GUARDS AND GUARDING

This module is designed to develop your awareness and competence in the topic Guards and Guarding. This is in accordance with your current training objectives set out in your ROA (record of achievement).

At the end of this input, the trainee will have an understanding of the hazards, the implications, risks and risk assessments needed.

The trainee will then be required to satisfactorily complete a test of understanding as verification.

EQUIPMENT HAZARDS

There are many hazards associated with machinery. They fall into three principal categories:

1) Hazards related to the machinery itself, such as shearing and abrasion and release of hazardous substances.

2) Hazards related to the location of the machine, such as stability (could it roll or fall over) or its proximity to another structure.

3) Hazards related to systems of work associated with the machine, such as manual handling injuries caused when putting material into the machine.

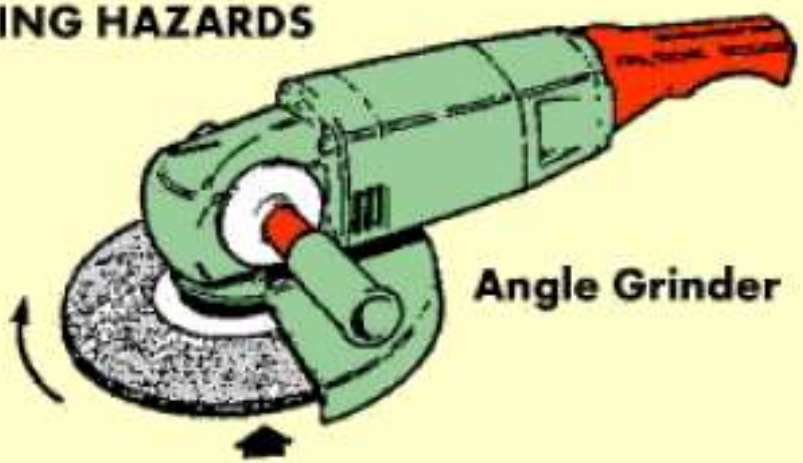
COMMON INJURIES AND RELATED SITUATIONS

The common injuries associated with machines are

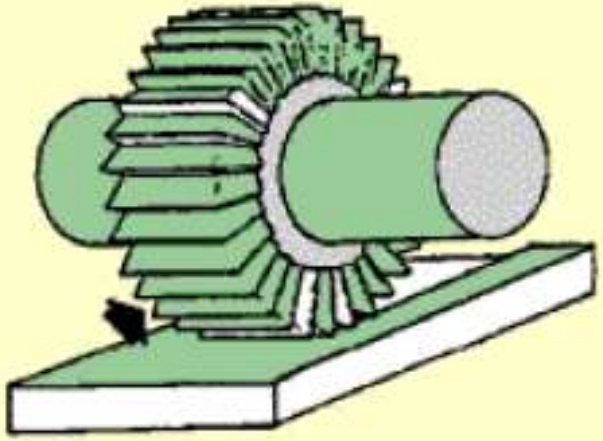
CUTTING

Examples of cutting hazards associated with machines include all kinds of obvious cutting tools such as jig saws, circular saws, milling machines, routers, spindle moulders, planing machines, band saws, rotary knives and angle grinders, as well as water jet cutting or sharp edges of moving sheet material in a machine.

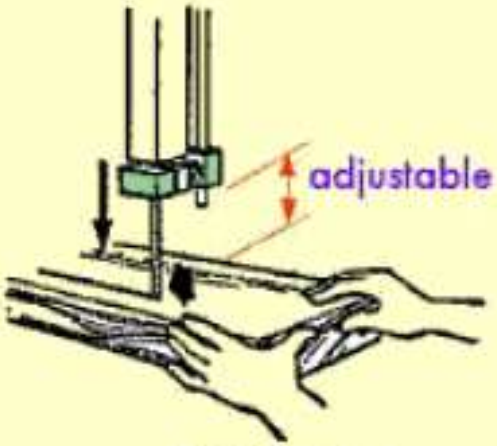
TYPICAL CUTTING HAZARDS



Angle Grinder



Milling Machine



Band saw

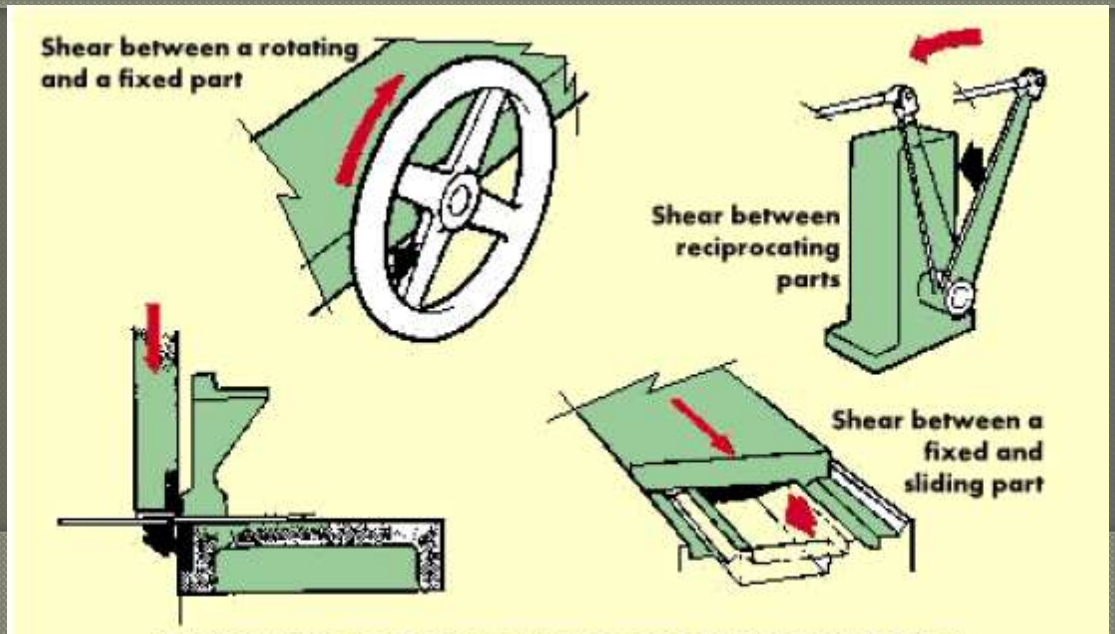
Circular Saw

SHEARING

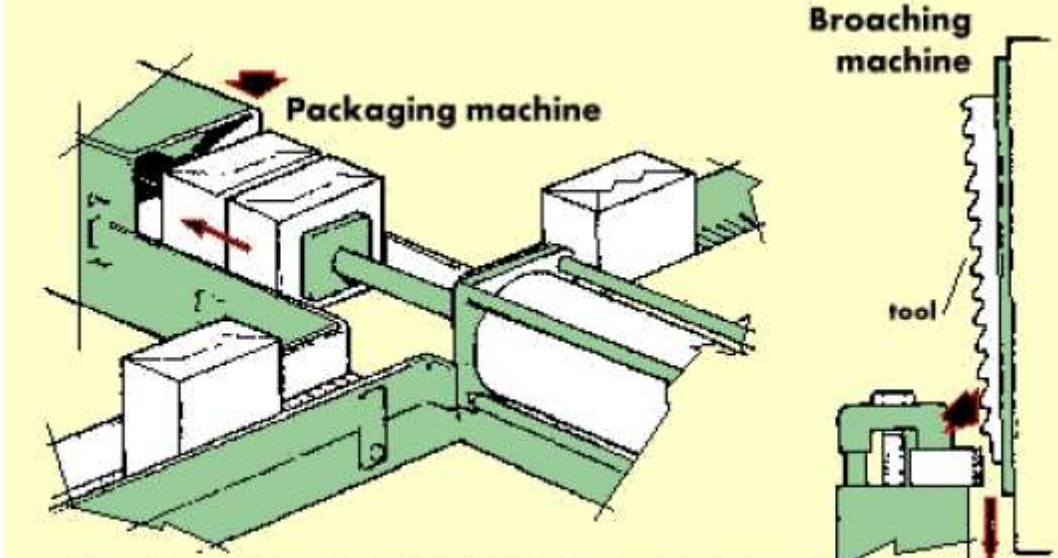
Parts of the human body may be sheared between:

Machine parts, e.g. the table of a metal planing machine (shaper) and its bed, the table and blade of a guillotine or power press, or between parts that oscillate such as in a wool scouring machine.

A machinery part and a workpiece, e.g. the tool of a broaching machine and the part being broached.



SHEAR HAZARDS BETWEEN TWO MACHINE PARTS



SHEAR HAZARDS BETWEEN A MACHINERY PART AND A WORKPIECE

STABBING AND PUNCTURING

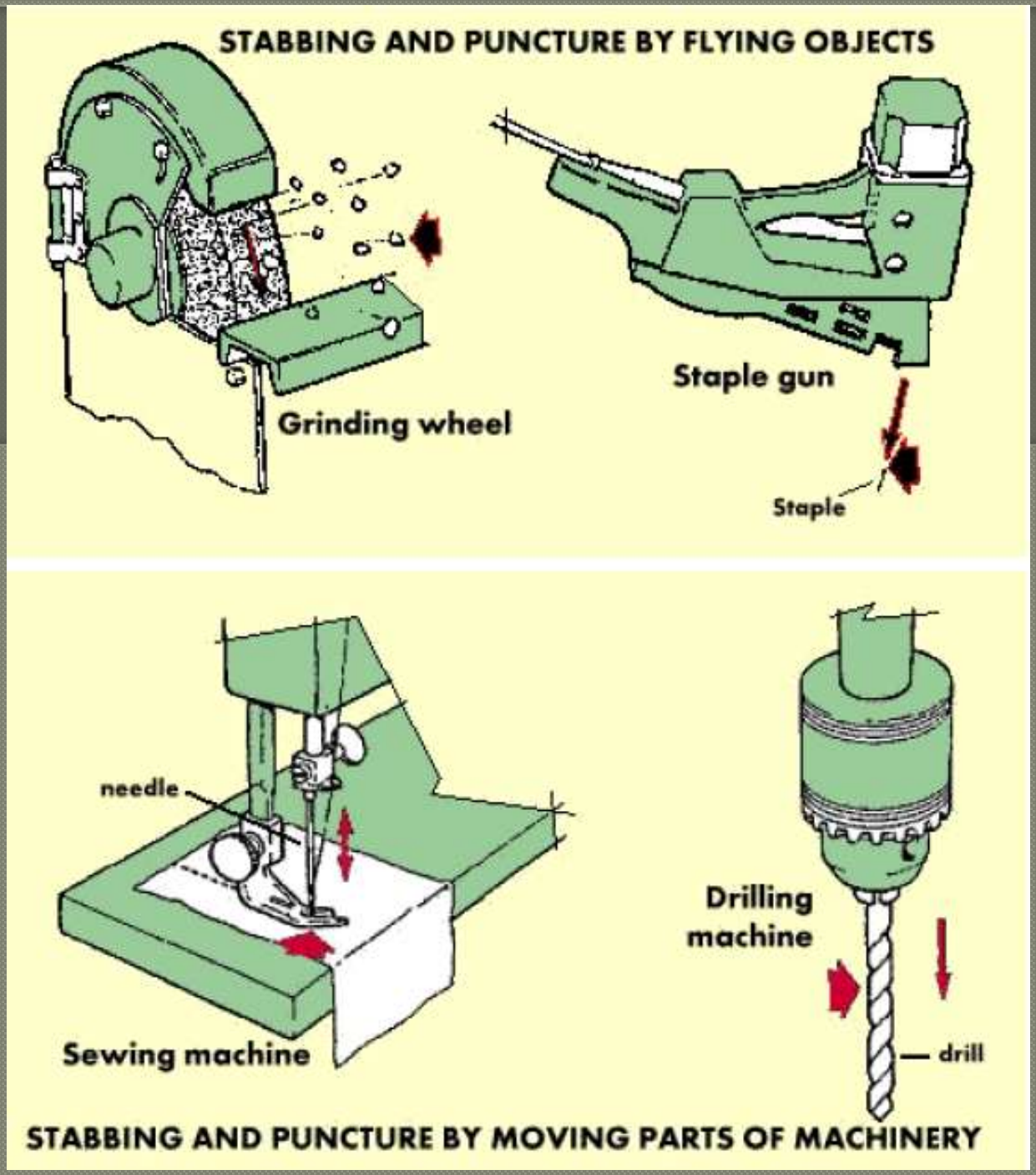
The human body may be penetrated by:

1) Flying objects such as:

Parts of a machine, e.g. the flying shuttle of a loom, a loose tool in a lathe, broken tooling on a press or the breaking-up of an abrasive wheel.

Material ejected from a machine, e.g. swarf, ejection of a workpiece, molten metal ejected from a diecasting machine, sparks from a welding process, a bolt from an explosive-powered tool or debris thrown by rotary mowers and hedge cutters.

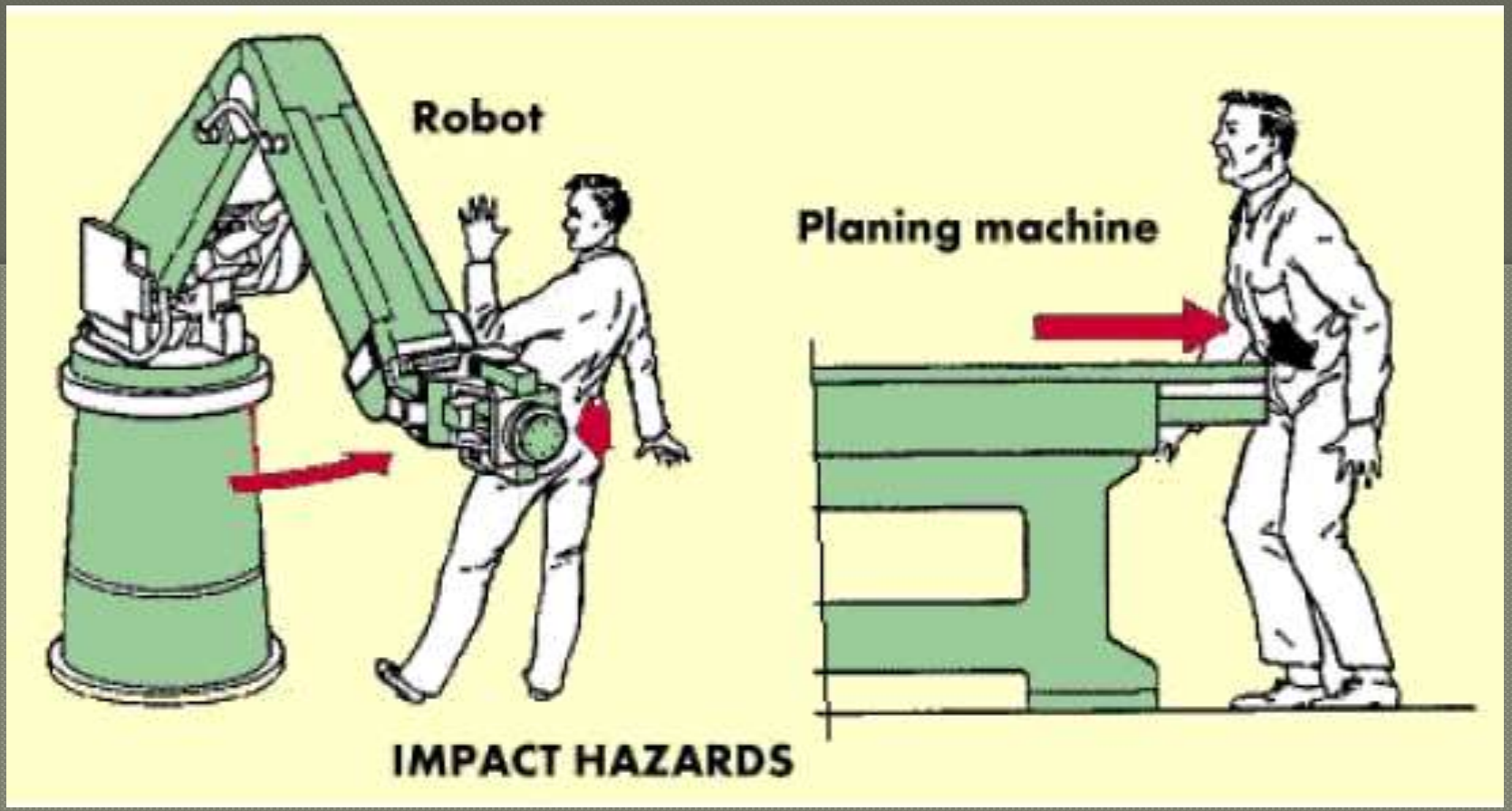
2) Rapidly moving parts of machinery or pieces of material, e.g. the needle of a sewing machine, the drill of a drilling machine or the arm of a robot.


STABBING AND PUNCTURE BY FLYING OBJECTS
Grinding wheel
Staple gun
Staple
needle
Sewing machine
Drilling machine
drill
STABBING AND PUNCTURE BY MOVING PARTS OF MACHINERY

IMPACT

Impact hazards relate to objects which strike the human body, but do not penetrate it. Examples include the rotating arm of a robot, the reciprocating bed of a metal planing machine and the pendulum movement of the arms of a wool scouring machine.

Impact hazards are different to crush hazards although the machines involved may be the same. Impact hazards operate against the inertia of the body whereas crush hazards involve the trapping of the body between two machine parts or between a machine part and a fixed structure.


Robot
Planing machine
IMPACT HAZARDS

ENTANGLEMENT

Entanglement involves being caught in a machine by loose clothing (such as gloves or neckties), jewellery, long hair, cleaning rags, bandages or rough material being fed into the machine.

Bodily contact of the following types may lead to entanglement:

1. Contact with a rotating surface, e.g. plain shafting, couplings, spindles, chucks, leadscrews*, mandrels* or rotating workpieces (including plain bar material).
2. Being caught on projections or in gaps. Belt fasteners and other projecting items (such as keys, set screws and cotter pins) are typical projection hazards whilst fan blades, spoked wheels (such as pulleys, sprockets, gear wheels and flywheels), mixer and beater arms and spiked cylinders are gap related hazards.

ENTANGLEMENT

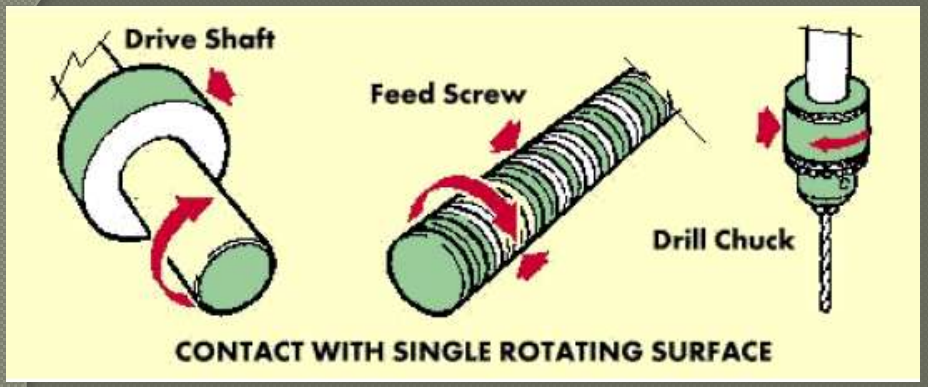
3. Contact with materials in motion, such as in centrifuges, tumble driers and dough mixers or swarf from machining operations.

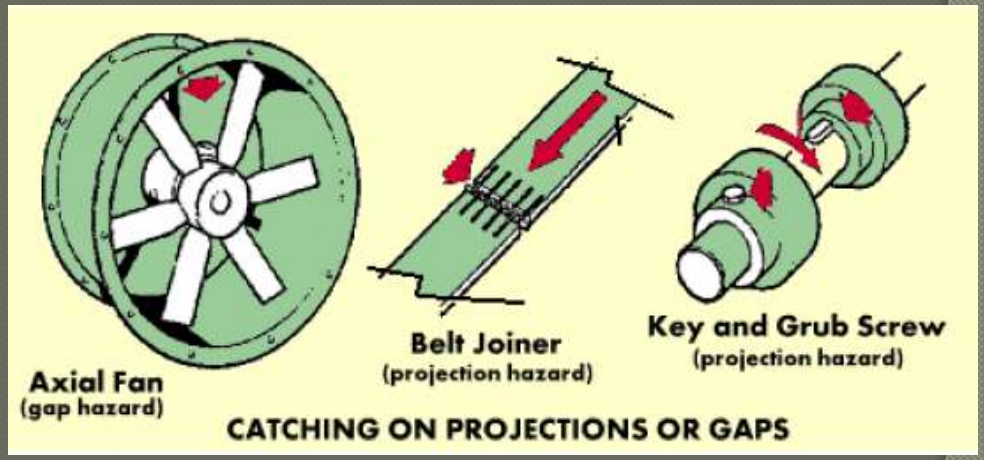
4. Being caught in the nip-point (Running Nip):-

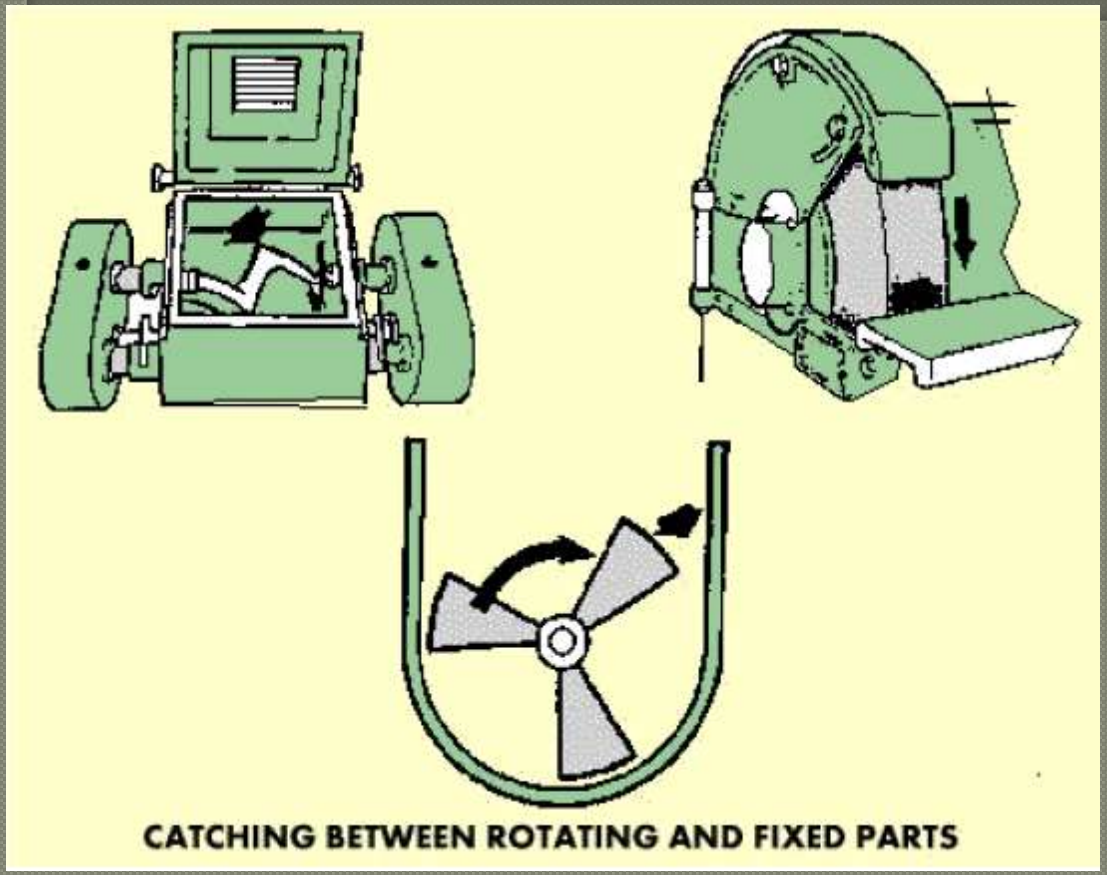
Between counter-rotating parts, i.e. cylindrical parts rotating in opposite directions such as gear wheels, rolling mills, mixing rolls and calenders or between material and a roll where material is being drawn between two rolls.

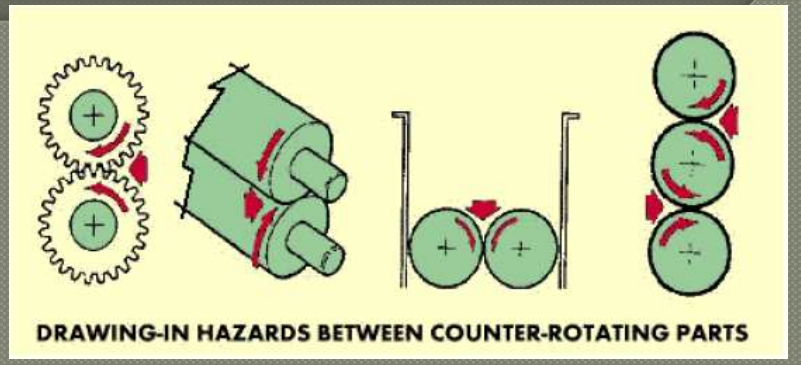
Between rotating and tangentially moving parts, e.g. a power transmission belt and its pulley, a chain and chain wheel, a rack and pinion, a conveyor belt and any of its pulleys and a rope and its storage reel.

Between rotating and fixed parts, e.g. spoked hand wheels or flywheels and the machinery bed, screw or worm conveyors and their casings, revolving mixer and mincing mechanisms in casings having unprotected openings, mixers, extruder screw and barrel or the periphery of an abrasive wheel and an incorrectly adjusted work rest.


Drive Shaft
Feed Screw
Drill Chuck
CONTACT WITH SINGLE ROTATING SURFACE


Axial Fan
(gap hazard)
Belt Joiner
(projection hazard)
Key and Grub Screw
(projection hazard)
CATCHING ON PROJECTIONS OR GAPS


CATCHING BETWEEN ROTATING AND FIXED PARTS

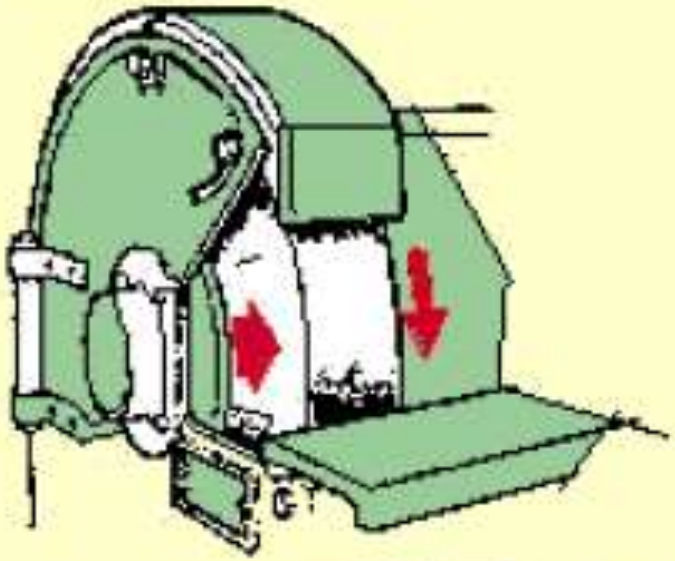

DRAWING-IN HAZARDS BETWEEN COUNTER-ROTATING PARTS

FRICTION AND ABRASION

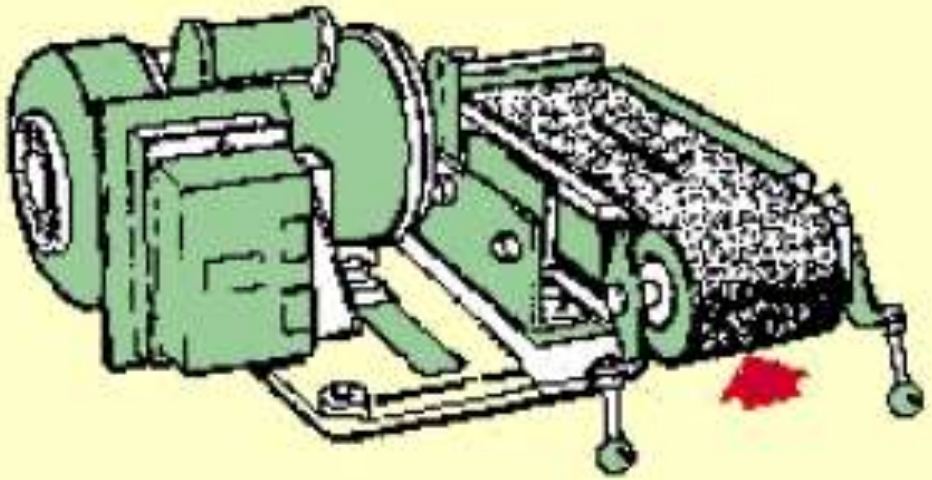
Friction burns can be caused by smooth parts operating at high speed, such as the rim of a centrifuge basket.

Other examples of friction or abrasion hazards include the periphery of a grinding wheel, the belt of a sanding machine, material running onto a reel or shaft, a conveyor belt and its drums or pulleys and fast-moving ropes or belts.

Grinding Wheel



Sanding Machine



FRICTION AND ABRASION HAZARDS

CRUSHING

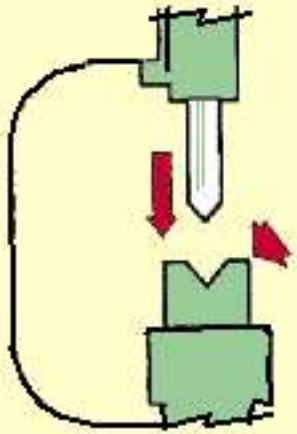
Crushing occurs when a part of the body is caught:

1. Between a fixed and moving part of a machine, such as the bed and tool of a power press;

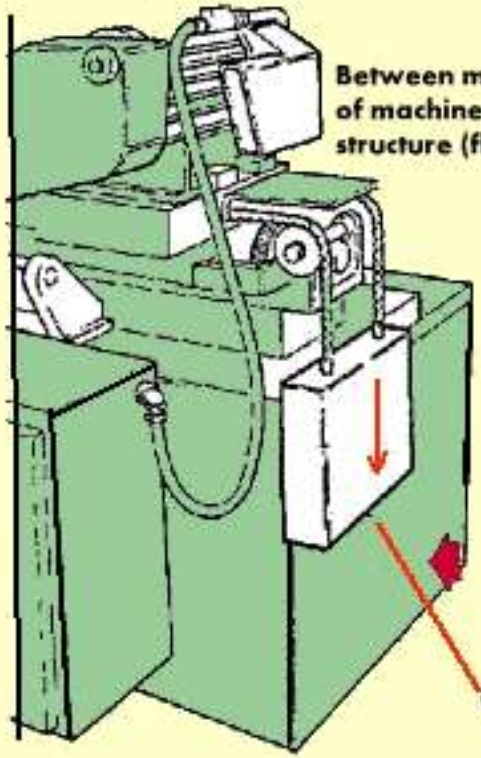
2. Between two moving parts of a machine, such as the support arms of a scissor lift platform;

3. Between a moving machine part and a fixed structure, such as a counterweight and the floor.

Between moving part of machine and fixed structure (wall)

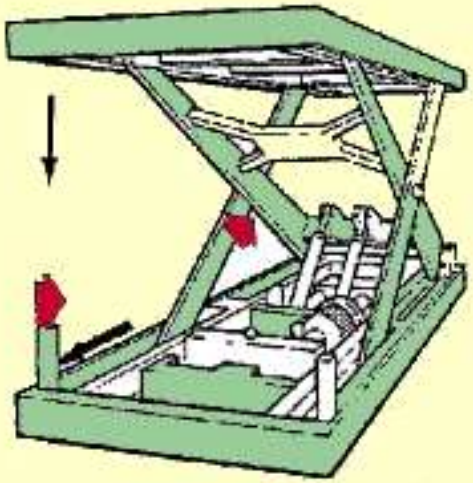


Between moving part of machine and fixed part of machine



Between moving part of machine and fixed structure (floor)

Counterweight



Between moving parts of machine

CRUSHING HAZARDS

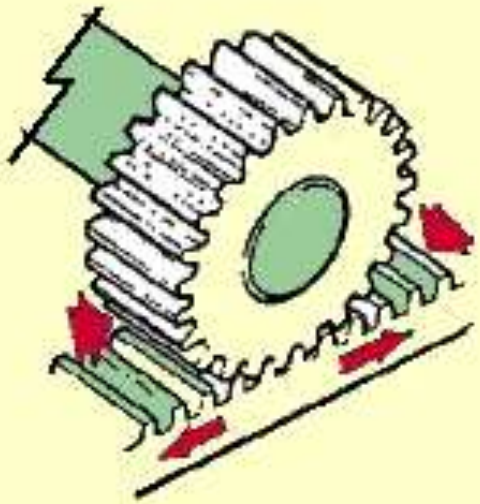
SHEARING OR CRUSHING – NIP POINTS

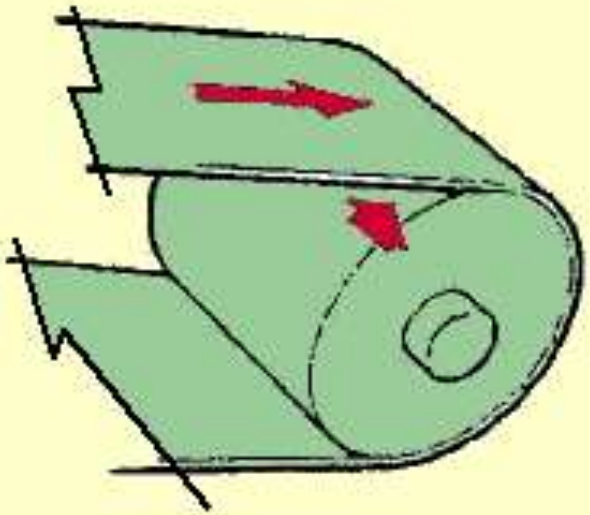
Shearing or crushing injuries can be caused when a part of the body is drawn into a "nip-point" formed in any of the following ways:

In-running nips* between two counter-rotating parts, e.g. meshing gears, rolling mills, mixing rolls, press rolls and calenders.

In-running nips between a rotating surface and a tangentially moving surface, e.g. a power transmission belt and its pulley, a chain and its chain wheel and a rack and its pinion.

Running nips between a rotating surface and a tangentially moving surface where material (e.g. metal, paper, cable or rope) runs on to a reel, drum or shaft.





NIP POINTS (DRAWING-IN HAZARDS)

PROJECTILES AND ENERGY RELEASE

Projectiles ejected from a machine

Failure of a machine, or seizing of component parts of a machine, can result in the expulsion of parts of the machine or material with the potential to cause serious injury.

Similarly, failure of the machine control system can cause the release of material being processed.

Examples are the disintegration of an abrasive wheel, the seizure of a brake or clutch, bursting of a high pressure hydraulic line, or the failure of work holding devices such as vices and clamps.

PROJECTILES AND ENERGY RELEASE

Release of potential energy

Unexpected release of potential energy may cause injury.

Examples are the energy stored in flywheels and springs, the release of pressure and objects falling under the force of gravity.

DEFINITIONS

Safety Device	A device other than a guard that eliminates or reduces danger.
Danger	A state or condition in which personal injury is reasonably foreseeable.
Safe Working Practice	A safe system of work, i.e., a method of working that eliminates or reduces the risk of injury.
Integrity	The ability of devices, systems and procedures to perform their function without failure or defeat.

DEFINITIONS

Interlock	Safety devices that interconnects a guard with the control system or the power system of the machinery.
Danger	A state or condition in which personal injury is reasonably foreseeable.
Risk	A combination of the probability of injury and the degree of the injury.
Hazard	A situation that may give rise to personal injury.

DEFINITIONS

Failure to Safety	Any failure of the machinery, its associated safeguards, control circuits or its power supply that leaves the machinery in a safe condition.
Failure to Danger	Any failure of the machinery, its associated safeguards, control circuits or its power supply that leaves the machinery in an unsafe condition.

DEFINITIONS

Guard	Physical barrier that prevents or reduces access to a danger point or area.
Machinery	Apparatus for producing or applying power, having fixed or moving parts each with definite functions.
Safeguard	A guard or device designed to protect persons from danger.

RISK ASSESSMENT

Risk, in relation to any injury or harm, means the likelihood of that injury or harm occurring. The amount of risk depends upon the circumstances. These include the type and size of machine, what it
is used for, the need for approach to it, ease of access and the quality of supervision present. Risk also depends upon the knowledge, skills and attitude of the person(s) present in those circumstances and an individual's awareness of the danger and the skill needed to avoid it. The ability to identify those at risk and to identify when the risk occurs is important and applies to operators as well as management.

RISK ASSESSMENT

Assessing the risks associated with each hazard is a way of identifying which hazards need to be controlled and which to tackle first.
To assess risk it is necessary to consider two factors:

1. The chance of each situation or event actually occurring (the likelihood).

2. The extent of the harm (injury or ill health) should it actually occur (the consequence).

RISK ASSESSMENT

Using research and observations about people's exposure to the hazard, determine "likelihood" using categories such as:

Very likely	could happen frequently.
Likely	could happen occasionally
Unlikely	could happen rarely
Highly unlikely	could happen but probable never will;

Then determine "consequence"
assuming such categories as:

Fatality	Major Injuries - normally irreversible
	Minor injuries - normally reversible
	Negligible injuries - requiring no treatment or first aid only.

RISK ASSESSMENT

Having determined the "likelihood" and "consequence" of each hazard, rate the hazards according to how serious the risk is. A risk table such as that illustrated below may facilitate this process.

Consequence	Likelihood			
	Very likely	Likely	Unlikely	Highly unlikely
Fatality	HIGH	HIGH	HIGH	MEDIUM
Major injuries	HIGH	HIGH	MEDIUM	MEDIUM
Minor injuries	HIGH	MEDIUM	MEDIUM	LOW
Negligible injuries	MEDIUM	MEDIUM	LOW	LOW

RISK ASSESSMENT

Events or situations assessed as very likely with fatal consequences are the most serious (HIGH risk)

Those assessed as highly unlikely with negligible injuries are the least serious (LOW risk).

When developing risk control strategies, hazards with a HIGH rating should be tackled first.

LEGAL REQUIREMENTS

Manufacturers of machinery are required to identify hazards to potential operators that arise from the construction of the machinery. They must assess the related risks and where necessary either control the hazards or arrange with the designer to alter the design to minimise them.