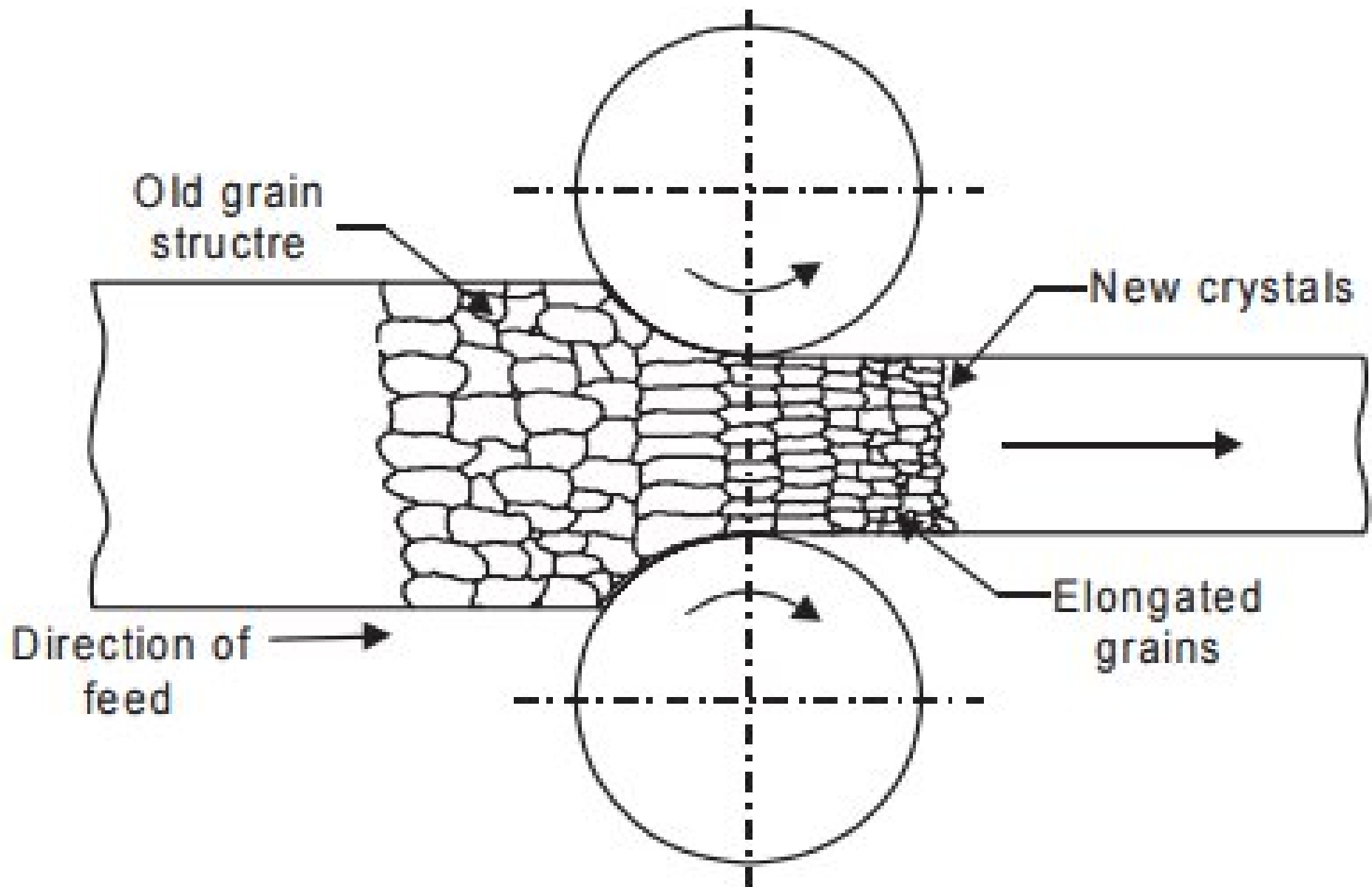


HOT WORKING

Hot Working is done at temperatures above the recrystallization temperature of the metal, and Cold Working is done at temperatures below the recrystallization temperature of the metal.

There are different methods of hot working process like forging, extrusion, rolling, spinning, drawing, piercing but the most commonly used method is forging & extrusion

The advantage of hot working is that it does not produce strain hardening; therefore there is no increase in hardness and yield strength.



It reduces strain hardening. Its components have better toughness. Its components have better ductility. Its components have better resistance to shocks and vibrations. Its components have better strength particularly the forged parts.

Mechanically forming material at about room temperature. Cold working processes include rolling, drawing, spinning, hammering, etc. As the amount of cold work increases the material gets harder owing to the deformation of the crystal structure, a process called work hardening.

The geometry of the metal can be changed easily since it is heated at a very high temperature. It's required less force to do it.

Advantages of cold working over hot working include: No heating required. Better surface finish. Superior dimensional control.

Forming Operations

Hot Working

- Above recrystallization temperature
- Allows for large deformations
- Less energy required than for cold working
- May result in surface oxidation

Cold Working

- Below recrystallization temperature
- Increases strength, but decreases ductility and corrosion resistance
- Better control of dimensions
- Better surface finish

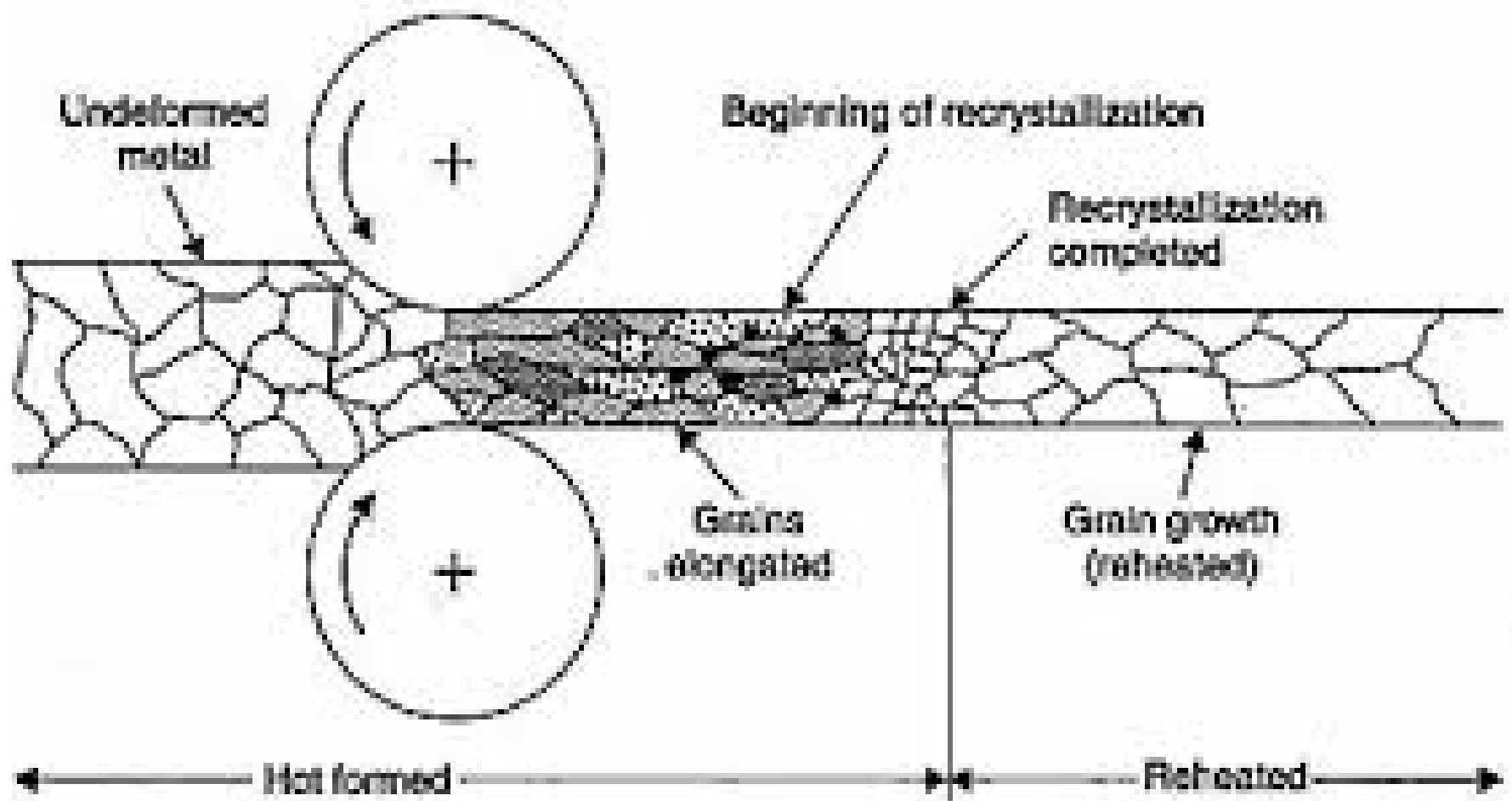
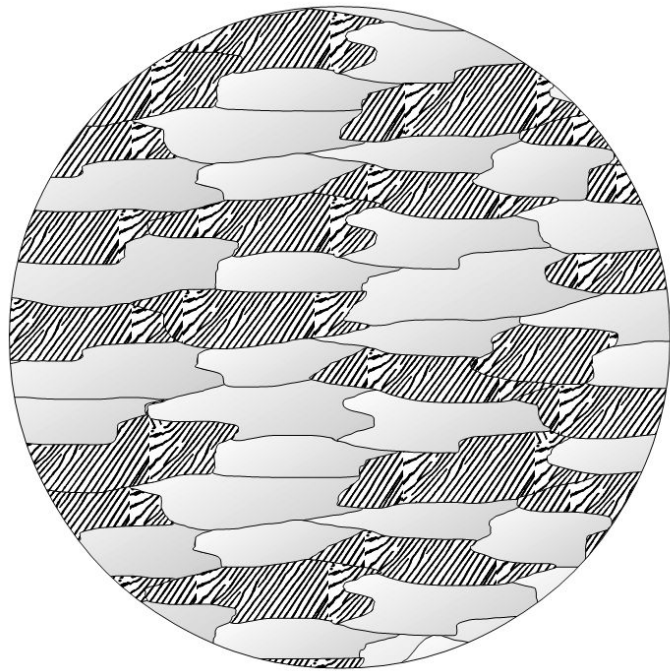


Fig. 3.2 : Hot working Processes

Strain Hardening is when a metal is strained beyond the yield point. An increasing stress is required to produce additional plastic deformation and the metal

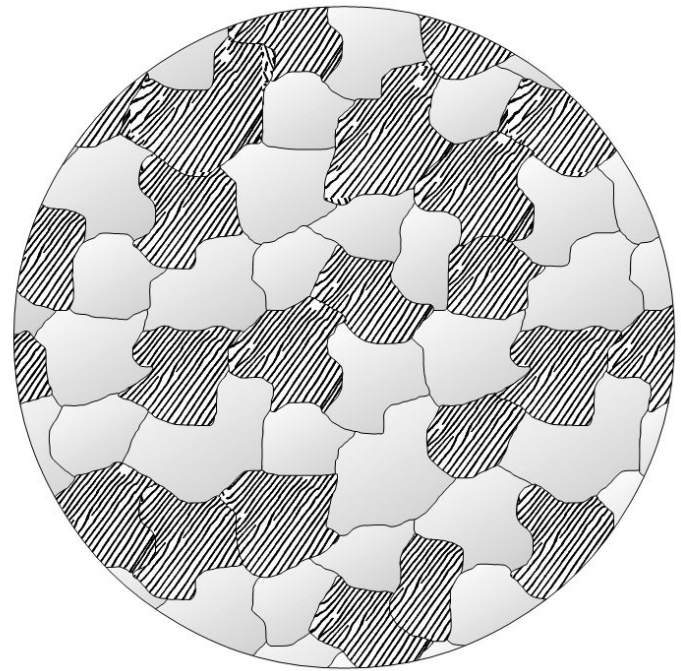
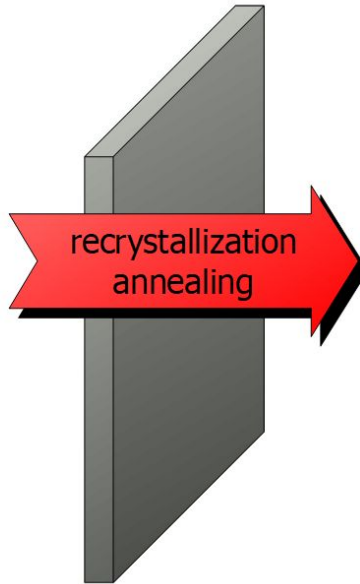
Strain hardening is a process to promote the metal harder and stronger due to plastic deformation.

Recrystallization is a process by which deformed grains are replaced by a new set of non-deformed grains



slightly deformed
microstructure

rolled sheet



coarse-grained recrystallized
microstructure

Common Metal Stamping Processes

Blanking.

Piercing.

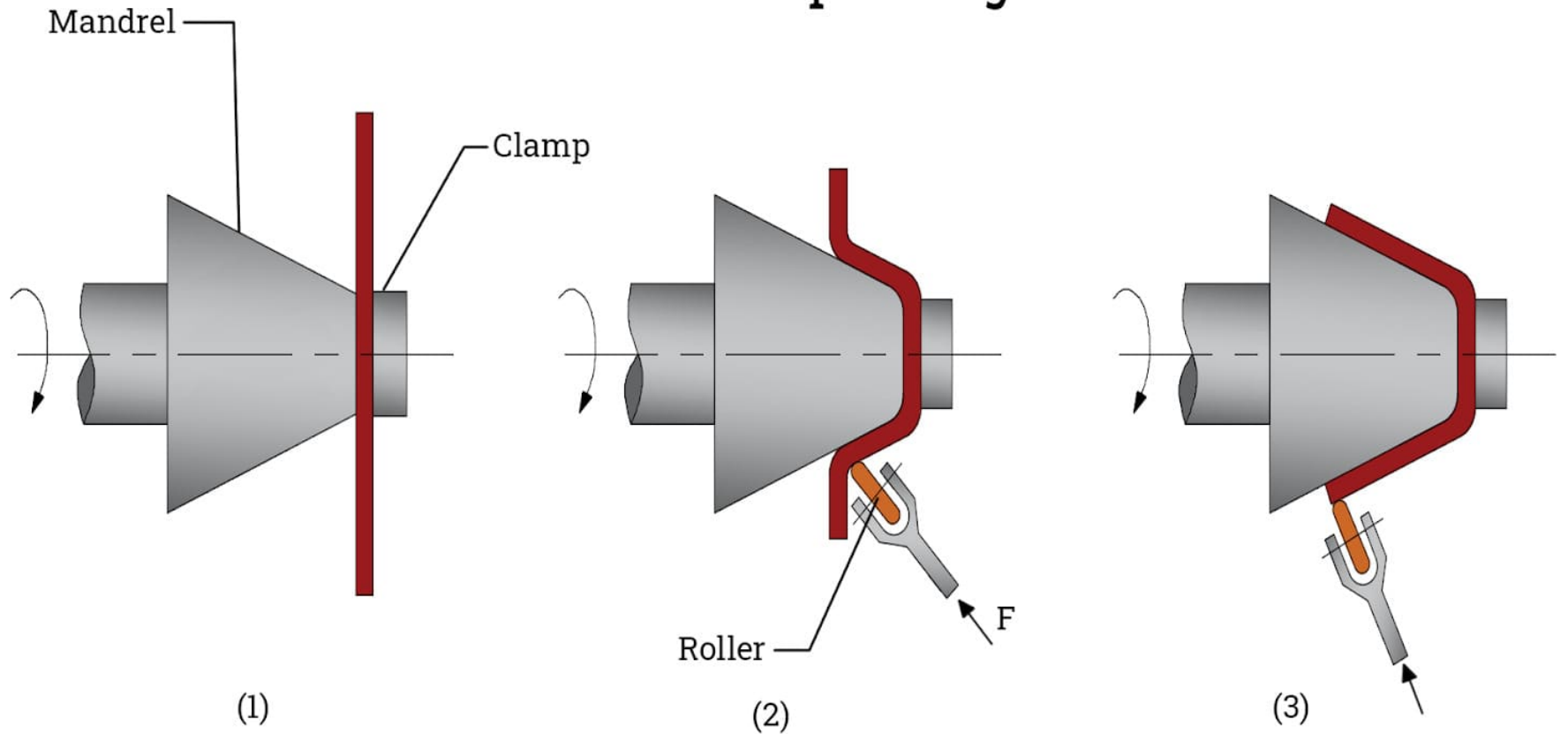
Drawing.

Bending.

Forming.

Hot spinning produces parts such as heads for pressure vessels, refinery equipment's and large tanks. (ii) Cold Spinning: Cold spinning process is similar to hot spinning except that the metal blank is worked at room temperature.

Hot/Cold Spinning



❑ Metal spinning, or spin forming, is a metalworking process that transforms a flat circular blank or disc shaped workpiece into axially symmetrical round shapes.

❑ It is accomplished by the application of lateral force by a roller positioned against the surface of the disc blank and a mandrel that is spinning on its axis at high speed.

❑ The mandrel serves as support for the workpiece and gives it its final shape.

Metal Spinning Products

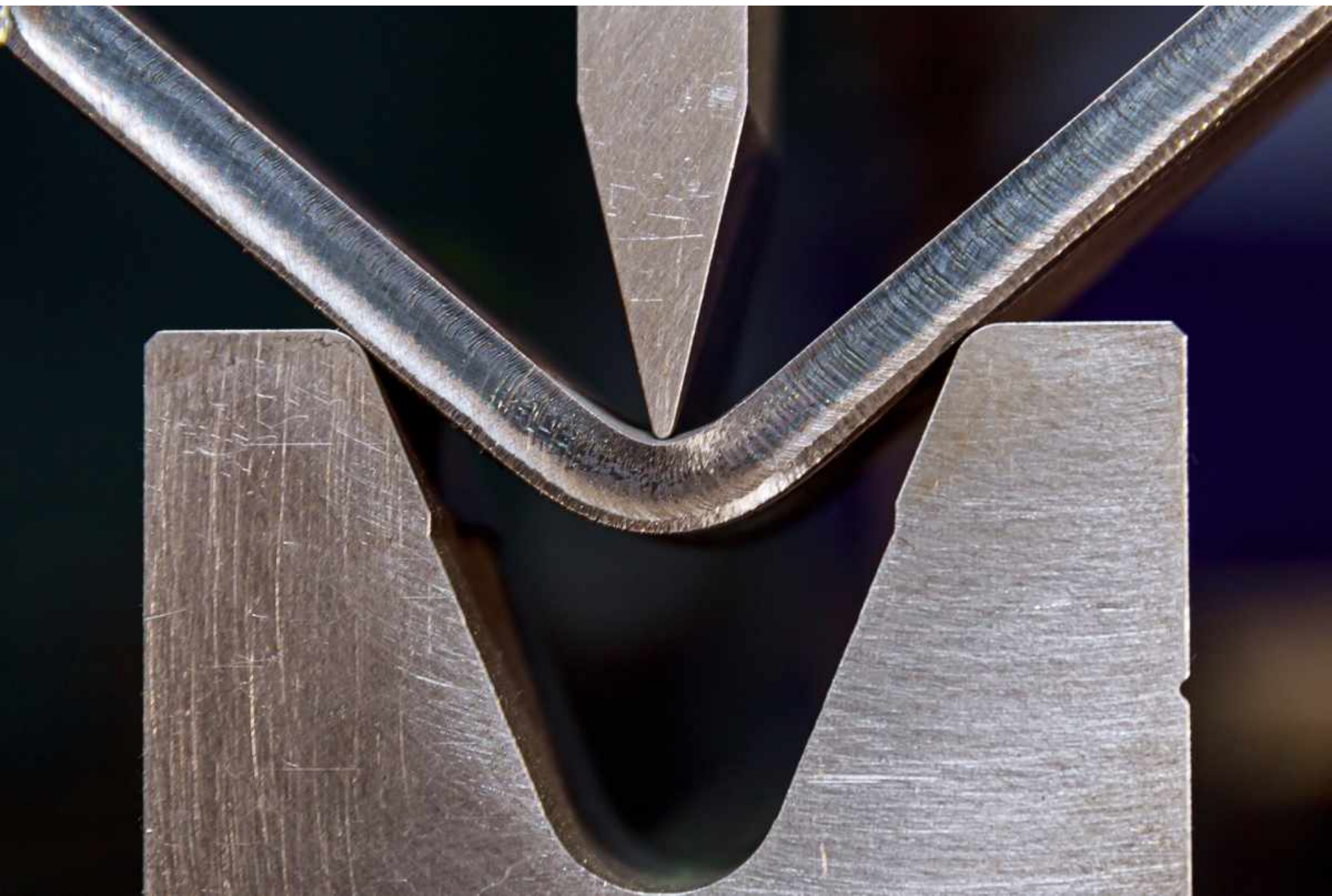


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METAL BENDING

➤ **Metal bending is a process by which metal can be deformed when applying force to the subject, which causes it to bend at an angle and form the anticipated shape, which often results in it being in a 'V' or a 'U' shape.**

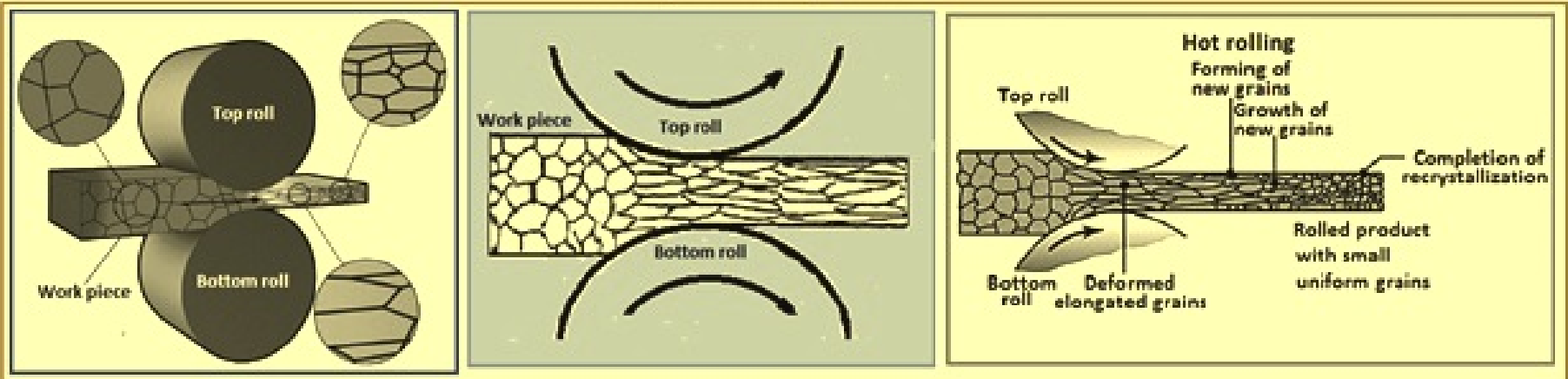
➤ **A press brake is a tool used in order to bend sheet metal and uses a punch and die to do this.**

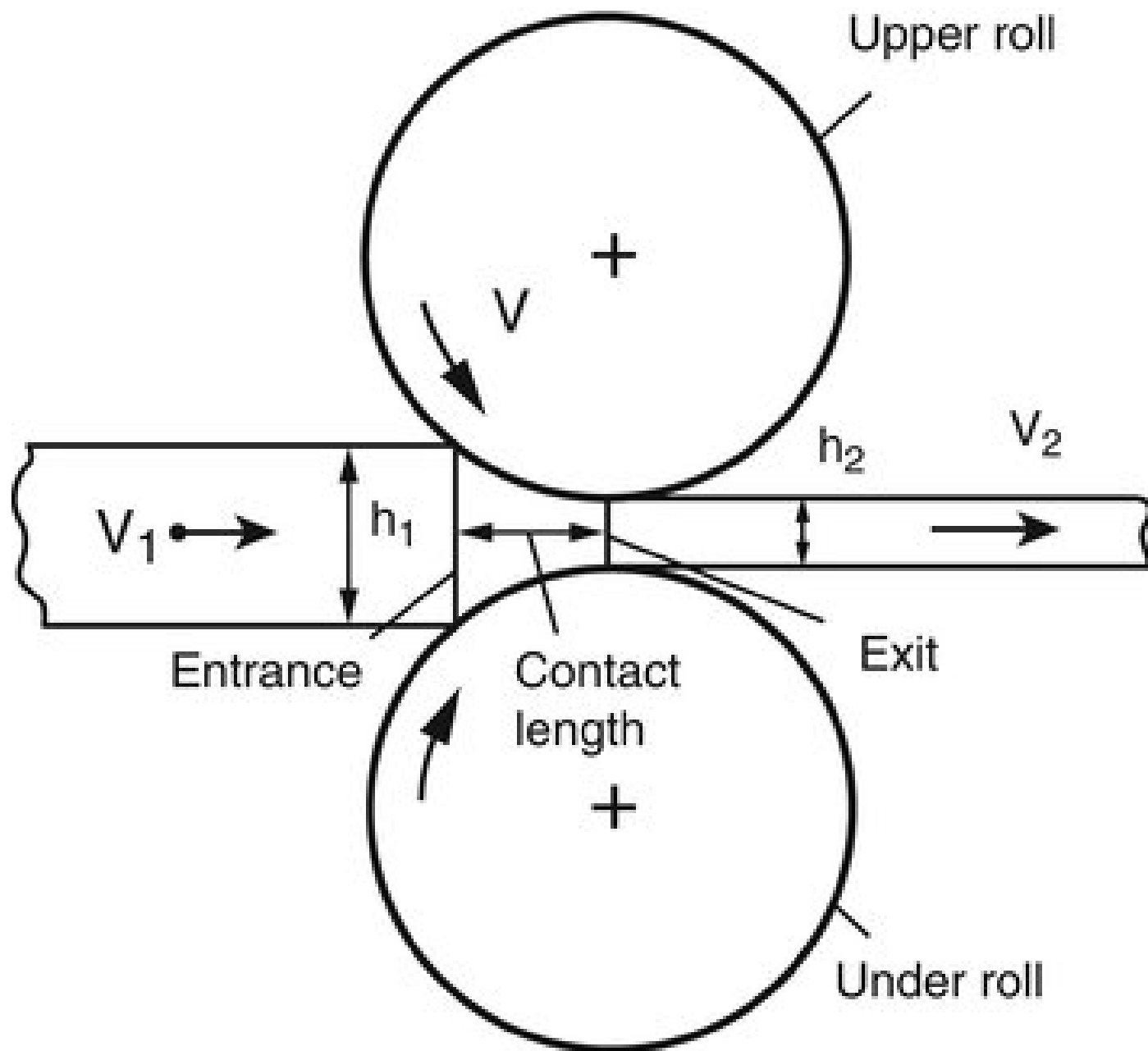


ROLLING

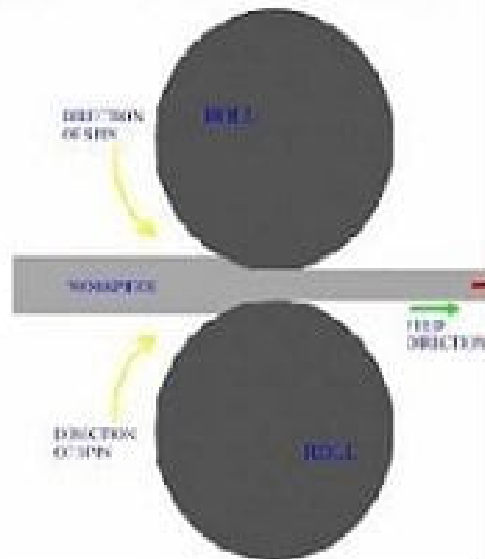
- ❑ Rolling is a process used to shape metal into a thin long layer by passing it through a gap of two rollers rotating in different directions
- ❑ Rolling is a process used to shape metal into a thin long layer by passing it through a gap of two rollers rotating in different directions (clockwise and anti-clockwise)

Concept of rolling of metals

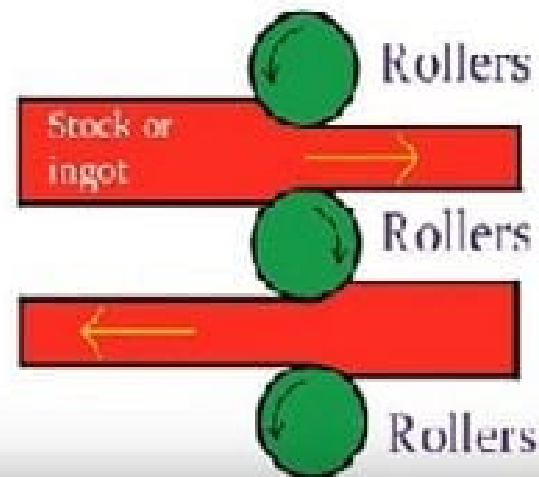




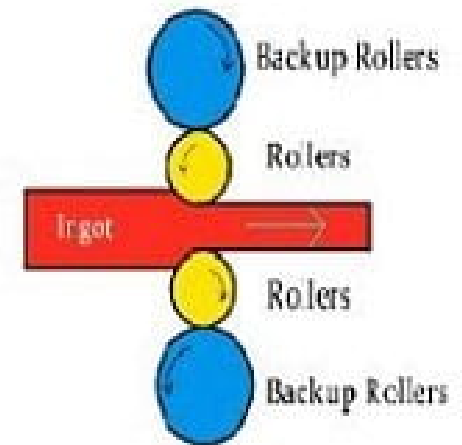
Two High Rolling Mill



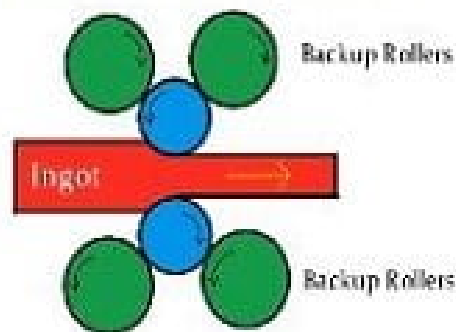
Three High Rolling Mill



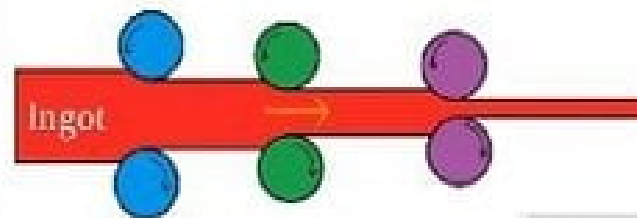
Four High Rolling Mill



Cluster Rolling Mill



Tandem Rolling Mill



Types Of Rolling Mills

Resolving forces For Equilibrium

$$2N \sin \theta = 2F \cos \theta$$

- $2F \cos \theta$ tries to pull the stock through the rolls
- $2N \sin \theta$ resist the rolling action

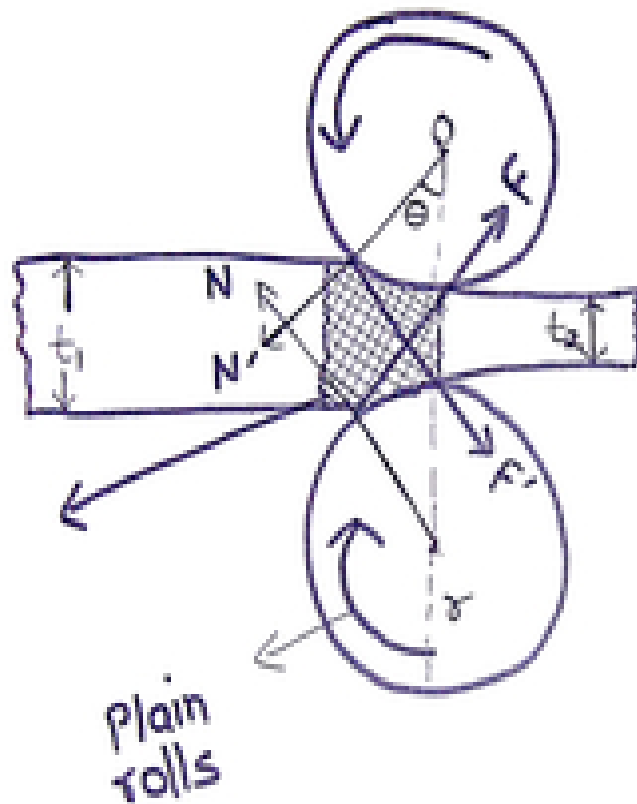
∴ For rolling to take place

$$2F \cos \theta > 2N \sin \theta$$

or

$$\tan \theta < \mu$$

$$\mu = \sqrt{\frac{t_1 - t_2}{s_1}}$$

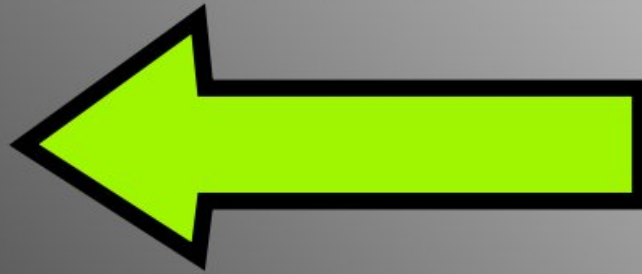


WIRE DRAWING

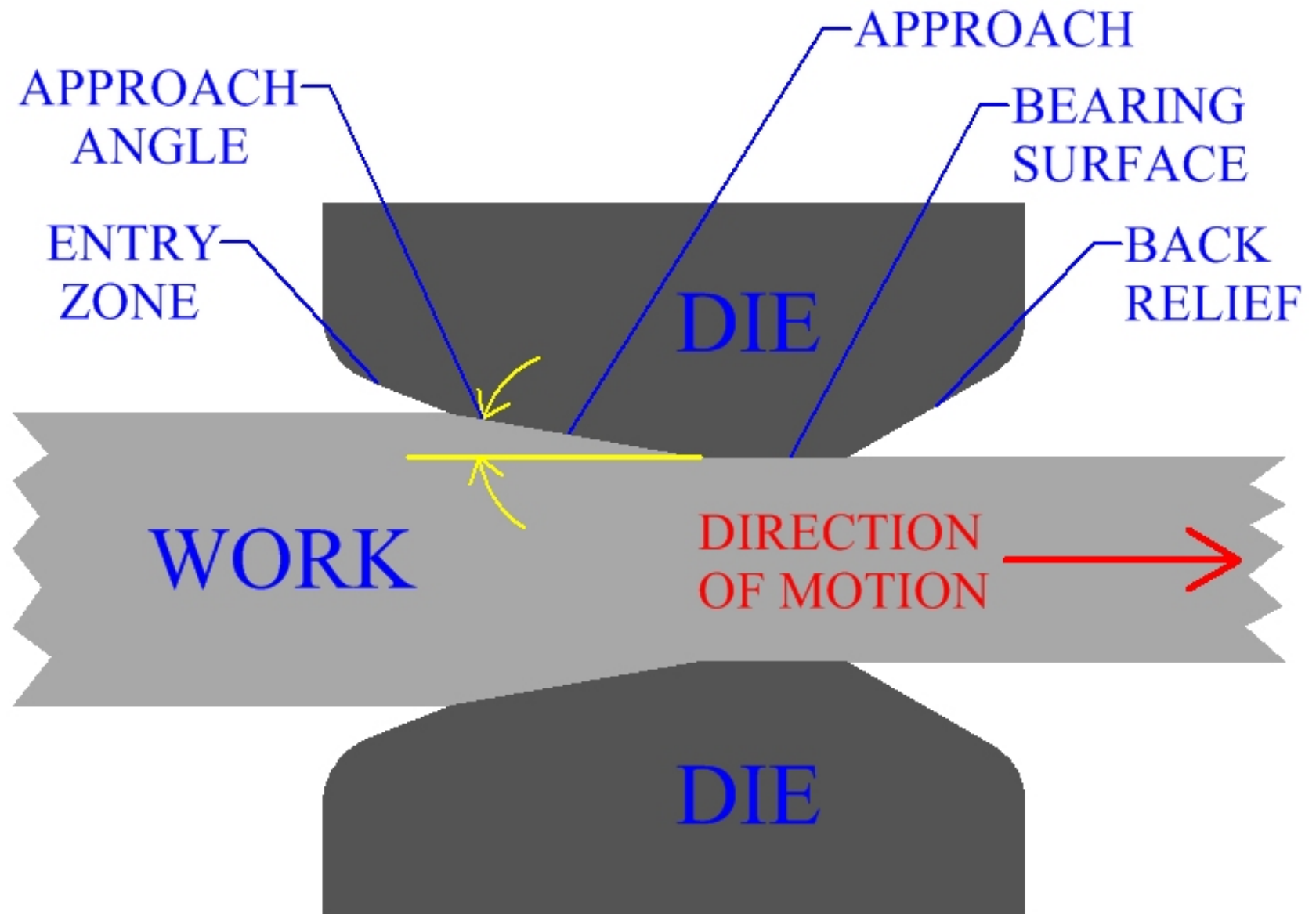
Die

Undrawn bar

Drawn bar



DRAWING DIE



❑ Among the most common metalworking techniques is metal drawing, a process that entails pulling a metal through a mold or die.

❑ Like the similar extrusion process, during which a metal is pushed through a die using a draw punch.

❑ Metal drawing can result in a metal with a depth that equals or exceeds its width or radius.

TUBE DRAWING

Initial tube

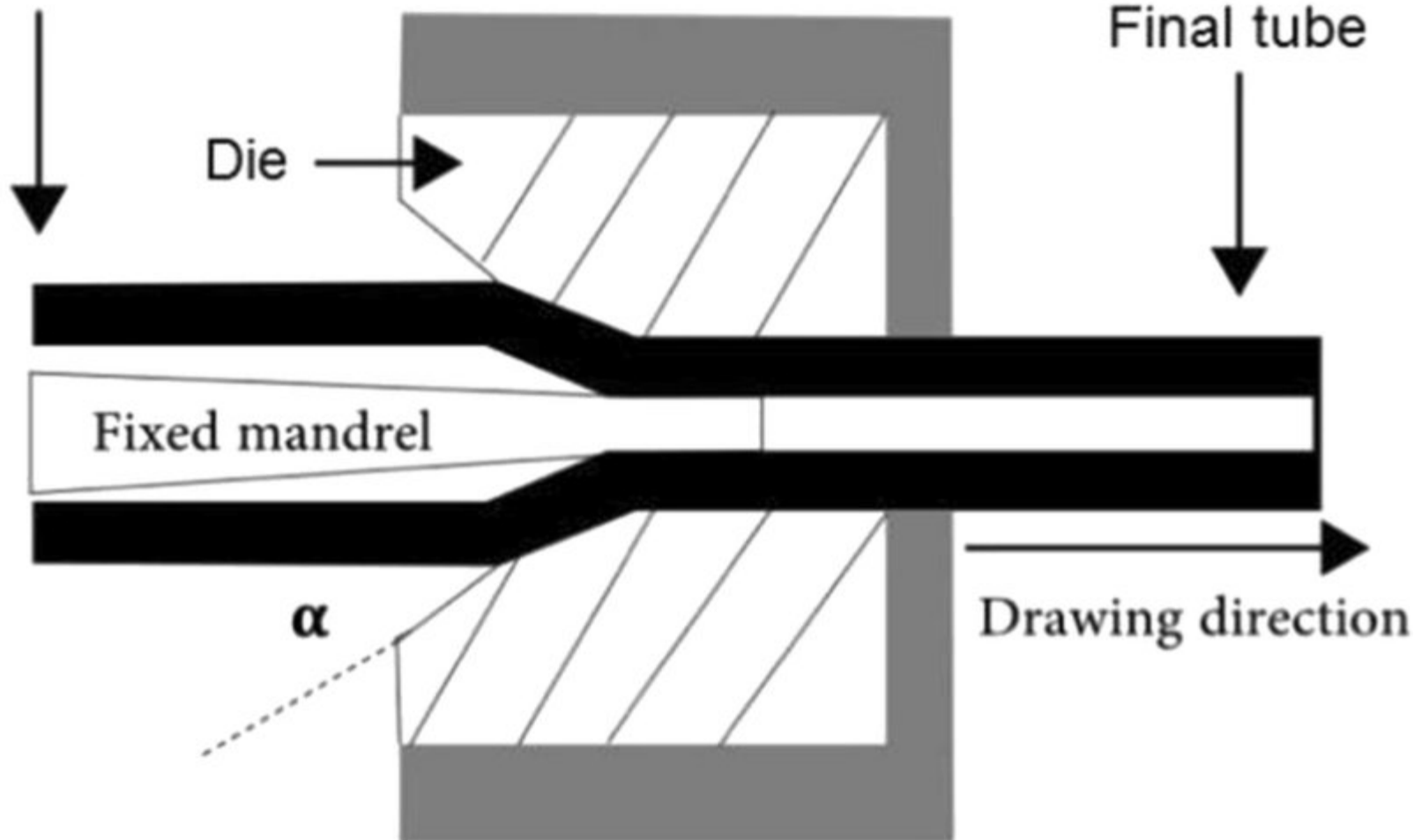
Final tube

Die

Fixed mandrel

α

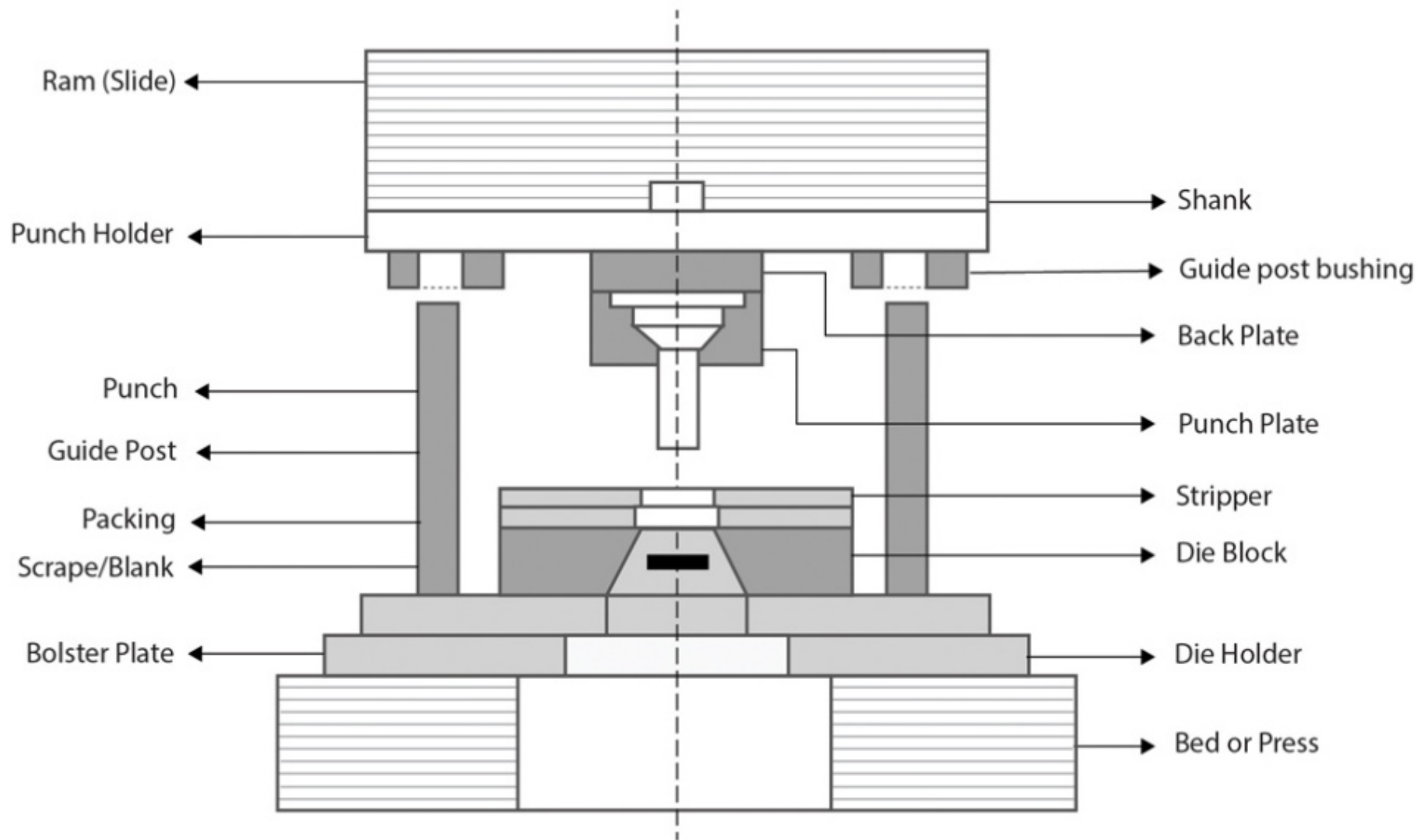
Drawing direction



PRESS TOOS

Generally press tools are categorized by the types of operation performed using the tool, such as blanking, piercing, bending, forming, forging, trimming etc.





DEEP DRAWING

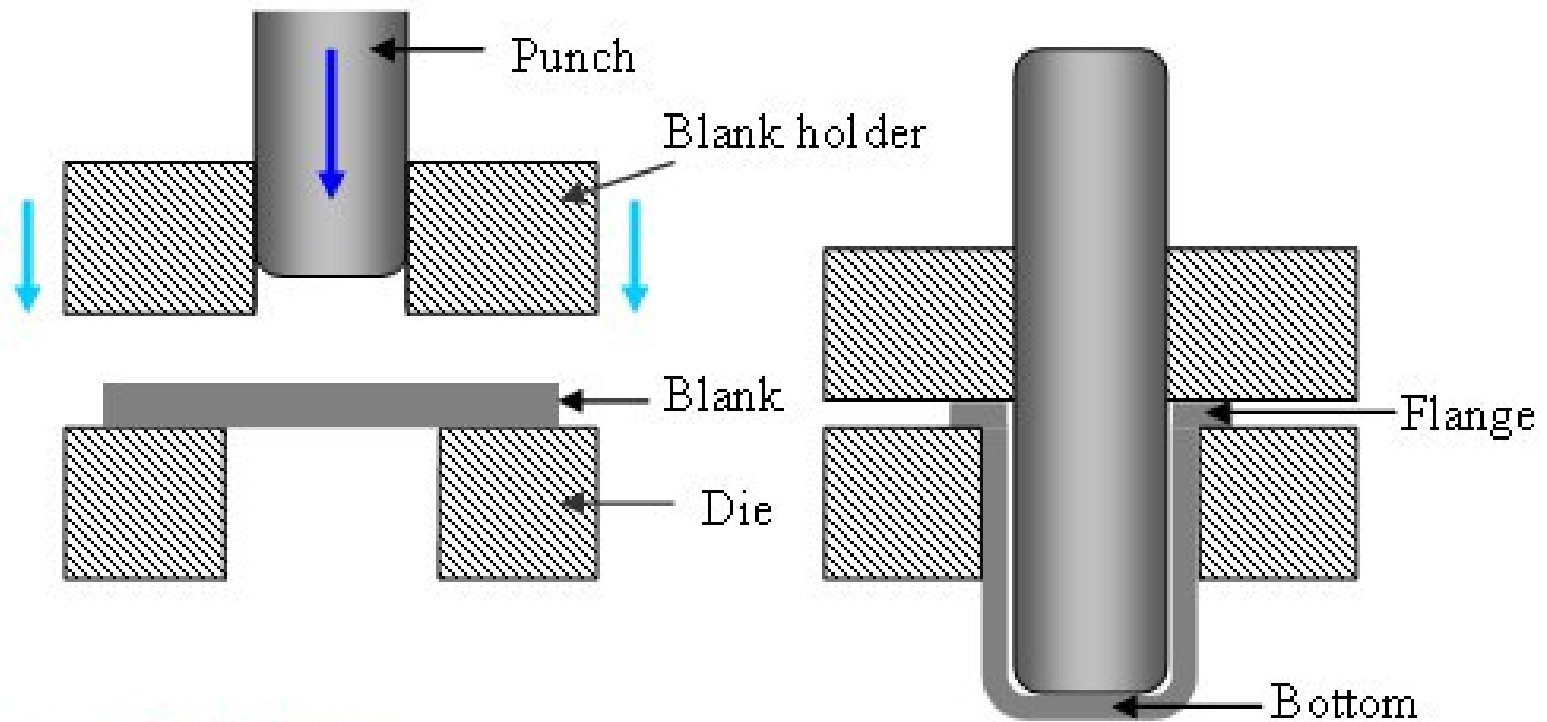
➤ Deep drawing is a sheet metal forming process in which a sheet metal blank is radially drawn into a forming die by the mechanical action of a punch.

➤ It is thus a shape transformation process with material retention.

➤ The process is considered "deep" drawing when the depth of the drawn part exceeds its diameter.

➤ If the depth of that bowl is greater than the radius of the initial blank – meaning the metal has been deformed a long way – the process is called deep drawing.

Deep drawing



❑ Deep drawing is a sheet metal forming process used industrially to produce cup-shaped, box-shaped, and other complex-curved hollow-shaped sheet parts.

❑ Deep drawing is suitable for a wide variety of materials including; stainless steel, aluminium, galvan, nickel-silver and brass, giving customers a wide variety of choice of material to suit their components needs.

❑ Clearance in deep drawing manufacture is greater than sheet thickness, usually clearance values are 107% to 115% of sheet thickness.