Section 3
Hazards associated with machinery & workplace

1. To know and understand **Mechanical Hazards**.
2. To recognise **primary areas** in machineries or workplace where mechanical hazards are present.
3. To identify the **"danger areas"** in machines.
4. To know & understand of **Non-Mechanical Hazards**.

Hazards associated with machinery

Three primary areas at a machine where hazards can be encountered.

1. **The machine's "perimeter"**

Area around a machine, where falling objects, flying debris or other hazards can be encountered.

2. **The "drive train"**

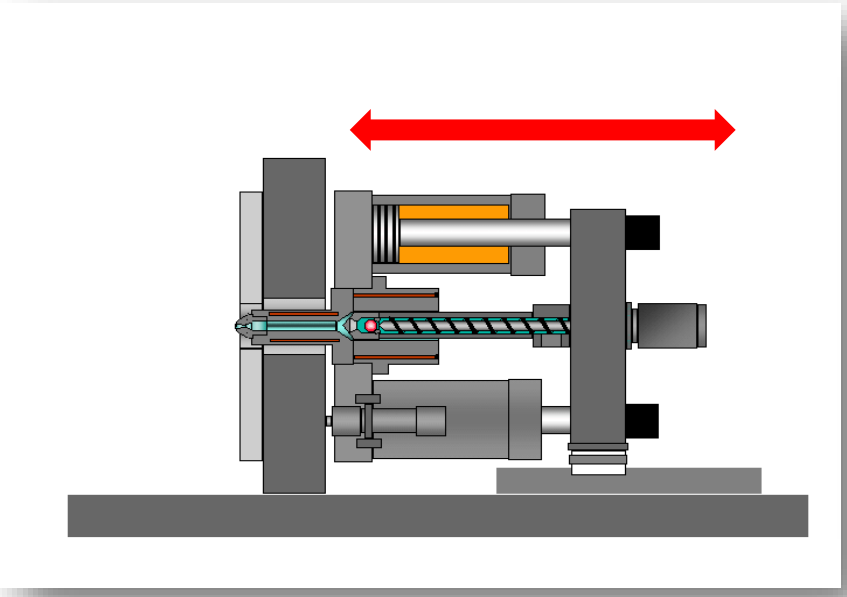
The moving parts that run the machine.

3. **"Points of operation"**

Location where a machine's mechanical or electrical energy is used to cut, bend or otherwise process materials.

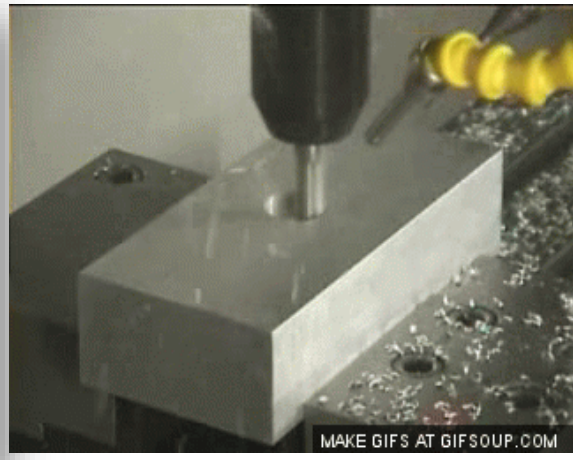
All equipment or machine operates using a combination of **THREE basic motions :**

1. **Rotation** - moving in a circular pattern.
2. **Reciprocation** - moving back and forth.
3. **Traverse motion** - moving in a straight line.



Sliding or reciprocating motion

Rotation
High speed sawing



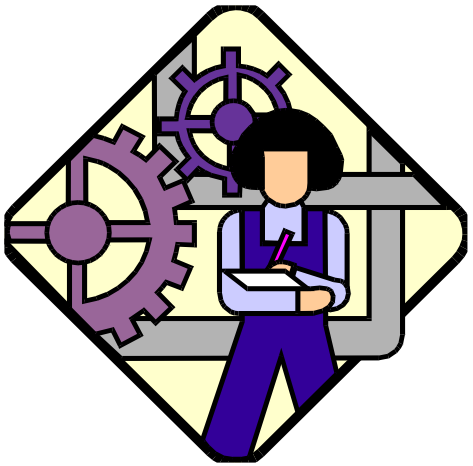
Combine
Rotation/Traverse
"Slot Milling"

Machine Hazard Identification

- ***Hazard*** is something which could cause injury.

- ***Risk*** is the likelihood of the hazard causing an injury, and the severity of an injury.

- The parts of a machine or area on the machine to pose hazards are the ***Danger Areas***?



Danger Areas

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

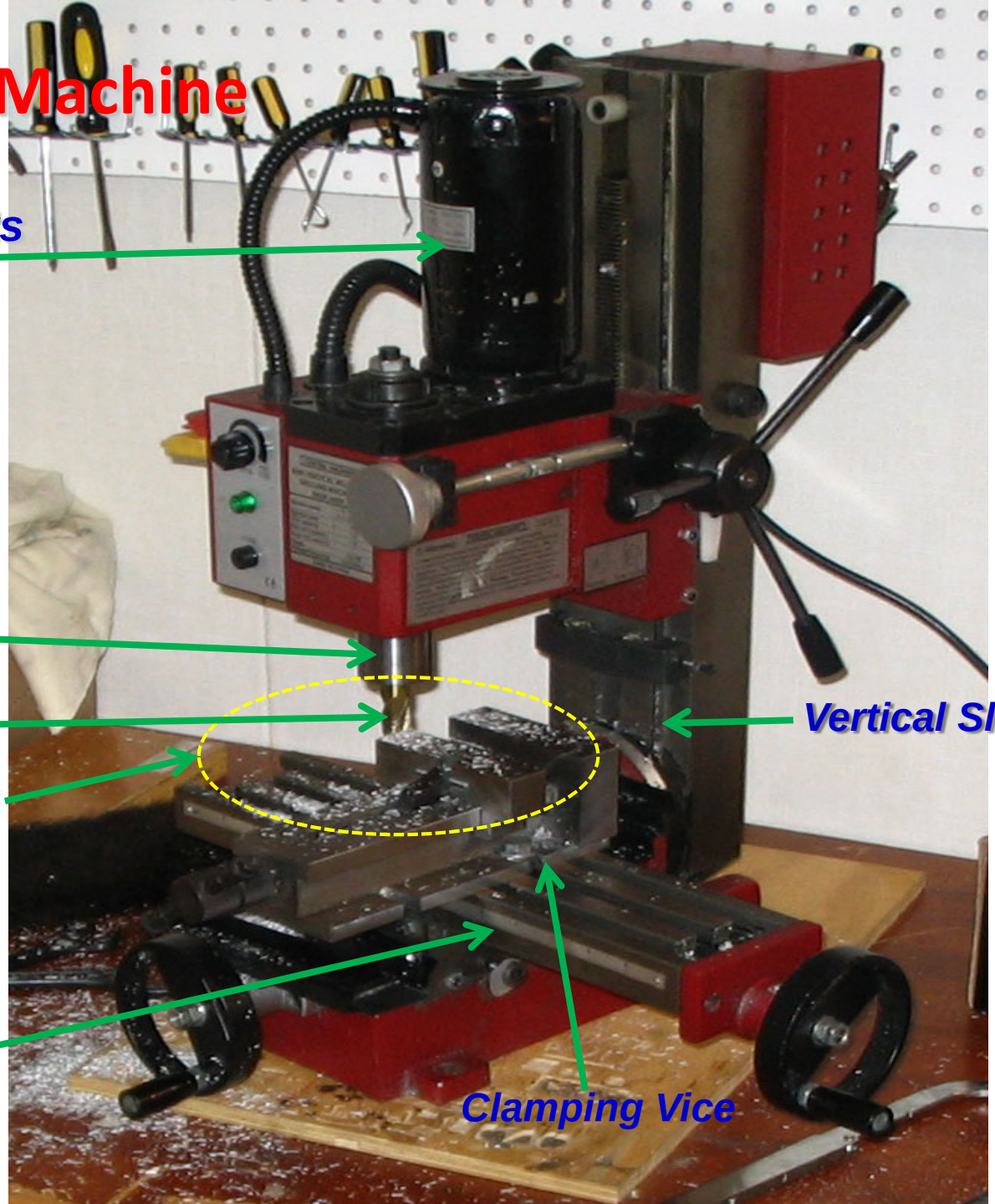
1. Parts which move or transmit power

- Belts, chains & pulleys
- gear trains & sprocket gears
- shafts & spindles
- slides & flywheels

2. Parts that do the work

- Blades
- Cutters & Tool bits
- Saw
- Drills & chucks

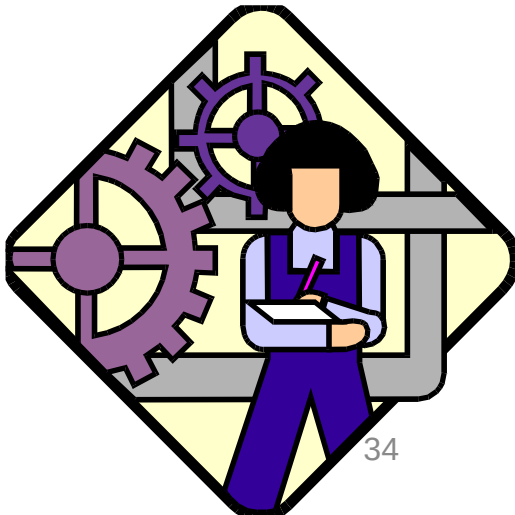
Danger Areas of Machine



Mechanical Hazards

Type of hazards due to machinery motions :

1. Entanglement hazards
2. Cutting hazards
3. Impact hazards
4. Shearing hazards
5. Crushing hazards
6. Draw-in hazards
7. Friction and abrasion hazards



Entanglement Hazards

Entanglement arise when loose clothing, hair or loose item got caught with the moving parts of a machine.

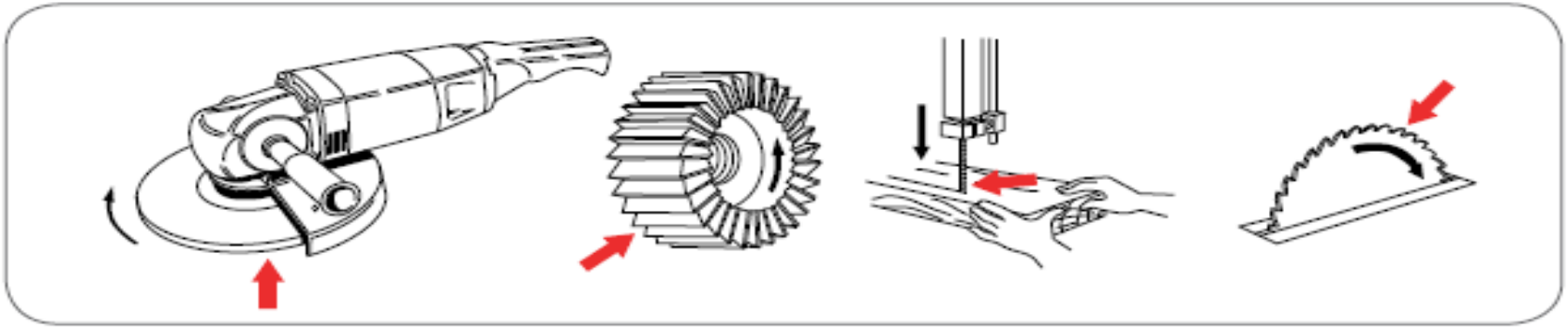
https://www.youtube.com/watch?v=EBSwOS90wgQ

Cutting Hazards

Cutting hazards are present in machines used to cut wood, metal or other materials at the point of operation.

Machines with moving cutting elements are dangerous.

They can cause severe injury (eg. deep cuts, amputations) due to its own momentum when they come into contact with a worker's body.



Examples of cutting hazards. From left: disc blades, sharp edges, band saw, circular saw.

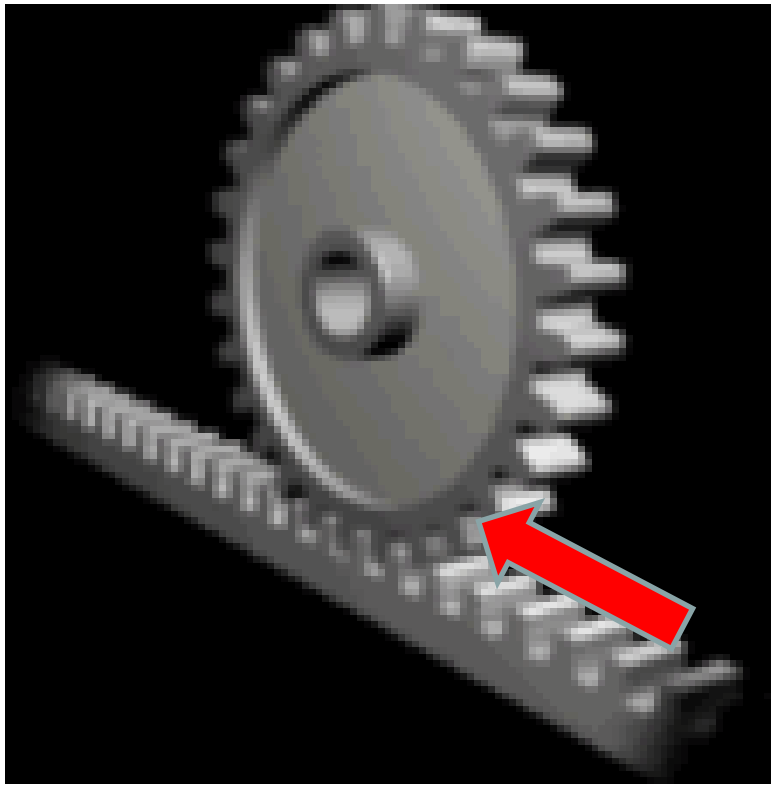
Possible injury to hands due to the unguarded rotating saw blade.

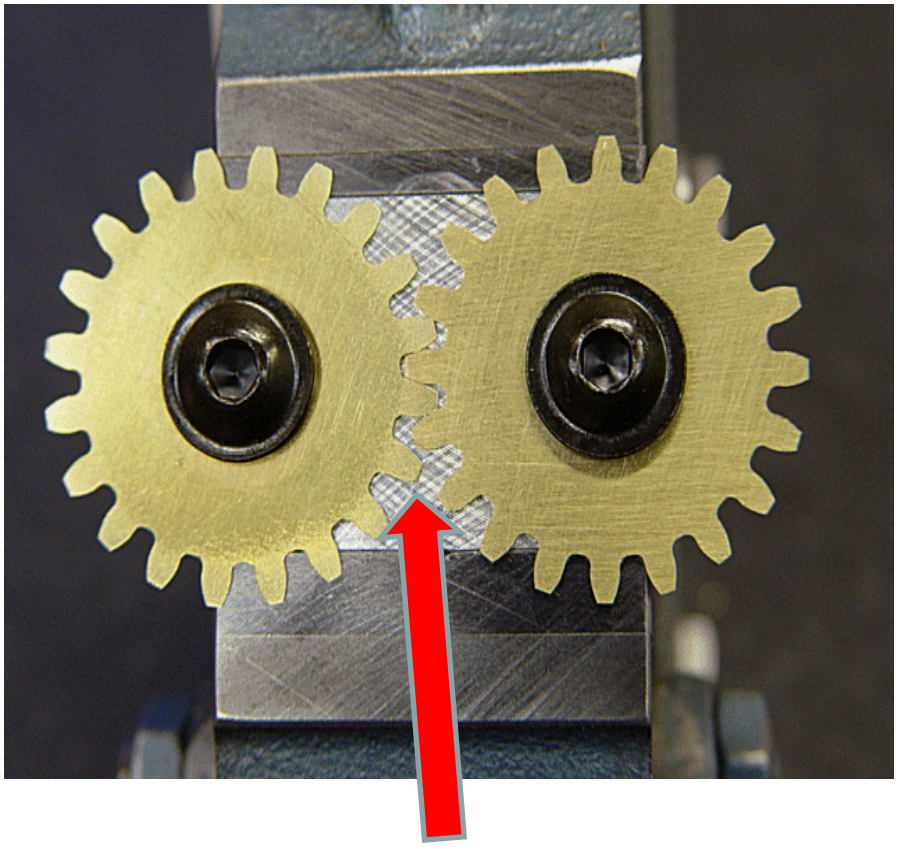
https://www.youtube.com/watch?v=xuLlar6-jIw

Finger cutting accident by a saw

Draw-in Hazards

Injuries can occur when a body part is drawn-in by in-running nip points formed by two counter-rotating parts or between rotating and tangentially moving surfaces.



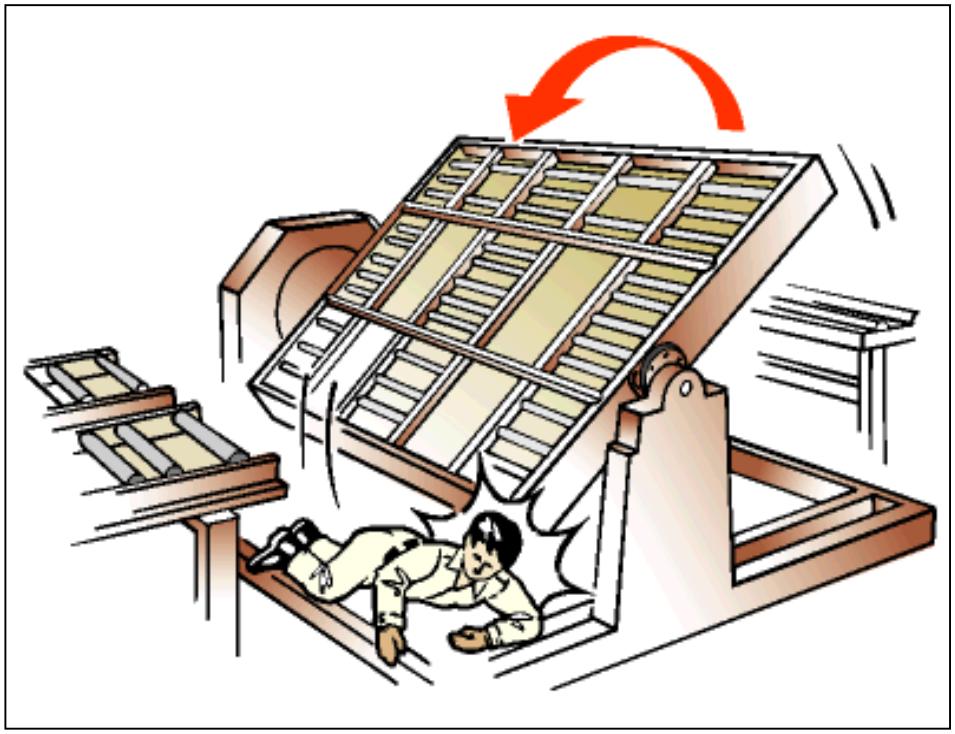


Entanglement & Draw-In Hazards

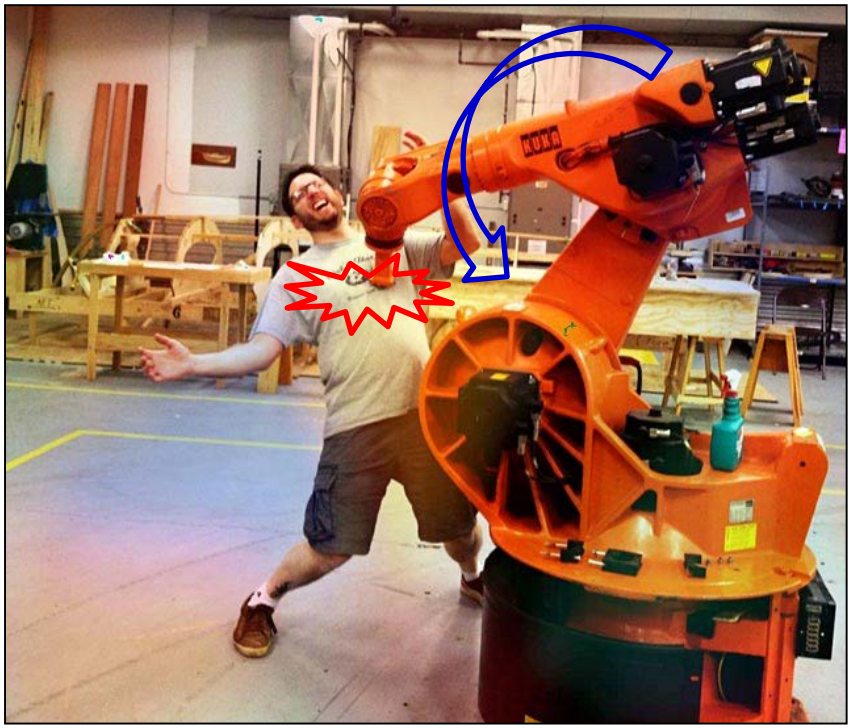
Industrial accident working on a Lathe

Impact Hazards

Impact hazards relate to objects that strike the human body, but do not penetrate it. The severity of an impact hazard depends on the speed, force and inertia of the moving machine part during operation or upon ejection from the machine .



Worker being struck by moving part of machines



Stuck by the rotating arm of robot

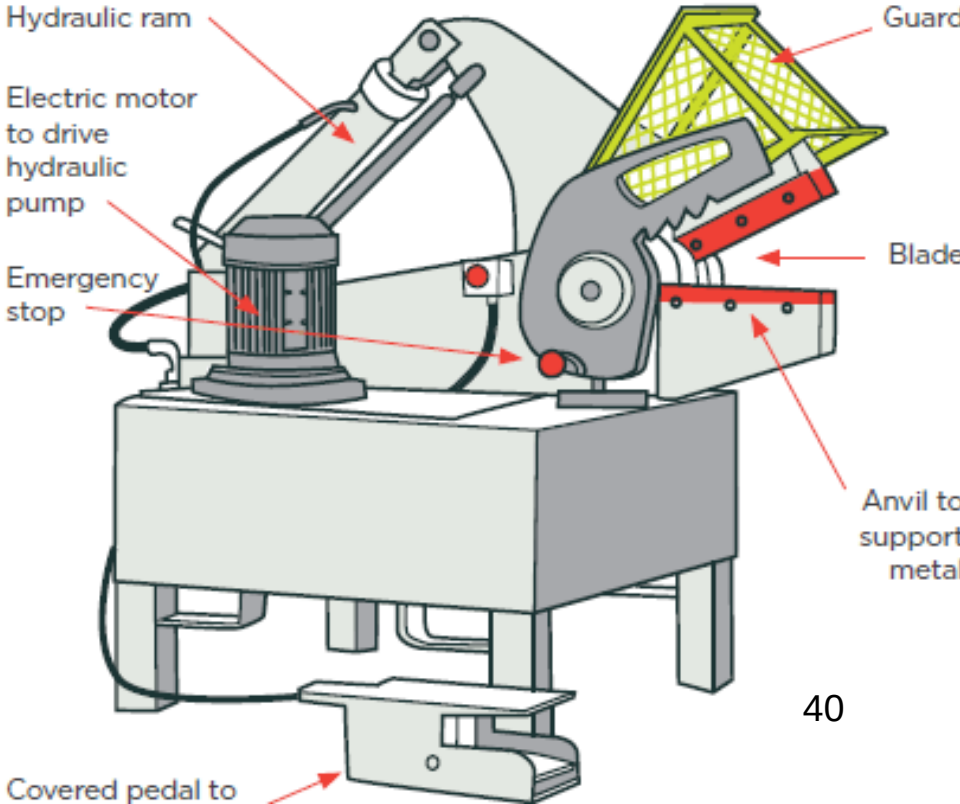
https://www.youtube.com/watch?v=FrKwm1ELOZ0

https://www.youtube.com/watch?v=DWPxgOaTWiE (Video: *Impact hazard of water-jet machine)*

Shearing Hazards

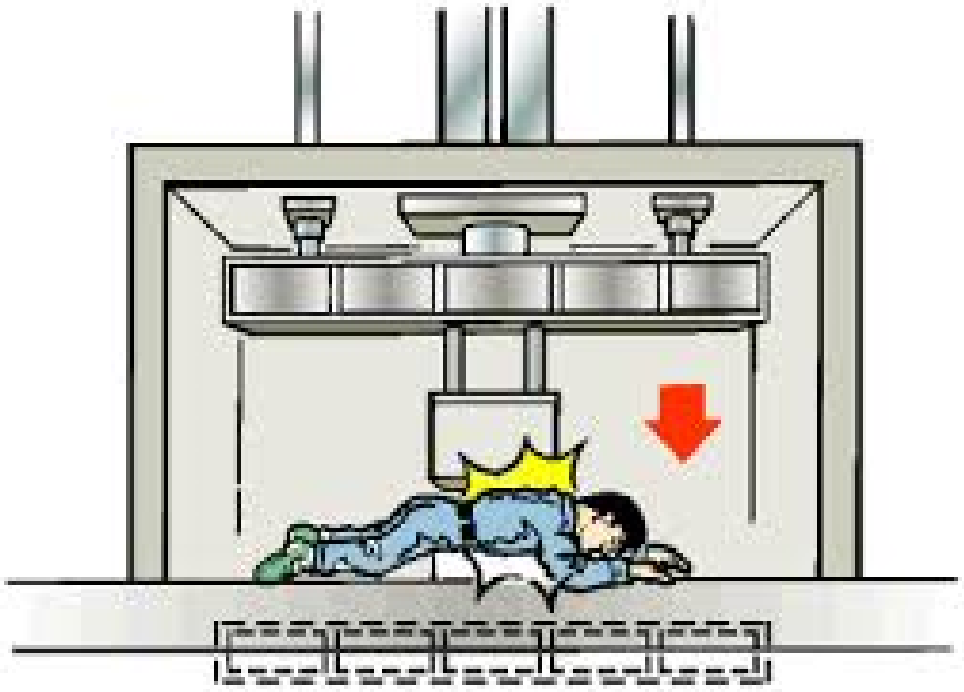
Parts of machines that move past each other or stationary objects can cause a shear point resulting in a crushing or cutting action.

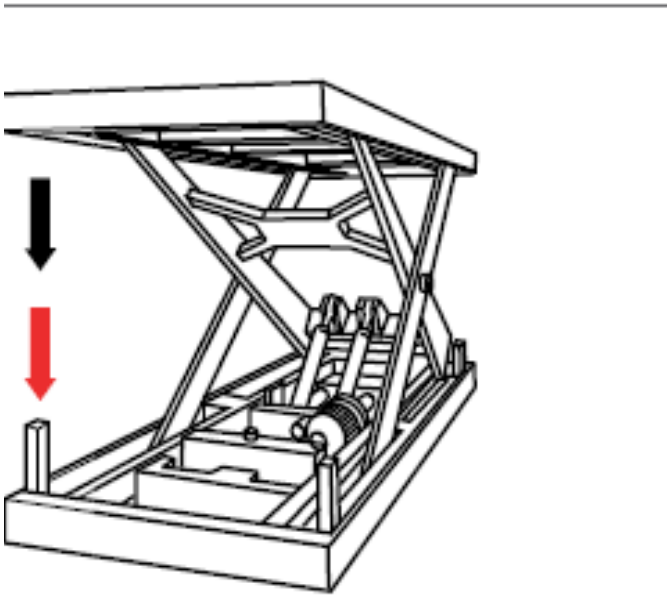
In general, shearing hazards are present between two machine parts such as power press punch, shearing machine, etc..



Crushing Hazards

It is caused when part of the body is caught between either two moving parts of machinery or a moving part and a stationary object.





https://www.youtube.com/watch?v=Cz-I_INr1ms

Friction and Abrasion Hazards

Friction burns and abrasions occurs when encountering rough surfaces moving at high speed e.g. sanding machine, grinding wheel etc. can cause abrasion injuries.

Grinding process

Sanding process

Abrasion injury in wire-brushing

https://www.youtube.com/watch?v=aaVqUpOrPs

Hand-held grinder

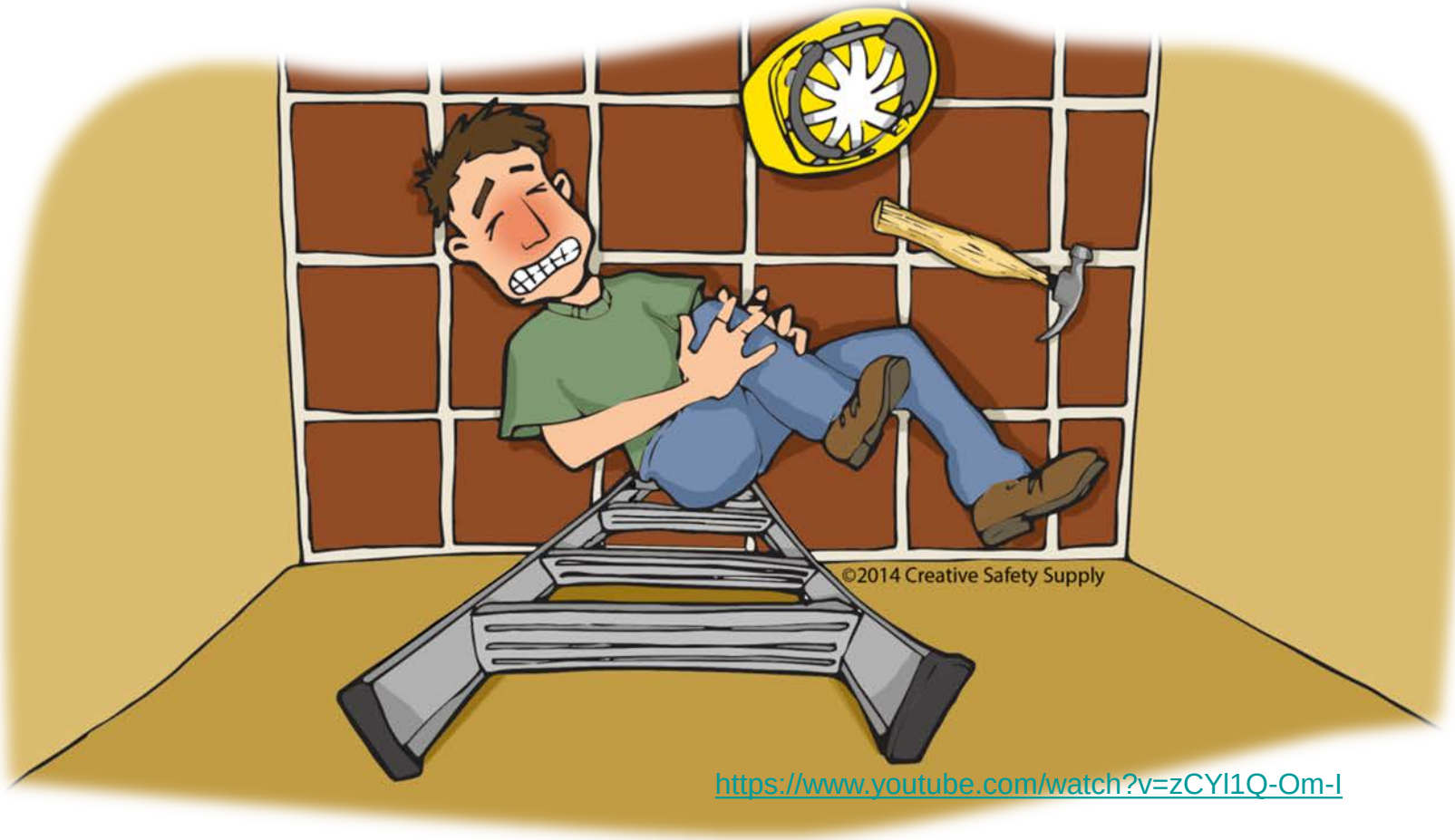
https://www.youtube.com/watch?v=P22Q46dIwug

Non-Mechanical Hazards

1. Fall from Heights Hazards
2. Noise Hazards
3. Electrical Hazards
4. Heat-related Hazards
5. Chemical Hazards
6. Fatigue
7. Ergonomic Risk factors

Fall from Heights Hazards

When required to work at heights, fall can lead to sprains or broken bones and in more serious cases, head injuries or even death.



https://www.youtube.com/watch?v=zCYl1Q-Om-I

Noise Hazards

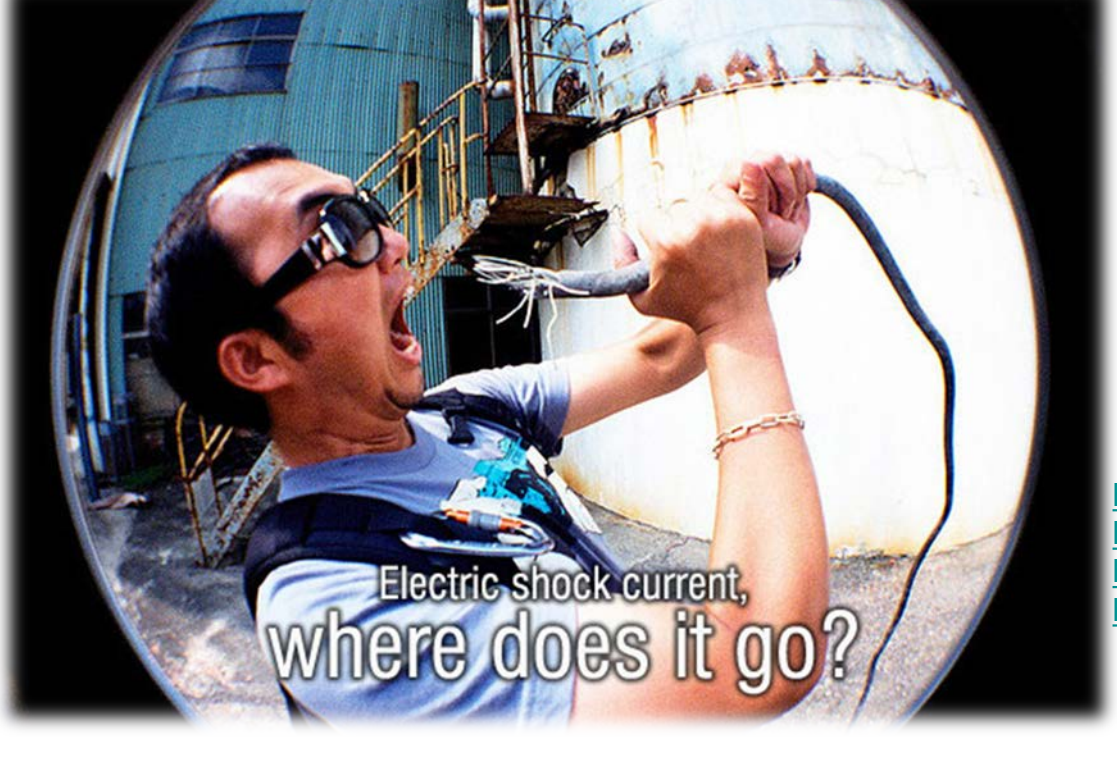
- Noise is often generated during machine operations and work activities.
- Prolonged exposure to excessive noise can cause NID (**Noise-Induced Deafness**).
- To prevent hearing loss, one should not be exposed to noise levels exceeding 85 dB (A) for 8 hours a day.

Sound Pressure Level dB(A)	Maximum Duration per Day
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes
106	4 minutes

https://www.youtube.com/watch?v=iTFPh-COLFk

Electrical Hazards

- Workers may be exposed to electrical hazards, for example, during electrical installations or when machines or power tools are in use.
- Accidents involving contact with electricity can happen when an electrical machine failed, electric circuits are overloaded or short-circuited, or when one comes into contact with a live wire.



https://www.youtube.com/watch?v=wal2KP1bbIY
https://www.youtube.com/watch?v=Hp1JdVwbN_U
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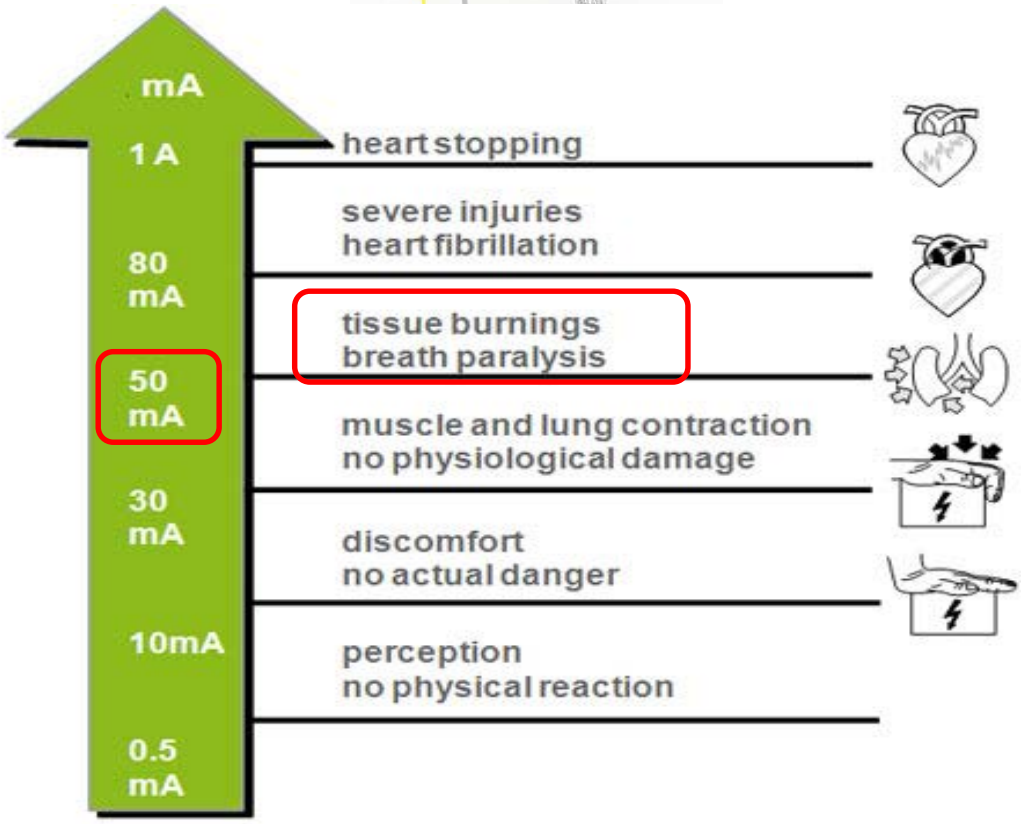
Danger of Electricity



Electrical Safety

1.Don't Overload Outlet

2. Don't Use Electricity Around Water

3. Wear Rubber

- To reduce the risk of power overload and fires due to the wires getting too hot.
- Water is a conductor (low resistance)
- Rubber is an insulator (high resistance)

Moisture provides a conductive path that could result in death.

Never work with wet hands, tools or clothing.

Remove Your Jewelry.

Electrical Hazard

Cords & Equipment

- Power tools and extension cords must be inspected each time they are used.

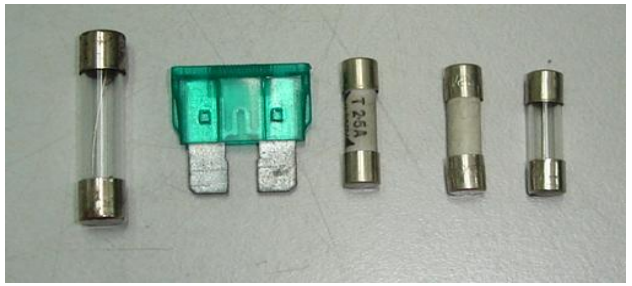
- They must be taken out of service immediately upon discovery of worn or broken insulation.

Protective And Safety Devices

- Every machine should incorporates special devices to protect the operator, protect the machine and building against fires
- These devices designed to cut off the power when it detects overcurrent

Ground fault circuit interrupters (GFCI) /Residual Current Circuit Breaker (RCCB)

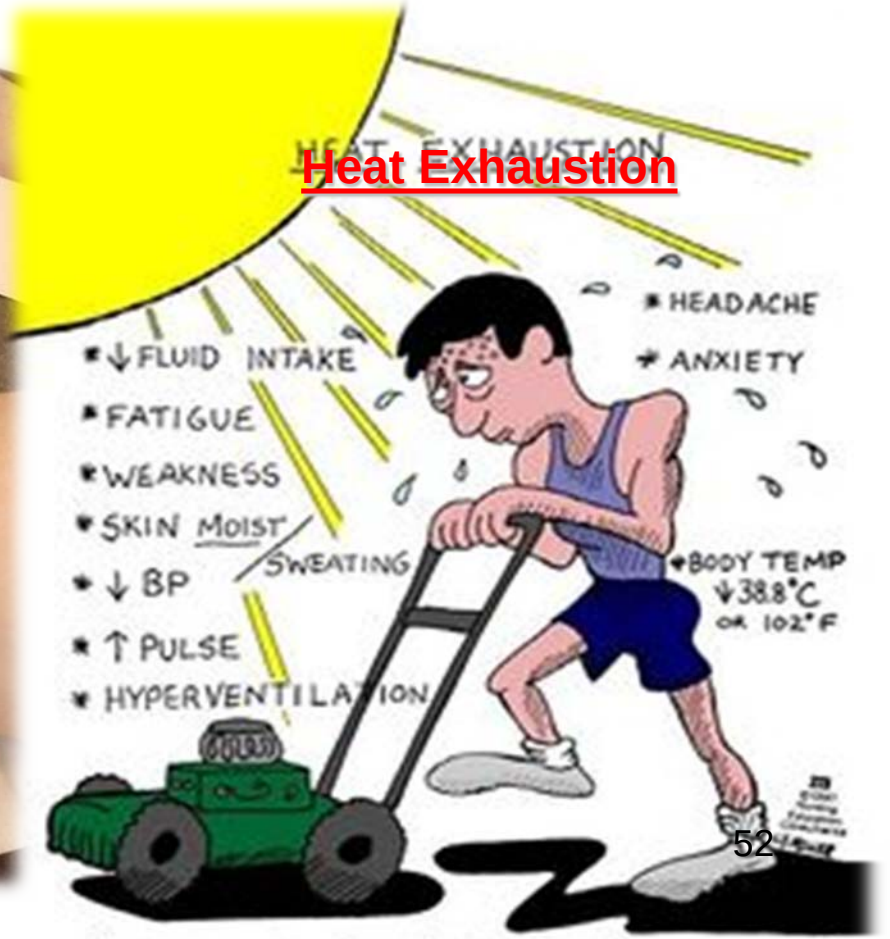
Fuse & MCB



Heat-related Hazards

- Contact with hot surfaces of machines can cause severe skin burns.
- Operations involving high temperatures, high humidity or strenuous physical activities cause heat-related illness (e.g. heat exhaustion or in severe cases, heat stroke).

https://www.youtube.com/watch?v=L3yjMstpY9Y



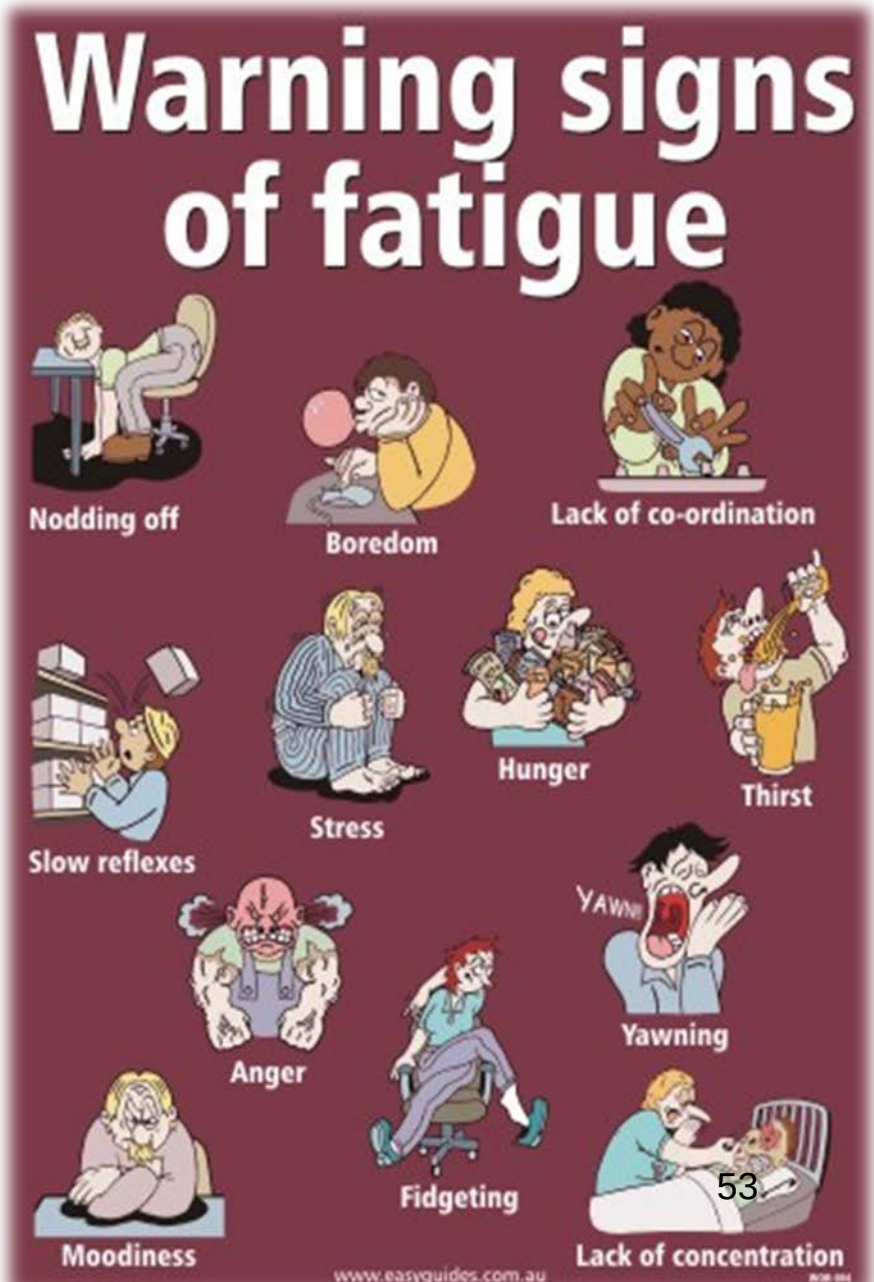
Fatigue

Fatigue is tiredness leading to reduced mental and physical performance that can endanger safety and health.

Fatigue can also lead to near-miss incidents, serious injuries and even fatal accidents due to reduced concentration and alertness.

Fatigue can be caused by:

- long working hours without rest;
- intense and sustained physical exertion/mental effort;
- lack of adequate rest and sleep.



https://www.youtube.com/watch?v=uW8FgS5DpWw

Chemical Hazards

Many equipment use chemicals in operations such as :

- Lubricants for moving parts of machines for smooth operation;
- Hydraulic fluids to operate mechanisms of machine;
- Coolant to cool the cutting process in machining;
- Acids for wet etching in wafer productions;
- Cleaning agents in machine maintenance

Prolonged chemical contact with the skin can lead to skin disorders (e.g., dermatitis)

(https://www.youtube.com/watch?v=uiB8qnlZTAM)

Prolonged exposure thru inhalation of chemical mist or vapour, can cause poor respiratory health (e.g. asthma).