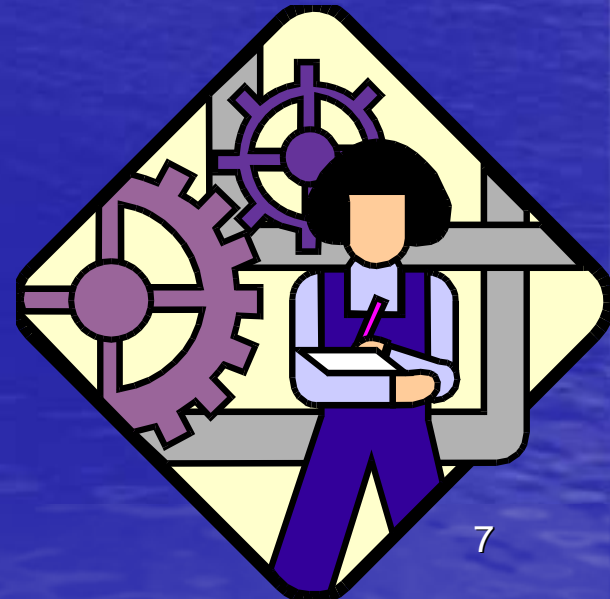
- 1. Parts which move or transmit power*
- 2. Parts that do the work*



# Danger Areas

## 1. Parts which move or transmit power

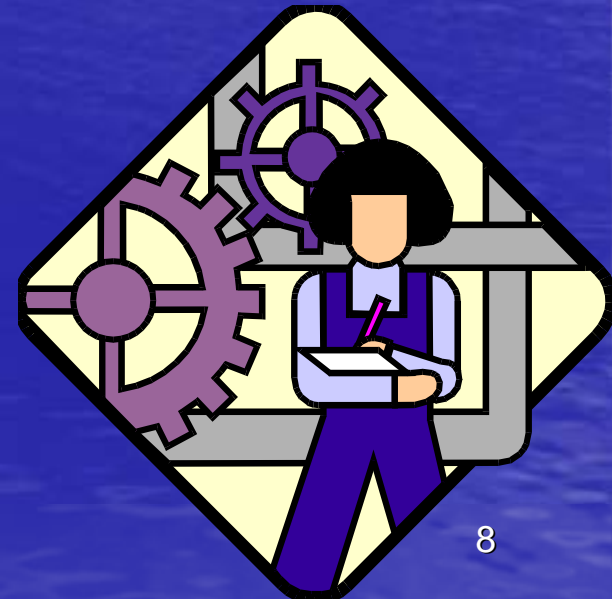
- belts & pulleys
- flywheels & gear wheels
- shafts & spindles
- slides & cams
- chain & sprocket gears



# Danger Areas

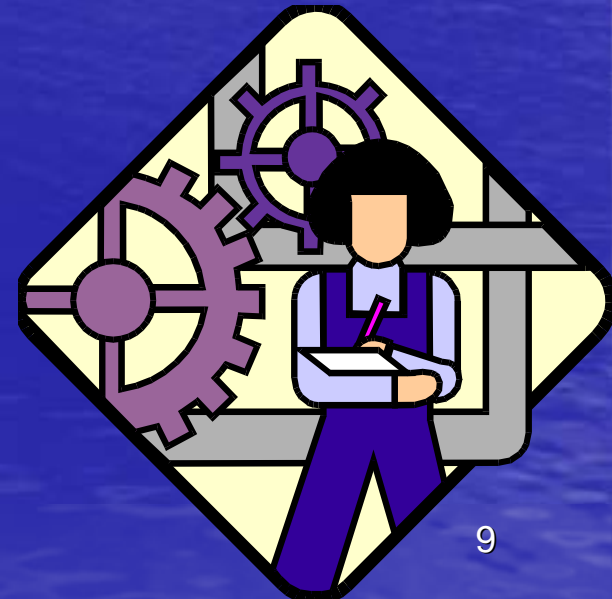
## 2. Parts that do the work

- tools & dies
- blades
- cutters
- saws
- drills and chucks
- rollers

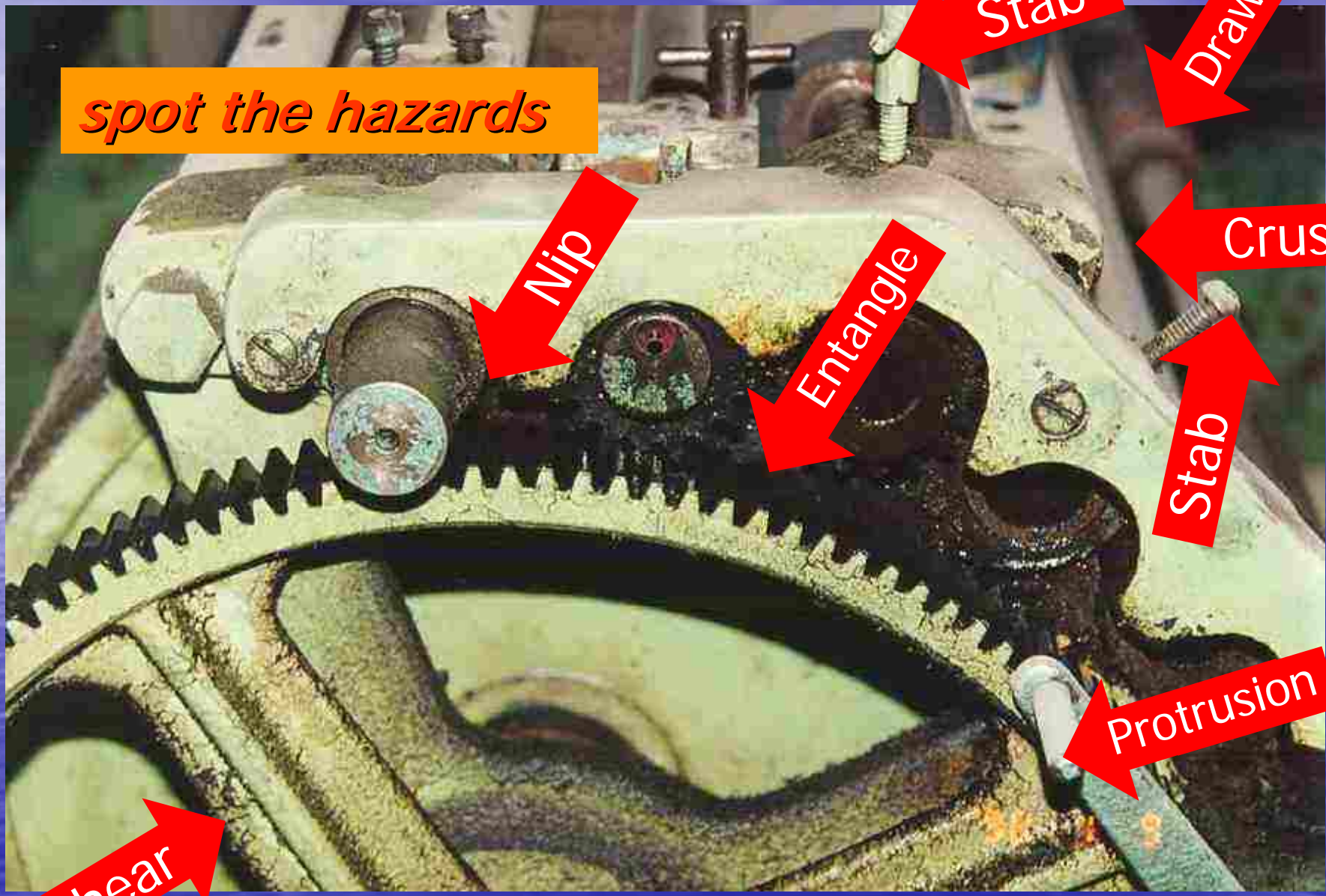


# To identify dangerous machine parts look for:

- shear points
- drawing-in points
- impact and crushing areas
- entanglement areas
- stabbing points
- cutting areas
- abrasion areas
- flying particles
- protrusions



*spot the hazards*



Stab

Draw in

Nip

Entangle

Crush

Stab

Protrusion

Shear

# Machine hazards controlled by guarding include:

- contact or entanglement with machinery
- trapping between machine and material or a fixed structure
- contact with material in motion
- being struck by material ejected from a machine
- release of potential energy

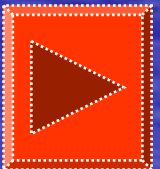
# *RISK ASSESSMENT*

# Assess the Risks

Once you have identified the danger areas (hazards), you should **assess** the risk (how likely it is to cause injury, and how severe the injury could be)

...and **control** these risks by guarding or in some other effective way

*Complete the following chart to determine the level of risk for each hazard identified*



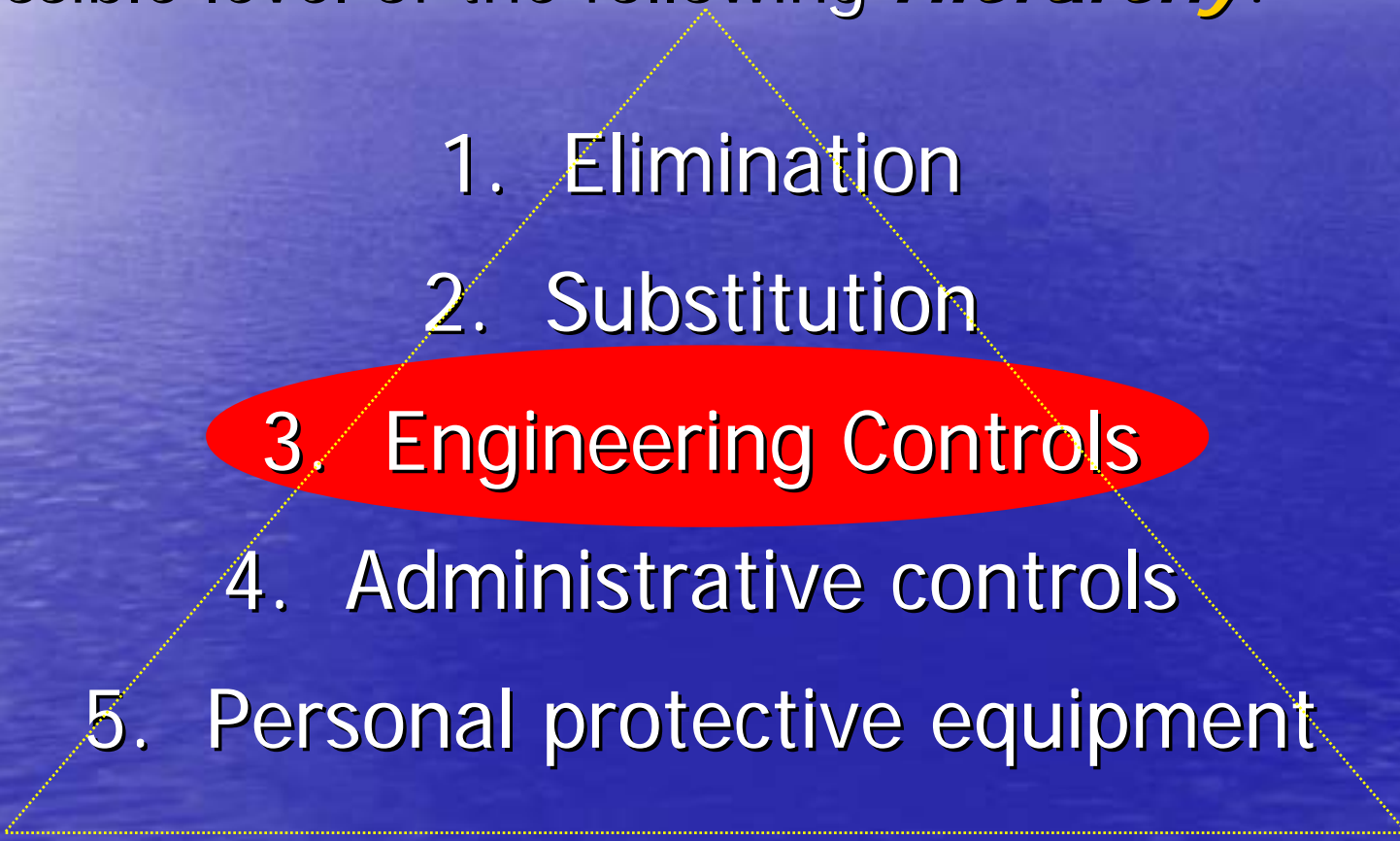
# The Risk Priority Chart

<b>PROBABILITY:</b> what is the likelihood of it happening?	<b>CONSEQUENCE:</b> how severely could it hurt someone?		
	<b>CATASTROPHIC</b> kills, disables, permanently injures	<b>MAJOR</b> significantly injures, <b>NOT</b> permanently injures	<b>MINOR</b> first aid only, no work time lost
<b>VERY LIKELY:</b> it could happen	1	2	3
<b>LIKELY:</b> it could happen occasionally	2	3	4
<b>UNLIKELY:</b> it could happen, although uncommon	3	4	5
<b>VERY UNLIKELY:</b> it could happen, although probably never will	4	5	6

- If you score a 1 or 2, do something NOW.
- If you score a 3 or 4, plan to do something soon.
- If you score a 5 or 6, plan to review the risk in the future. <sup>14</sup>

# Control the Risk

Select ***Risk Control*** measures from the highest possible level of the following ***Hierarchy***:

- 
1. Elimination
  2. Substitution
  3. Engineering Controls
  4. Administrative controls
  5. Personal protective equipment

# Make sure machine guards are in place!!

- all guards should be correctly and securely fitted **BEFORE** operating a machine
- machine guarding is vital to every workplace using machinery
- guards need not be complicated nor interfere with productivity

# *TYPES OF GUARDS*

# Selecting a Guard

There are a number of different *types* of guards, all suited to particular purposes.

You must consider which type of guard is best suited for *your needs*.

# Fixed Guards

- no moving parts
- protect only when fixed in position
- should be easy to remove and replace
- are only opened or removed with a *tool*
- simple, low maintenance, often the cheapest form of guarding
- may interfere with production/maintenance



Pedestal Grinder with Fixed and Adjustable Guards

# Interlock Guards

- have moveable parts that are interconnected with the control system
- usually electrical, mechanical, hydraulic or pneumatic interconnections
- machinery will not operate unless guard is closed
- less likely to slow production
- generally more expensive and require more checking and maintenance



Interlocked Guard on Dough Divider

# Automatic Guards

- automatically moves into position as the machine, or cycle, is started
- guard movement/velocity may create a hazard
- only suitable for slower machine cycles
  - push away guards
  - self-adjusting guards, etc



Self Adjusting Guard - Radial Arm Saw



Push Away Guard

# Distance Guards

A *fixed guard* that prevents access to a dangerous area through a *barrier* or *fence*

- permanent
- simple





Fixed and Interlocked Barrier Fence Guard

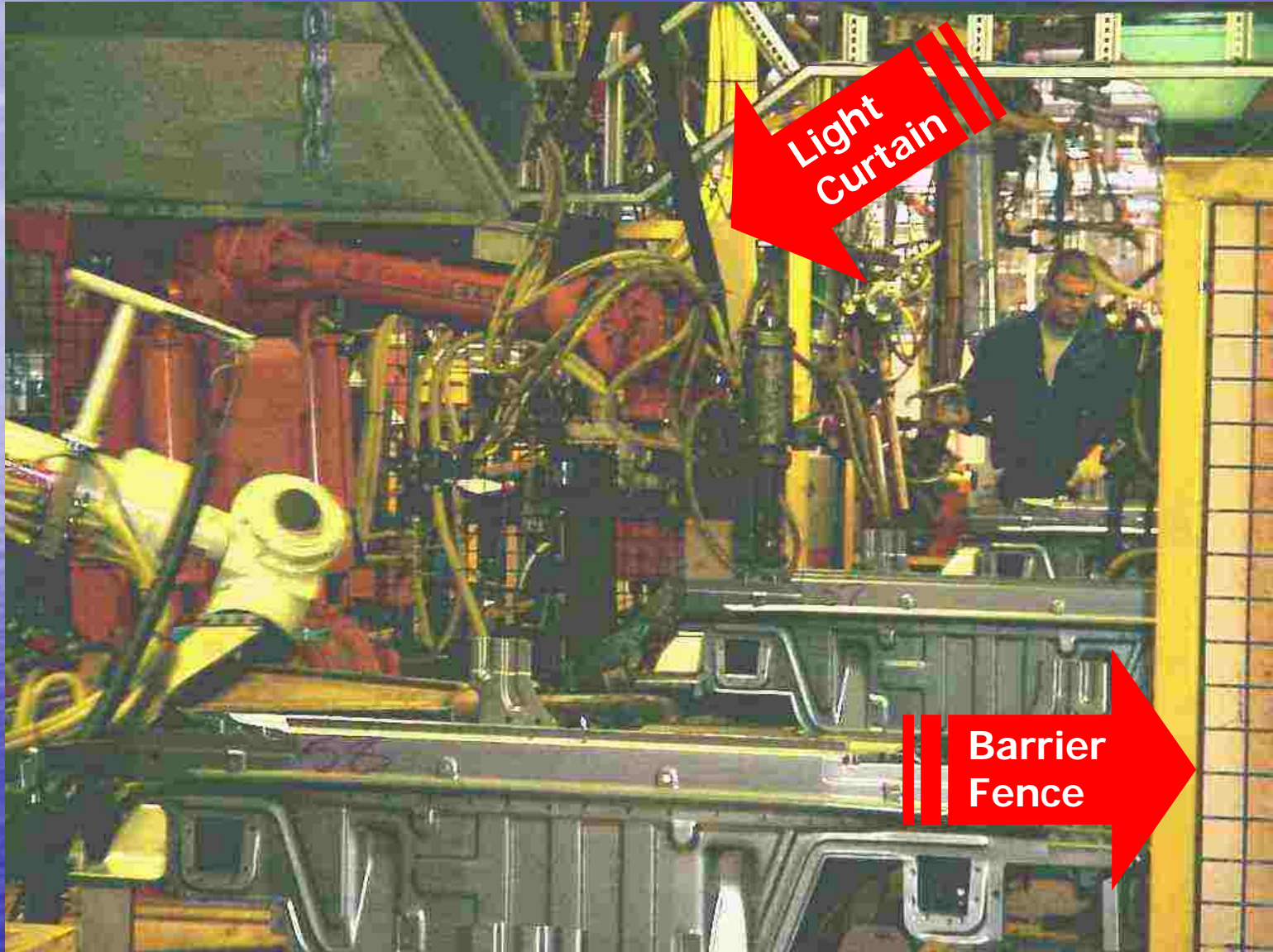
# Presence-sensing Devices

Detect the presence of a person, or part of a person, in a defined area and prevents the dangerous parts of machinery moving while they are in that area

- photo-electric light curtains
- infra-red scanners
- pressure mats



Presence Sensing Laser Scanner



Combination of Guards - Manual Loading Robots

# *GUARD DESIGN*

# Guard Design

- the primary function of a guard is to *provide a physical barrier* which prevents access to dangerous parts of a machine
- poorly designed or inappropriate guarding has often contributed to machinery injuries

# Guard Design

- design for *easy removal* and *replacement* - makes tasks such as cleaning, machine adjustment or belt changes easier - *particularly if this needs to be done regularly*
- guards can only be removed with the aid of a *tool*
- hinged guards must be *interlocked*
- guard material must be of a good quality
- good design will aid dust and noise reduction

# Guard Ergonomics

Reach Measurements - design and position guards to restrict access to danger points as follows:

<i>Reach</i>	<i>Minimum Distance Assumed</i>
– Arm reach	850mm - under arm to fingertip
– Elbow reach	550mm - inside elbow to finger tip
– Wrist reach	230mm - wrist to tip of middle finger
– Vertical reach	2500mm - floor to danger point
– Finger reach	130mm

*\* distances include an allowance for clearance from danger points*



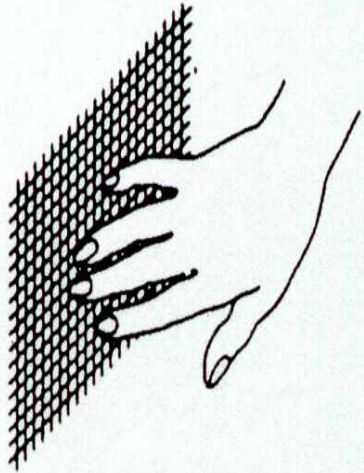
# Guard Placement

*Size of mesh or other opening in guard*

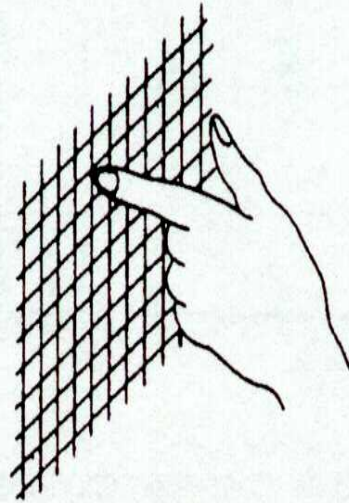
*Minimum distance between guard and danger point*

- |                     |          |
|---------------------|----------|
| • less than 9mm     | - 15mm   |
| • 9 to 25mm         | - 120mm  |
| • 25 to 40 mm       | - 200mm  |
| • greater than 40mm | - 1000mm |

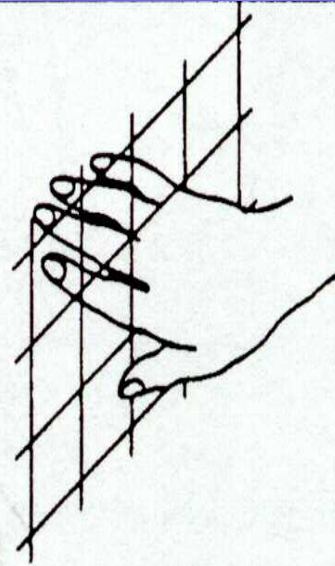
*\* distance from underside of guard to the floor shall not exceed 250mm*



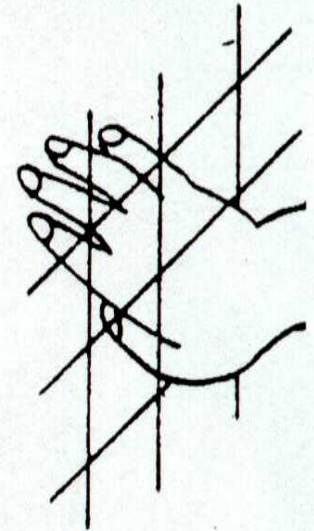
(a) No admittance



(b) Reach restricted to  
root of finger



(c) Reach restricted to  
root of thumb



(d) Reach restricted  
to thickness  
of hand

## Use of Mesh for Guards

# *GUARDS FOR COMMON MACHINE TYPES*

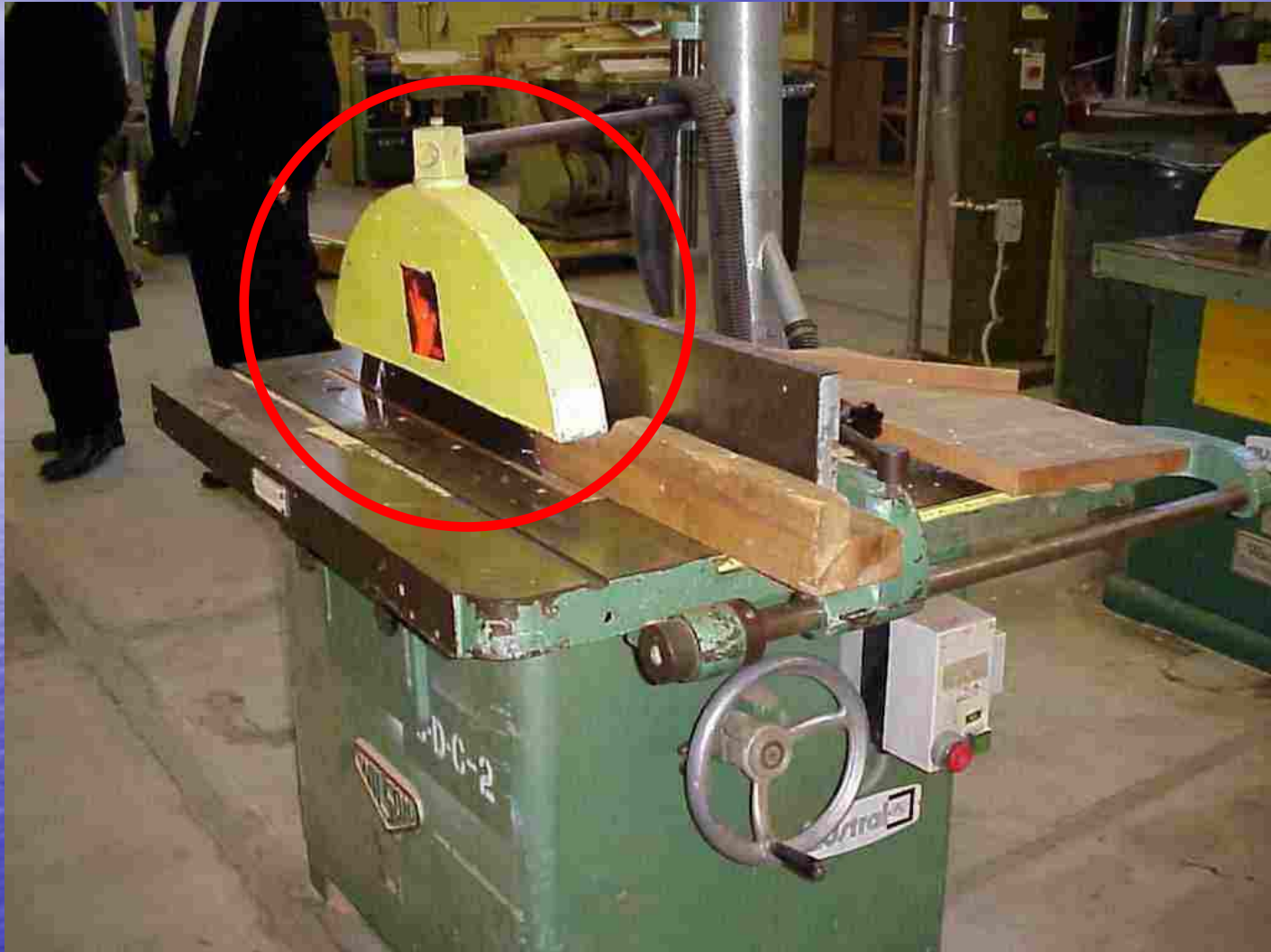
# Exposed Rotational Cutting

- cut-off saws
- milling machines
- friction cutting
- boring equipment

*Fixed* and *moving guards* should be fitted where appropriate



Bridge Guard - Wood Planer



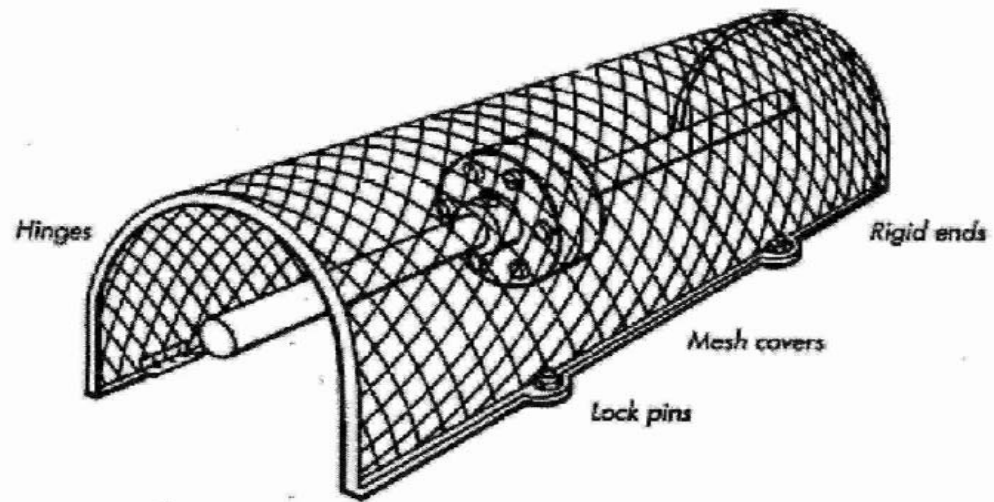
Top Guard - Rip Saw

# Rotating Shafts and Rollers

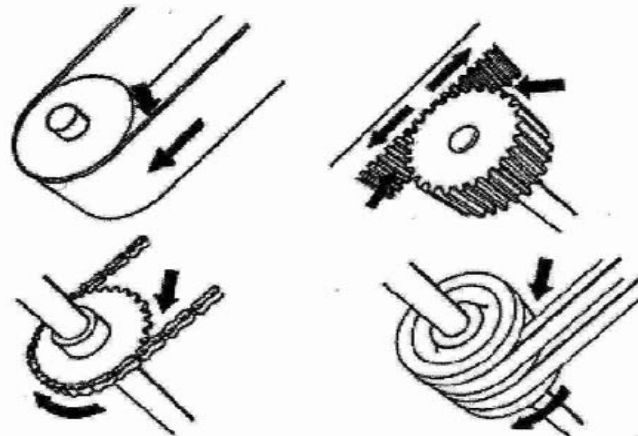
*Fixed guards* are preferred for rotating shafts and rollers, such as:

- couplings
- spindles
- fan-shafts
- ironing rollers

\* must protect against loose clothing and long hair becoming caught in rotating shafts

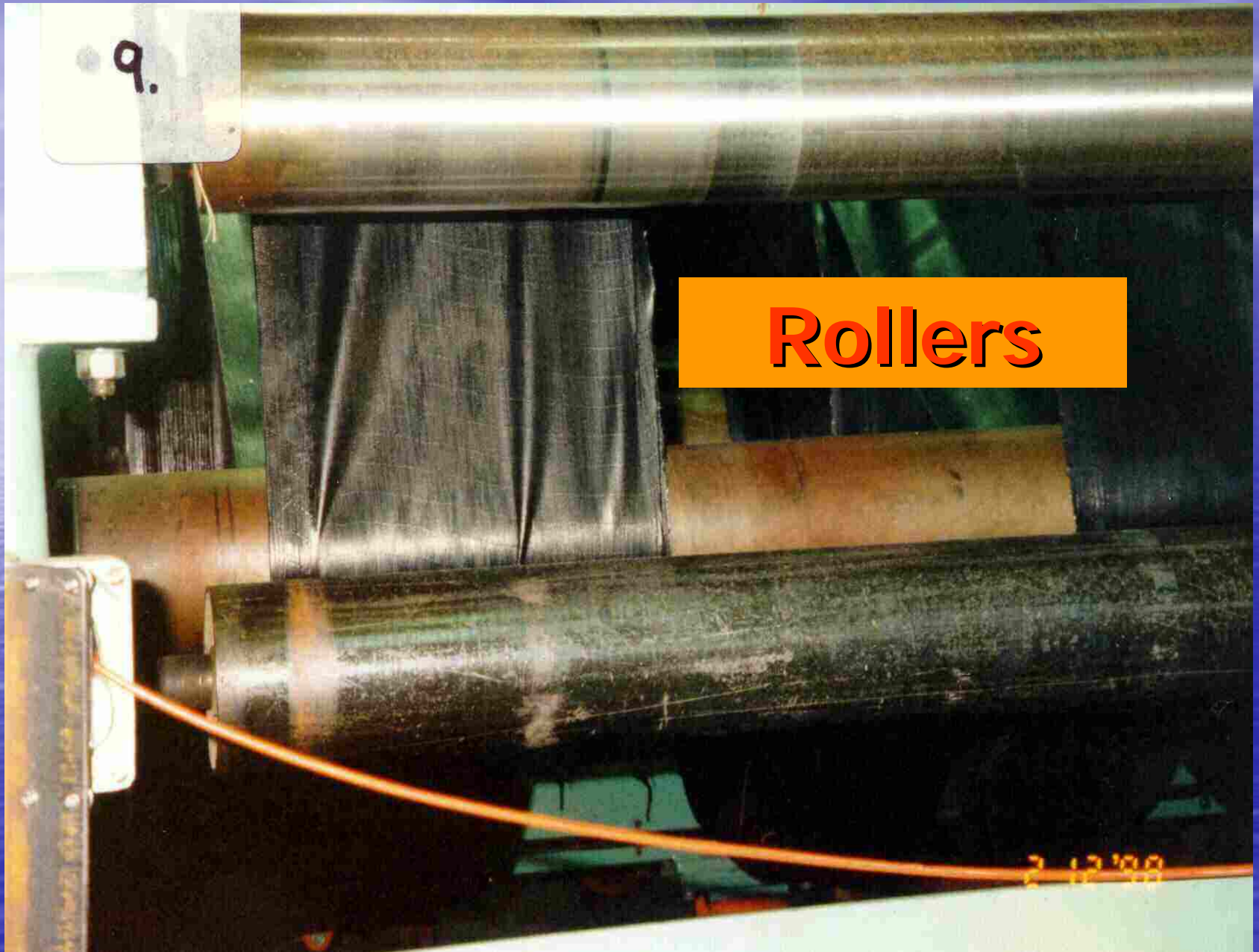


ROTATING SHAFTS/COUPLINGS



*DRAWING-IN HAZARDS BETWEEN ROTATING  
AND TANGENTIALLY MOVING SURFACES*

DRAWING-IN HAZARDS BETWEEN ROTATING  
AND TANGENTIALLY MOVING SURFACES



**Rollers**

2.

# Roller Hazard

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# Roller Guarding

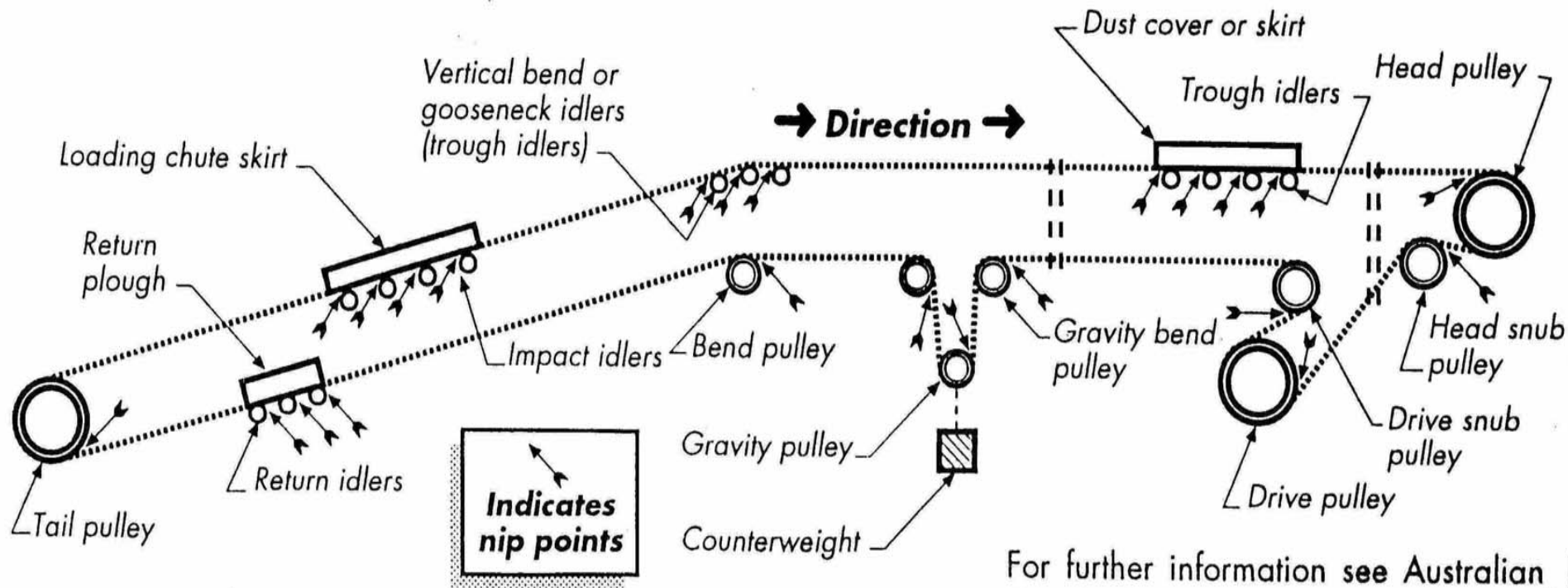
# Conveyors (Bulk Handling)

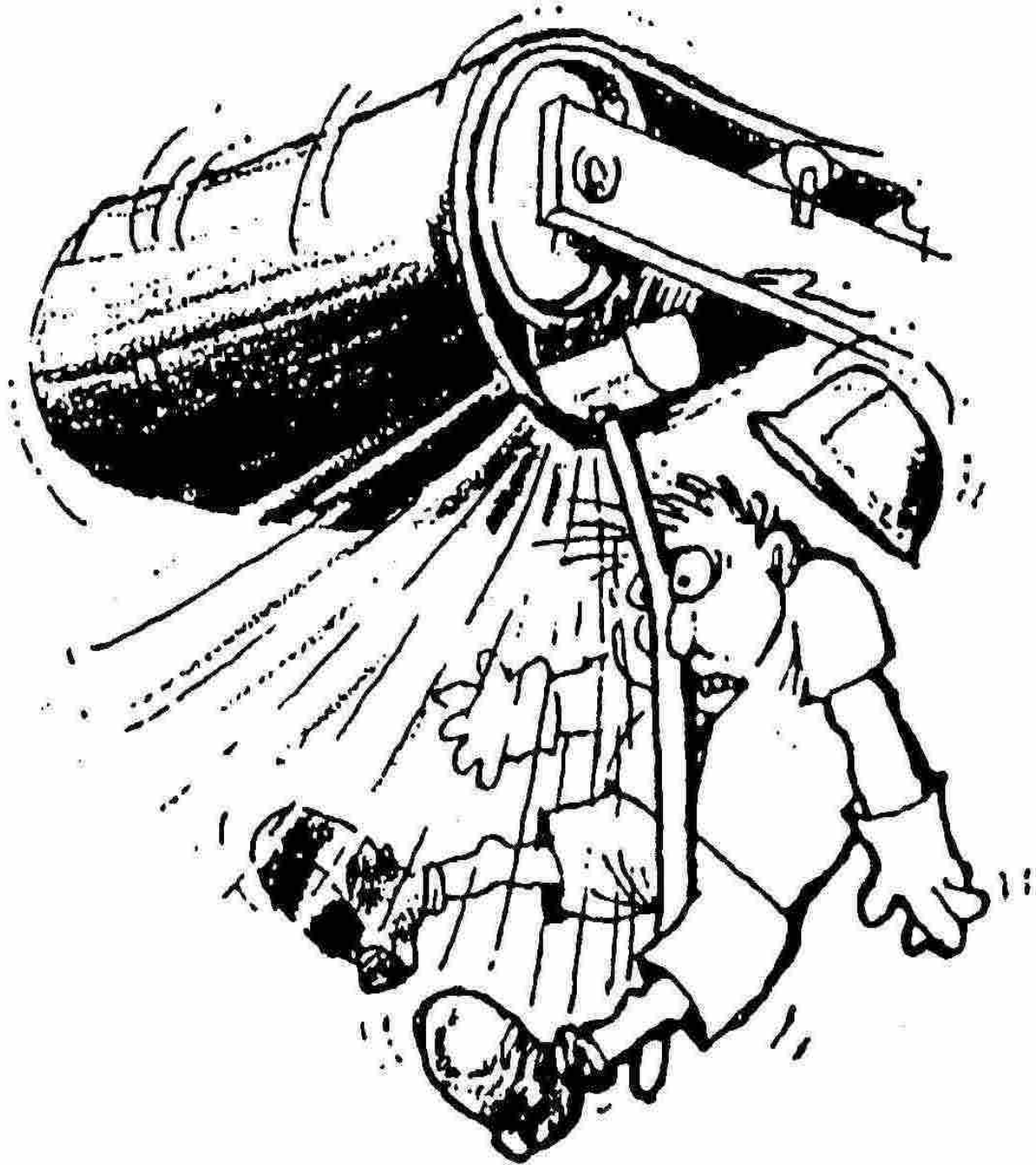
## Main Types

- belt conveyors
- screw conveyors
- bucket conveyors

...all require guarding, usually with *fixed guards*

On **belt conveyors** the most important danger points are the nip points.





# Power Presses

## Two Categories:

- power stamping presses
- brake presses

\* guards should prevent access to the trapping area at all times when the press is stroking

# Power Stamping Press

Guard type will depend upon the job and the associated hazard

- fixed guard
  - interlocked
  - presence sensing devices
  - two-handed controls
  - usually a **combination** of these is appropriate
- \* it is mandatory that **regular** operational checks and maintenance is conducted and ***recorded***



Power Stamping Press Guarding

# Brake Press

- generally *presence sensing devices* (eg light curtains) are appropriate
- “dead man” type foot pedal actuator for each operator
- guard front and rear



Brake Press  
Guarding System

# Pullback device

- Uses a series of cables attached to the operator's hands, wrists, and/or arms
- Primarily used on machines with stroking action
- Allows access to the point of operation when the slide/ram is up
- Withdraws hands when the slide/ram begins to descend



# Pullback device (cont'd)



- Hands in die, feeding
- Point of operation exposed
- Pullback device attached and properly adjusted



- Die closed
- Hands withdrawn from point of operation by pullback device

# *OTHER CONTROLS*

# Other Safeguards

- physical guarding is not the only safety aspect of Machine Guarding
- other *safeguards* are required to maintain a safe system of work

# Isolation Procedures

- all machinery should be fitted with a means of isolation from all energy sources (except those required for safety systems)
- isolators should be clearly identified and be capable of being locked if reconnection could place persons at risk (during maintenance, repairs, etc)

# Isolation Procedures

Secondary key lock  
on each stop switch  
to prevent  
unauthorized start-up

Located on right side  
at the back of stop  
switch



# Isolation: Lock-out/ tag-out

An appropriate isolation method is a ***lock-out/ tag-out system***, in which one or more padlocks are fitted to the isolation switch, as well as danger tags with the exposed persons' names on them.



Lock Out / Tag Out Isolation System

# Emergency Stop Controls

- shall be ***prominent*** and readily ***accessible*** from all operator positions
- coloured ***red***
- suitably marked
  - Emergency Stop Buttons shall be “mushroom head” latch-in or lock-in manual reset type
  - lanyards, trip wires or similar devices are acceptable
- require a ***manual reset*** before restarting
- not to be used for normal stopping
- not to be relied upon for isolation
- ***NOT an alternative to guarding***



# Access Provisions

- machinery *design* should allow routine adjustment, lubrication and maintenance without removing guards or extensive dismantling of components
- lubrication and routine maintenance facilities should be incorporated *outside* the danger area wherever practical

# Administration

- shut down procedures
- maintenance schedules and records
- Safe Operating Procedures

# Training

- in safe working procedures, guarding and hazards of the machine they operate
- training records shall be kept

# Personal Protective Equipment

- used **if not possible** to completely control the hazard
- check fit, comfort, maintenance, correct use & training



# Legislative Framework

## **Occupational Health and Safety, RSO 1990**

describes how to provide health and safety in workplaces and is law that must be followed

## **Industrial Establishments Regulation 851, RRO**

**1990** set out the general principles, providing practical steps to be followed in order to prevent injuries and illness at work – and is law

**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 solutions can be applied, ex. Forklift trucks

**CSA Standards** provide general information to meet occupational health and safety obligations - some may be listed in the Regulations as Approved Codes of Practice

# Examples of guarding and safety systems in shops



Questions?



**Thank you**



- Special thanks to the Department for Administrative and Information Services, Australia