

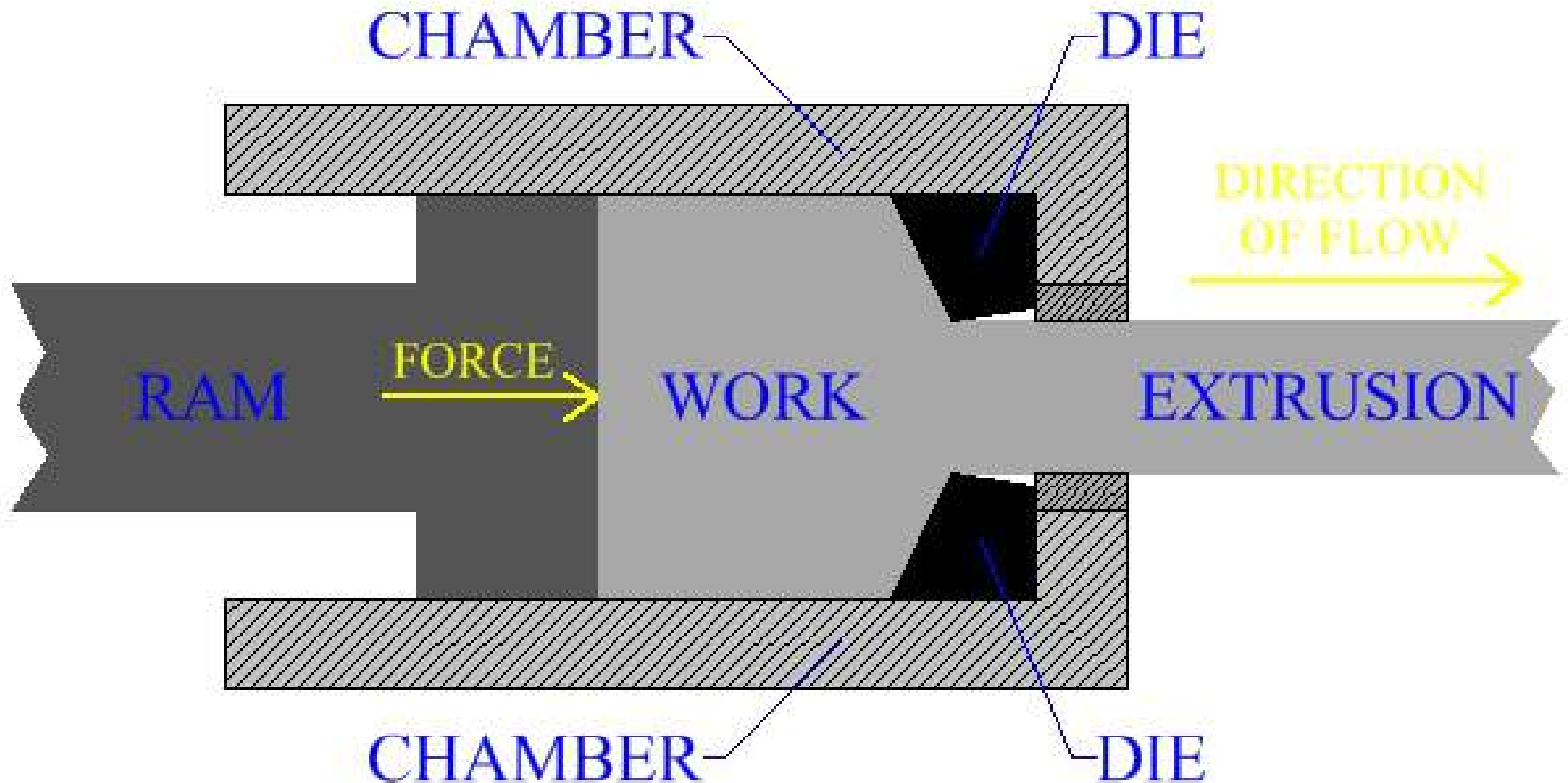
EXTRUSION

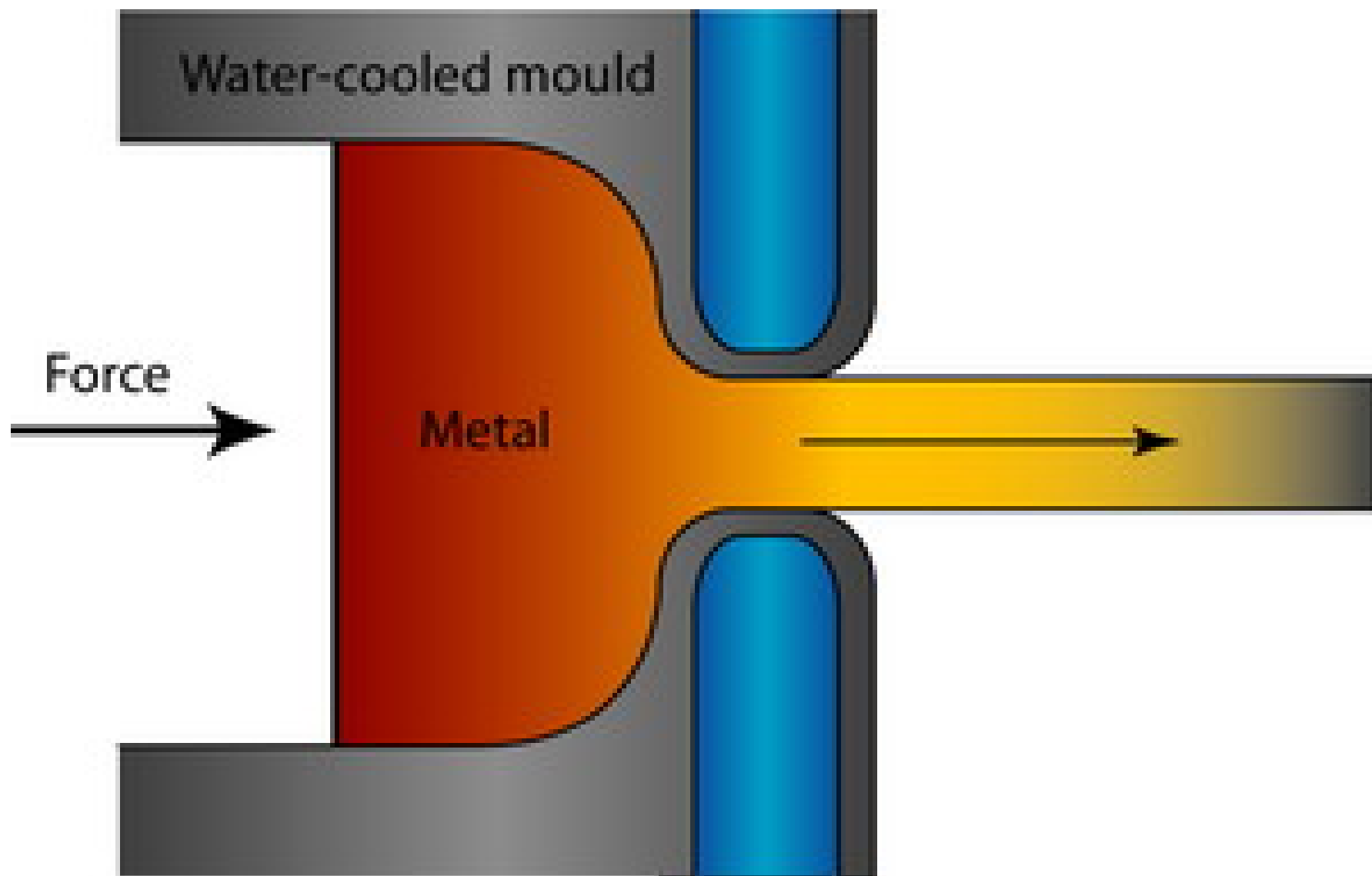
- ❑ Metal extrusion is a forming process in which we force a metal (either hot or cold) through a die.**
- ❑ This imparts the die shape to the extruded metal as it passes through the cavity.**
- ❑ The material emerging from the die is known as “extrudate”.**
- ❑ The metal endures compressive and shear stress to achieve the die shape.**

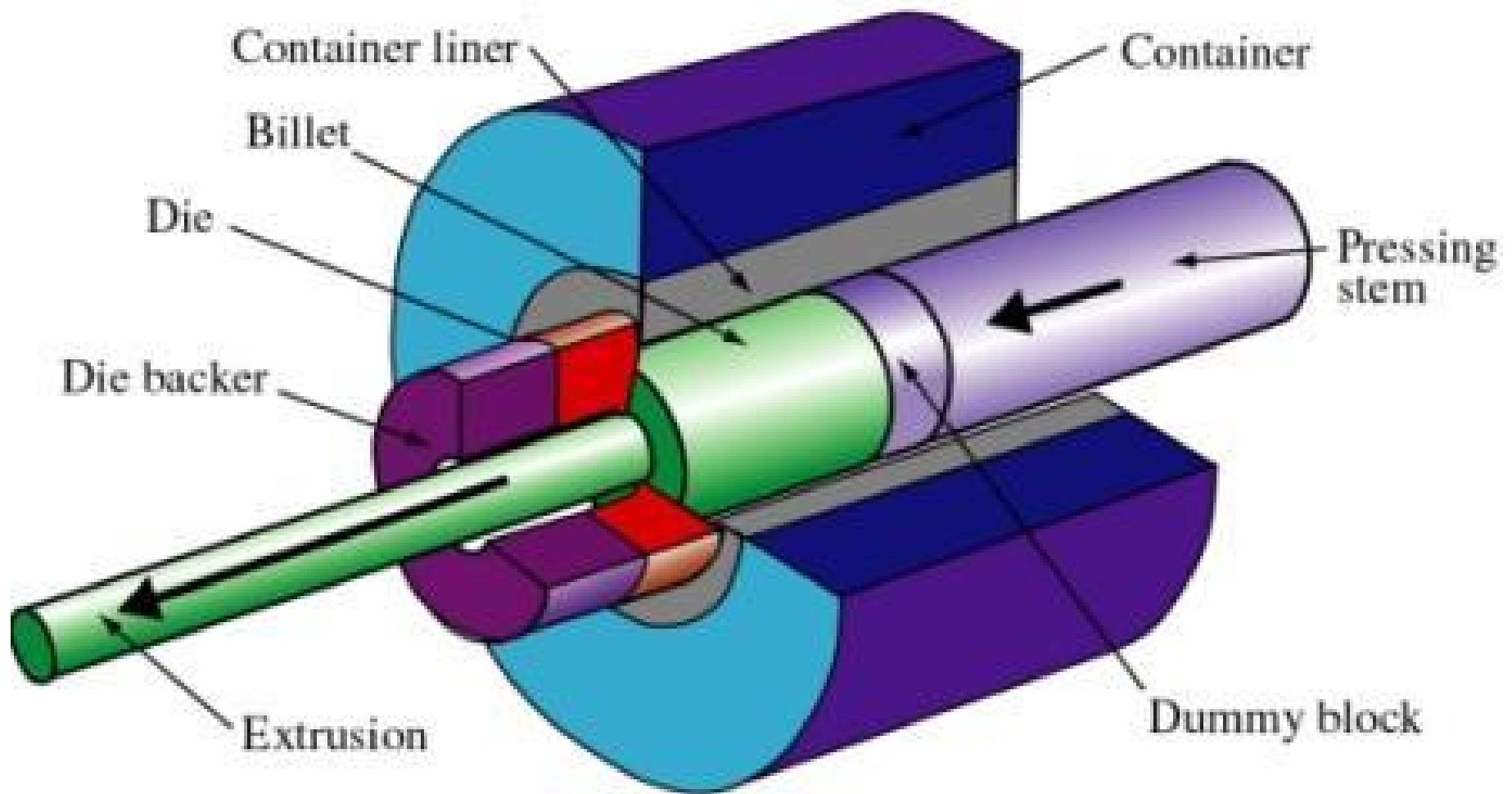
- ✓ **Direct extrusion, also called as forward extrusion, occurs when the direction of flow of metal is the same that movement of ram.**
- ✓ **Many cross sections are manufactured by this method.**
- ✓ **The cross section produced will be uniform over the entire length of the metal extrusion.**

FORWARD EXTRUSION

DIRECT EXTRUSION







❖ Extrusion is a metal forming process in which metal is forced to flow through a die to convert it into desire shape.

❖ This process is extensively used in pipes and steel rods manufacturing.

❖ Extrusion is a process where a material undergoes plastic deformation by the application of a force causing that material to flow through an orifice or die.

❖ The most commonly extruded materials are Aluminium, Copper, Steel, Magnesium, and Lead. Plastics and ceramics are also extruded extensively

source:plucka.co



➤ **Materials that are commonly cold extruded include: lead, tin, aluminum, copper, zirconium, titanium, molybdenum, beryllium, vanadium, niobium, and steel.**

➤ **Examples of products produced by this process are: collapsible tubes, fire extinguisher cases, shock absorber cylinders and gear blanks.**

➤ **products of metal extrusion contain accurate and highly precise measurements. Another benefit of this process is that it eliminates the need for more higher-intensive processes, such as welding.**



❑ Hot extrusion of steel and stainless steel is carried out at very high temperatures.

❑ A furnace heats solid steel 'billets' or rod lengths to around 1,100 degrees Celsius.

❑ Then a hydraulic press forces the hot steel or stainless steel through a shaped aperture or die, forming a length of extruded profile.

❑ Common Plastic Extrusion Materials

PE – Polyethylene.

PP – Polypropylene.

PVC – Polyvinyl chloride.

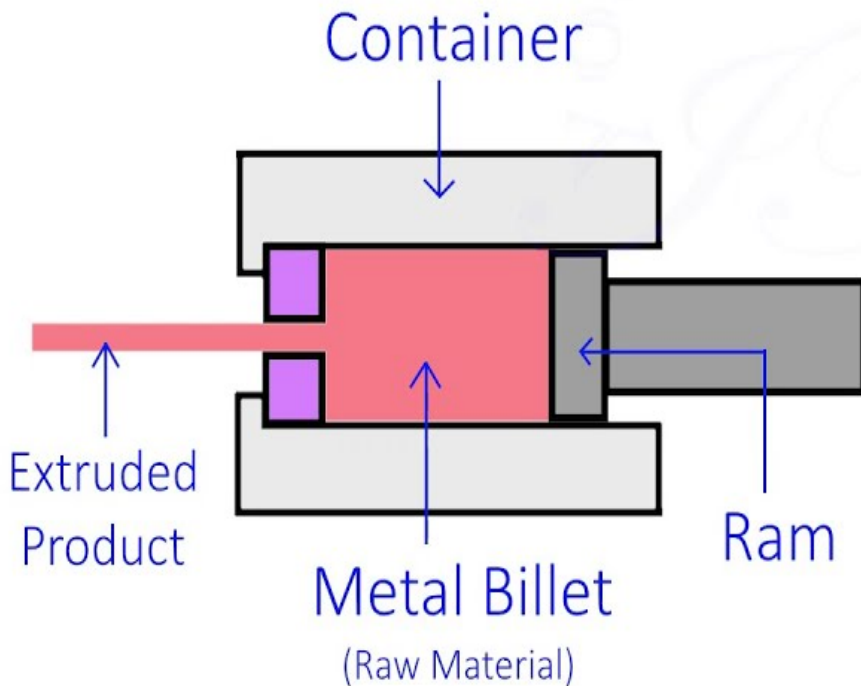


❑ Indirect or backward extrusion is a type of metal extrusion process wherein the billet(work-piece) is kept inside the chamber, which is completely closed on one side.

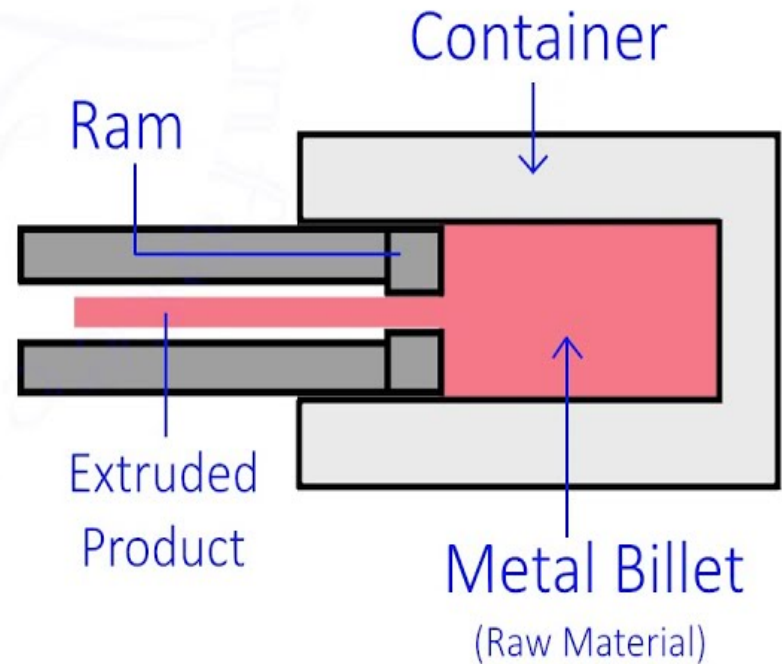
❑ In this type of extrusion, the billet and the container move simultaneously whereas the die remains stationery.

❑ Hot extrusion is the production process used to form special steel profiles with a constant longitudinal cross-section. It acts through a force called “compression”. This process can be employed to manufacture solid or hollow profiled bars, with complex geometries and a fixed cross-section, in a single step.

Direct Extrusion



Indirect Extrusion

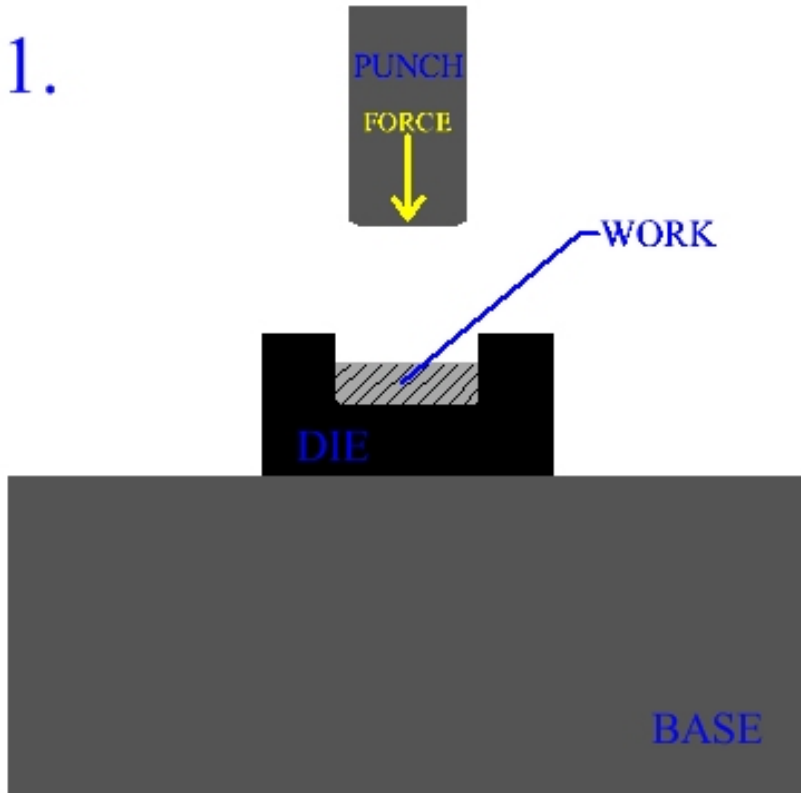


IMPACT EXTRUSION

- ☐ Impact extrusion is a manufacturing process similar to extrusion and drawing by which products are made with a metal slug.
- ☐ The slug is pressed at a high velocity with extreme force into a die or mold by a punch.

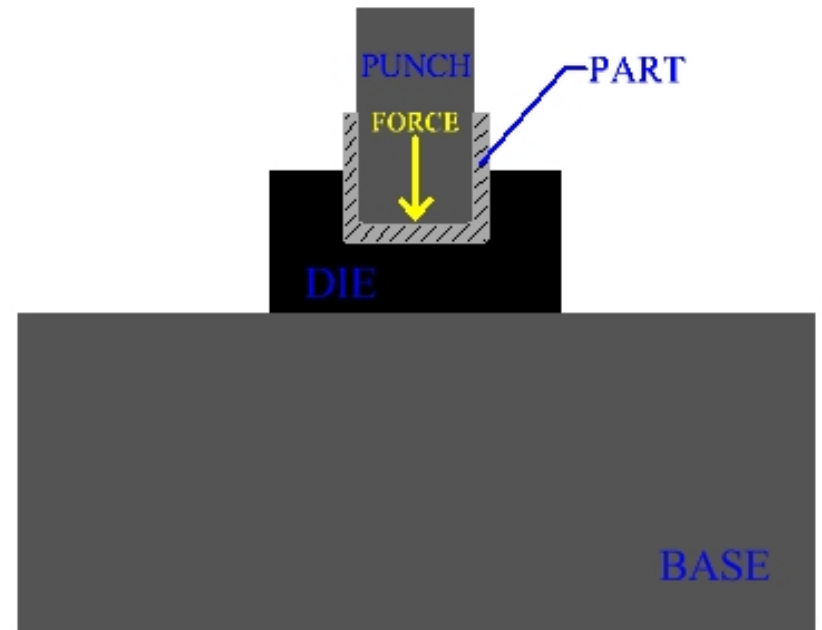
IMPACT EXTRUSION

1.



PUNCH APPROACHES WORK
AT A HIGH VELOCITY

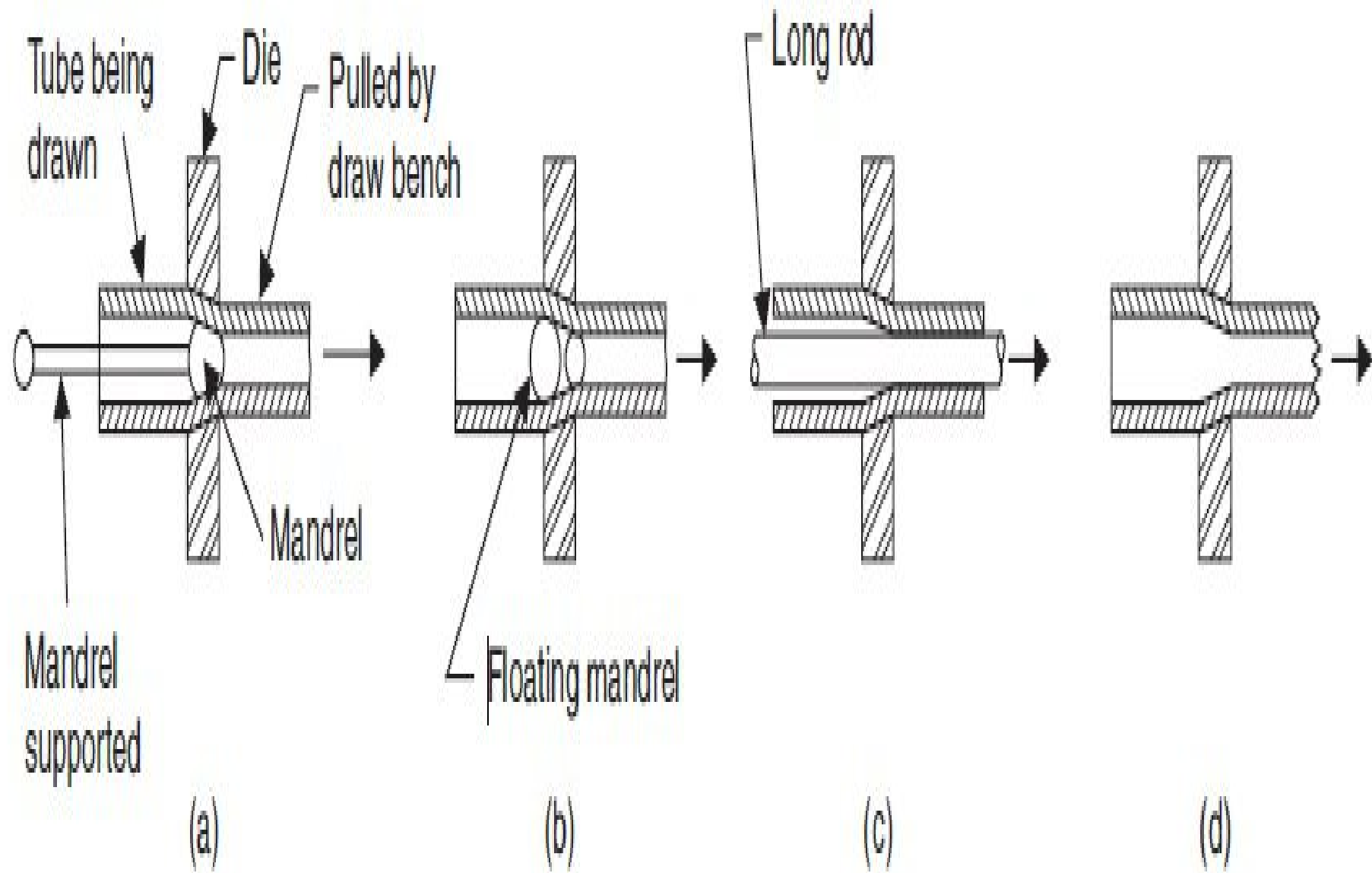
2.



PART IS FORMED BY THE
IMPACT WITH WORK

TUBE EXTRUSION

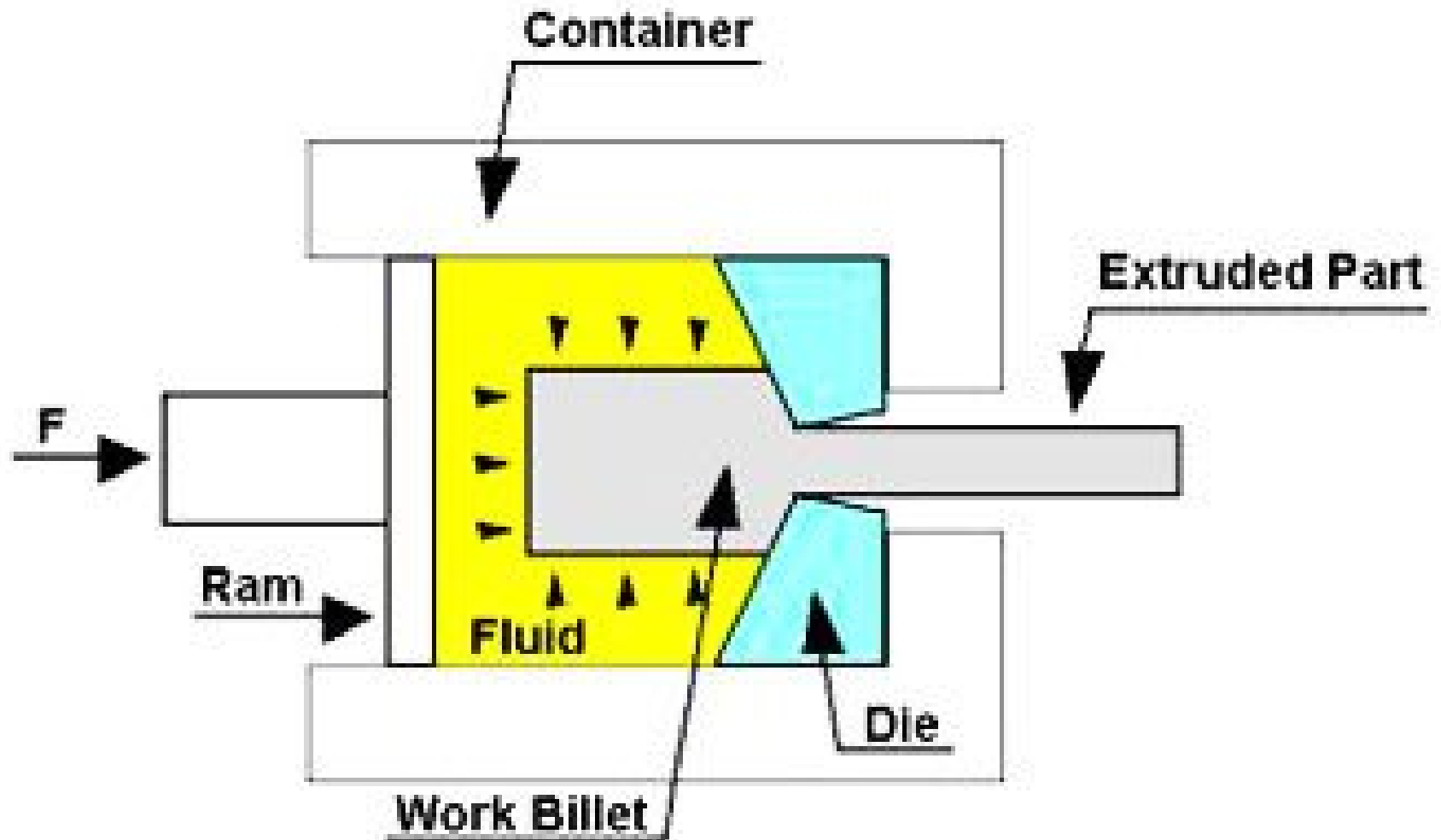
- ❖ An extruder converts the polyethylene raw material to a continuous tubular melt by extrusion through an annular die.**
- ❖ The molten pipe then proceeds through a sizing or calibration device (which fixes its dimensions) to a cooling trough**



HYDROSTATIC EXTRUSION

Hydrostatic extrusion, In this process, the billet in the container is extruded through a die by a liquid pressure medium instead of by the direct acting forces with a ram. There is no friction along the container wall.

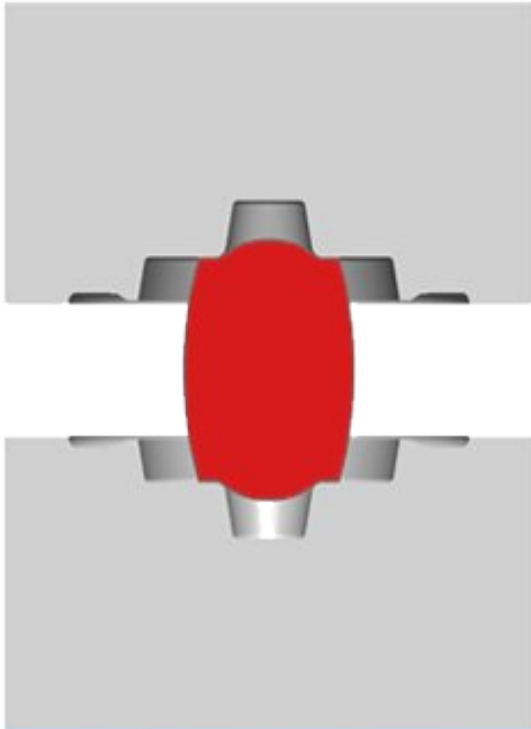
HYDROSTATIC EXTRUSION



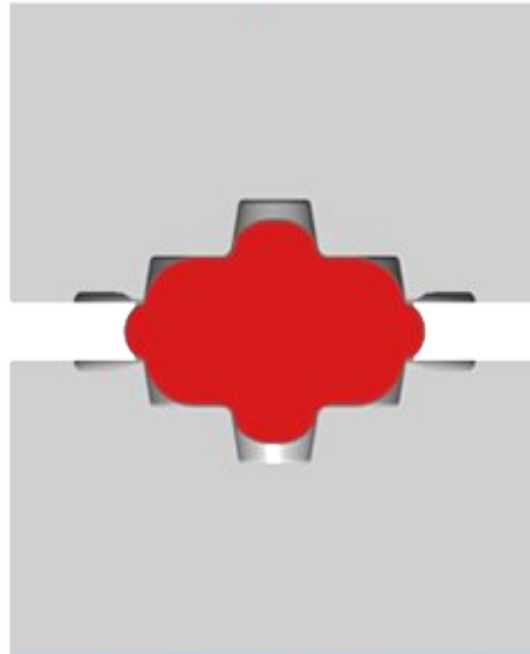
FORGING PROCESS

- ❑ Metal forging is the process in which metals are formed and shaped using compressive forces.**
- ❑ The forces are delivered using hammering, pressing, or rolling.**
- ❑ There are a number of forging processes – cold forging, warm forging, and hot forging**
- ❑ There are four types of forging manufacturing processes that are commonly used to shape metal parts.**
- ❑ These processes include impression die forging (closed die), cold forging, open die forging, and seamless rolled ring forging.**

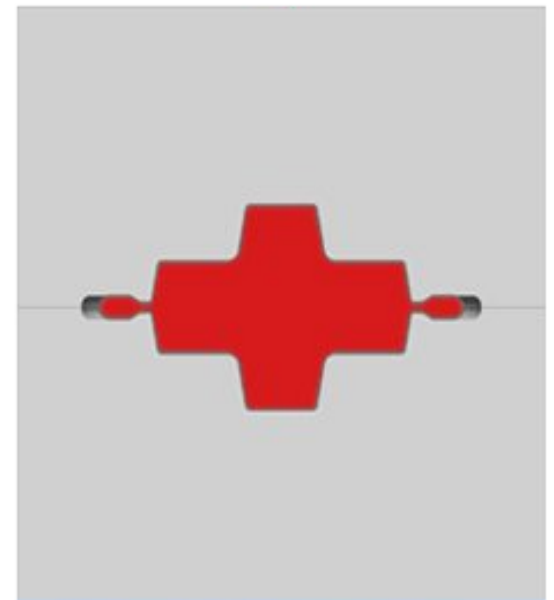
DOWNWARDS MOVEMENT OF TOP DIE



**HOT METAL BILLET IN CONTACT
WITH MOVING DIE**



**RESTRICTION OF LATERAL FLOW
CAUSING CAVITY TO FILL**



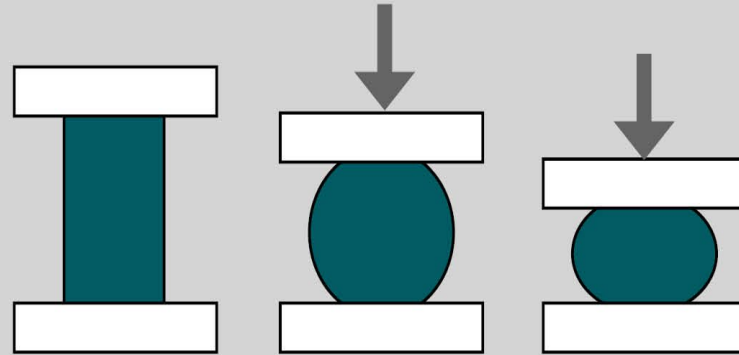
DIE CAVITY FINALLY FILLED

Open-die forging is also known as smith forging. A hammer strikes and deforms a metal on a stationary anvil.

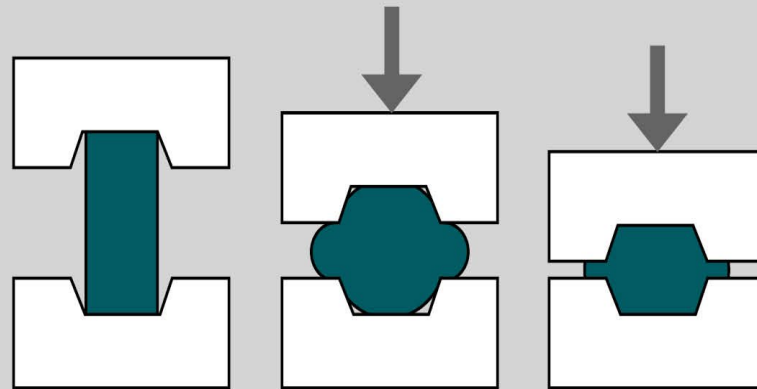


Open and Closed Die Forging Processes

(1) OPEN-DIE FORGING



(2) CLOSED-DIE FORGING

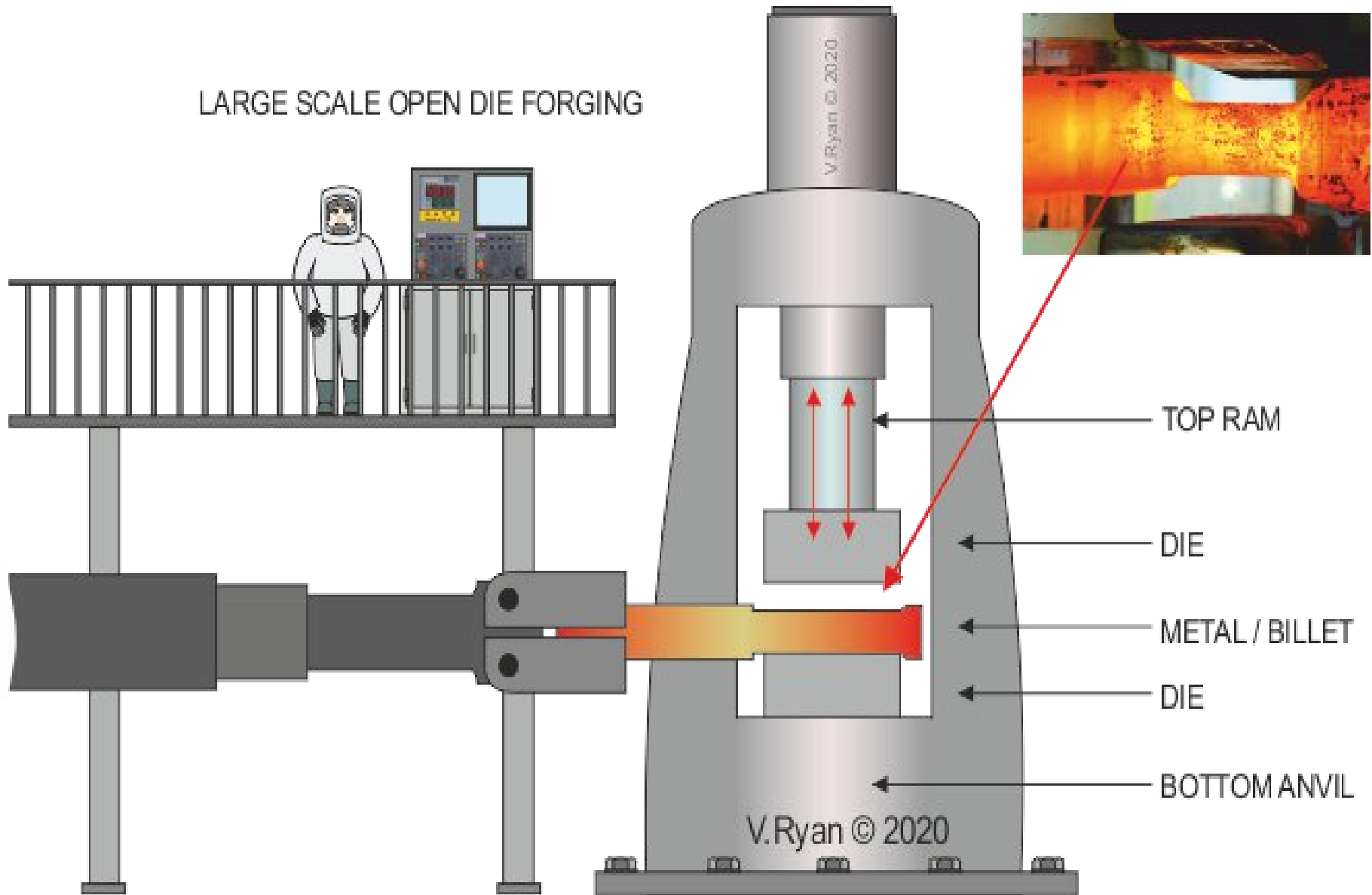


❑ Drop forging is a metal forming process. A workpiece is inserted into a die and then hammered until it has assumed the shape of the die.

❑ The lower die is a stationary part, while the upper part is a moving hammer dropped onto the workpiece in order to deform it.

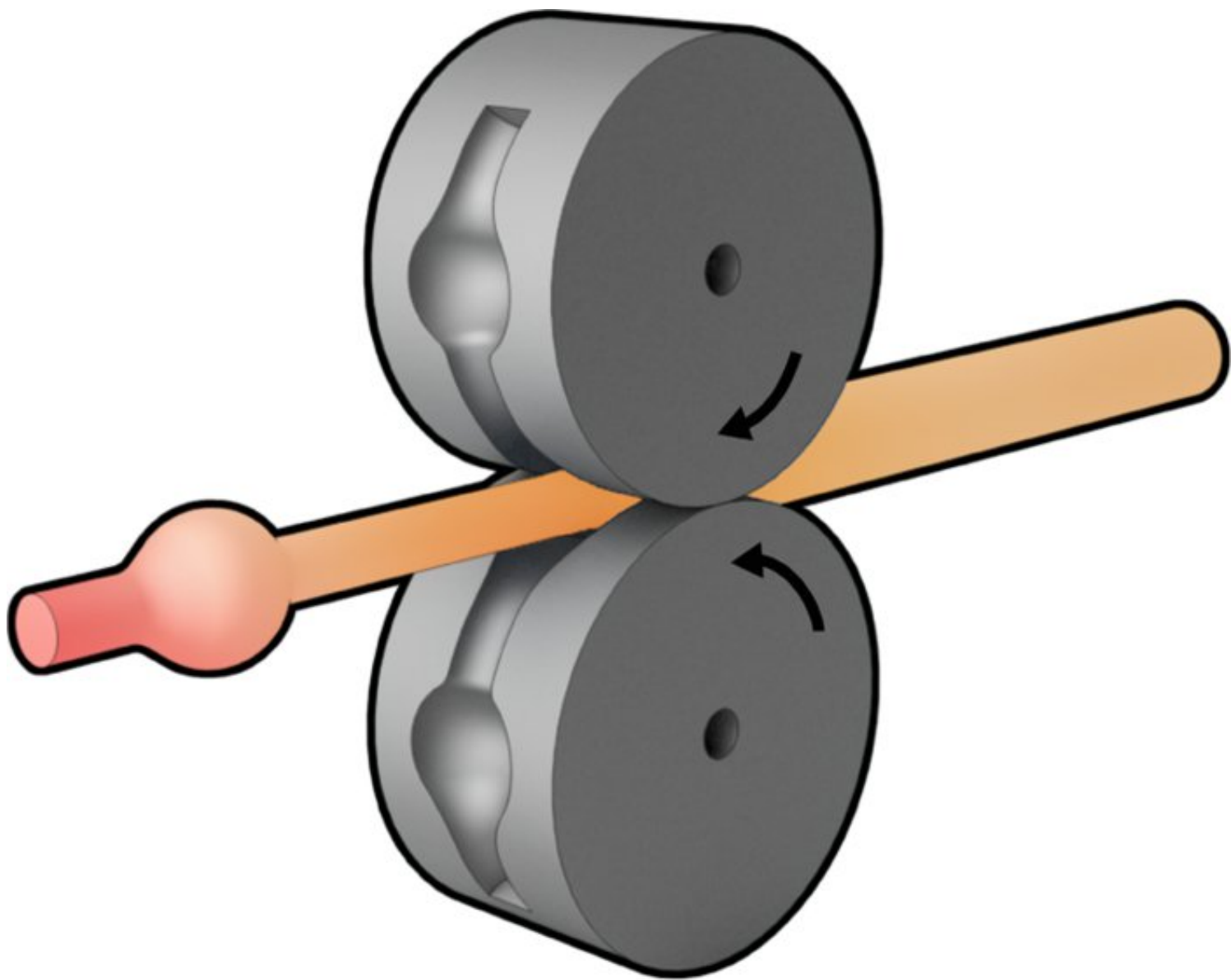
❑ The drop forging process improves the strength of the metal by aligning the grain along the lines of potential stress, which cannot be achieved through casting, machining, or fabrication.

LARGE SCALE OPEN DIE FORGING



❖ Roll forging, also known as roll forming, is a forging method that uses opposing rolls to form a metal part.

❖ Even though roll forging uses rolls to produce parts and components, it is still considered a metal forging process and not a rolling process.



MANUFACTURINGGUIDE

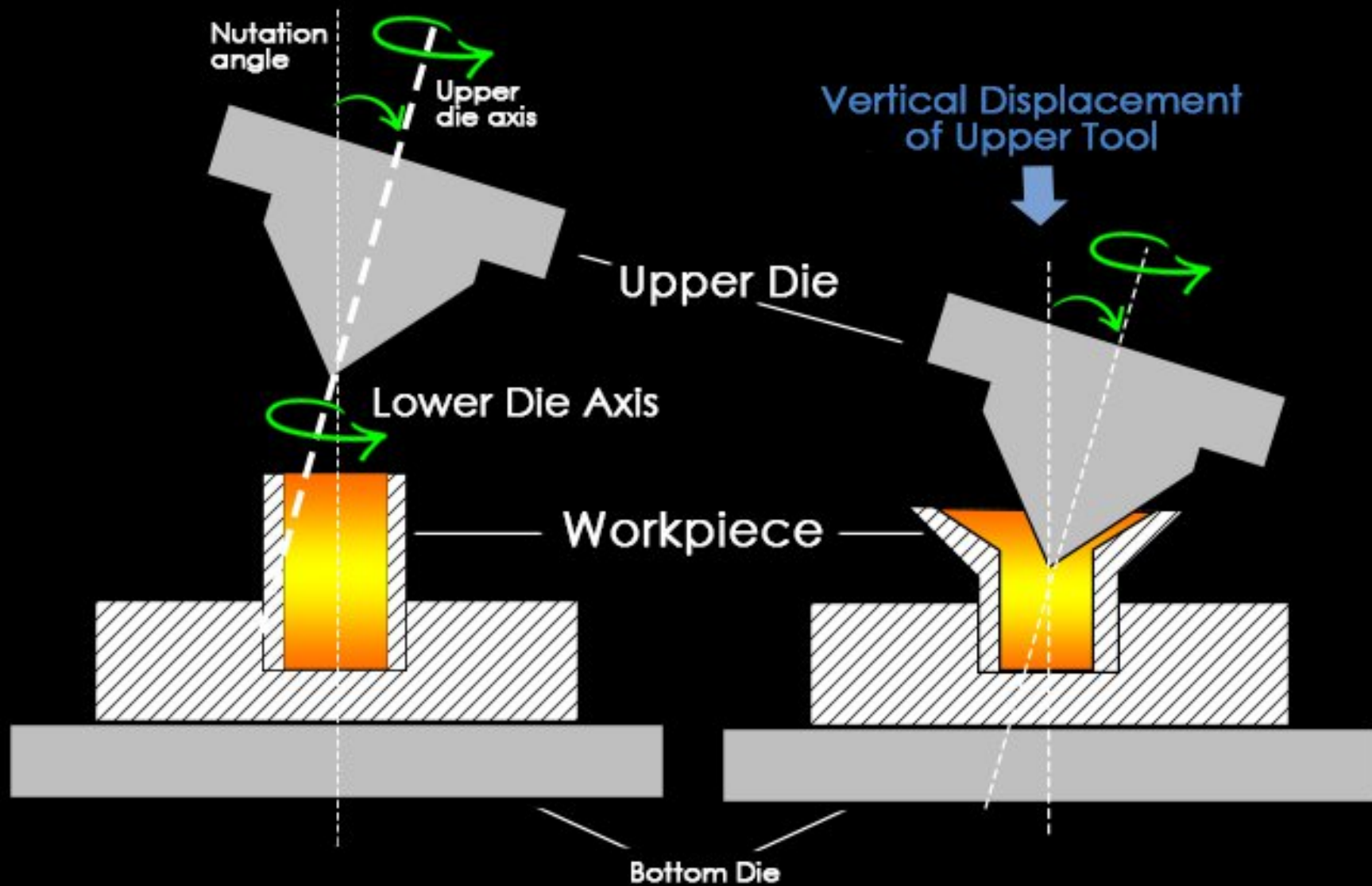
FORGING HAMMER

The handle of the forging hammer is typically made of a wooden material and the head is sometimes made of high-carbon steel or alloy steel



ROTARY FORGING

- ❑ Rotary forging is a cold-forming process used to forge round shapes.**
- ❑ The process deforms a metal blank using a combination of rotation, rolling and axial compression.**



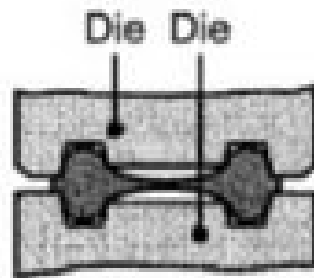
FORGING DEFECTS

- **Defects occur due to improper design of forging die.**
- **It is also due to sharp corner, and excessive chilling in forging product.**
- **The fillet radius of the die should be increase to remove these defects**

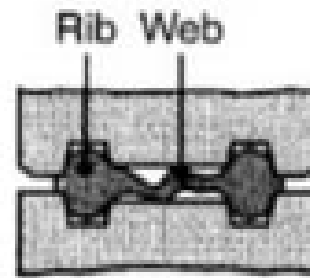
Forging Defects



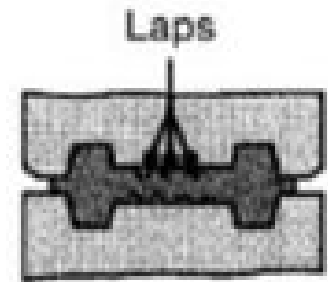
1. Blocked forging



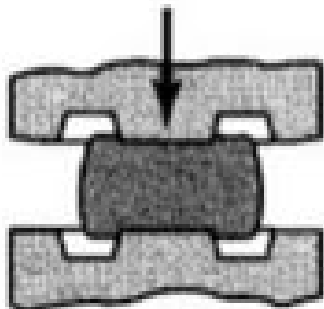
2. Begin finishing



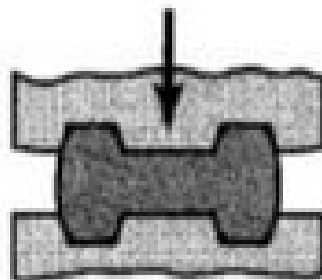
3. Web buckles



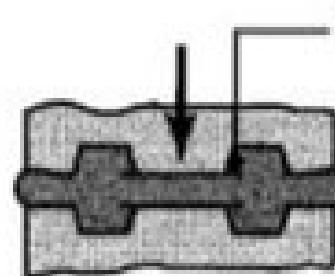
4. Laps in finished forging



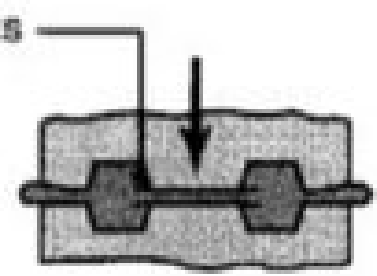
1. Forging begins



2. Die cavities are being filled



3. Cracks develop in ribs

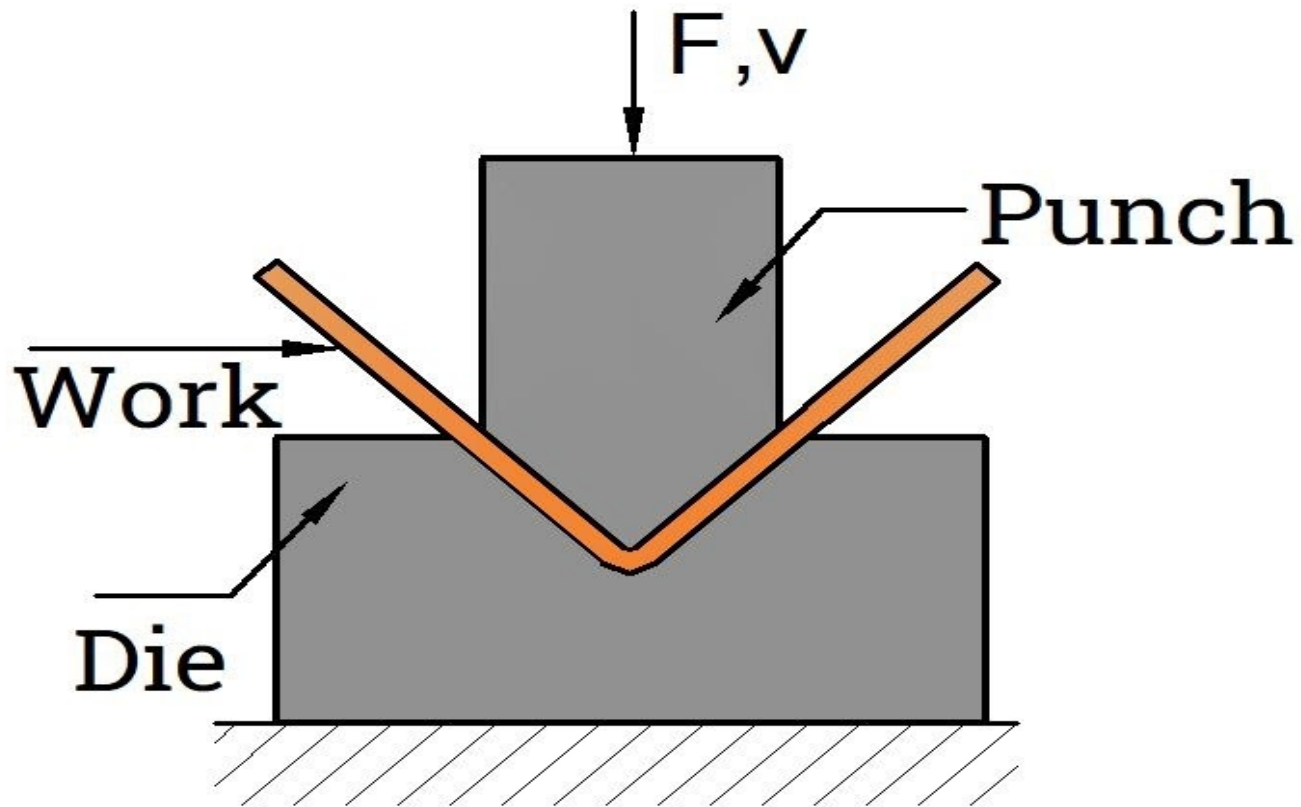


4. Cracks propagate through ribs

COLD FORGING

- ❑ Cold forging uses a displacement process to shape the material into the desired shape.**
- ❑ Compressive force squeezes the metal between a punch and die at room temperature until the material conforms to the die's contours.**
- ❑ Cold forging techniques include rolling, drawing, spinning, heading, and extruding.**

Cold Forge Bending



SWAGING

Swaging, is a metal-forming technique in which the metal of one part is deformed to fit around another part by hammering, or by forcing the material through a die.

•

❑ A swage is the shaped tool used to transform an object's shape into the desired form by bending or shaping.

❑ Swaging is used in the metalworking field, known as metallurgy, to serve a variety of purposes.

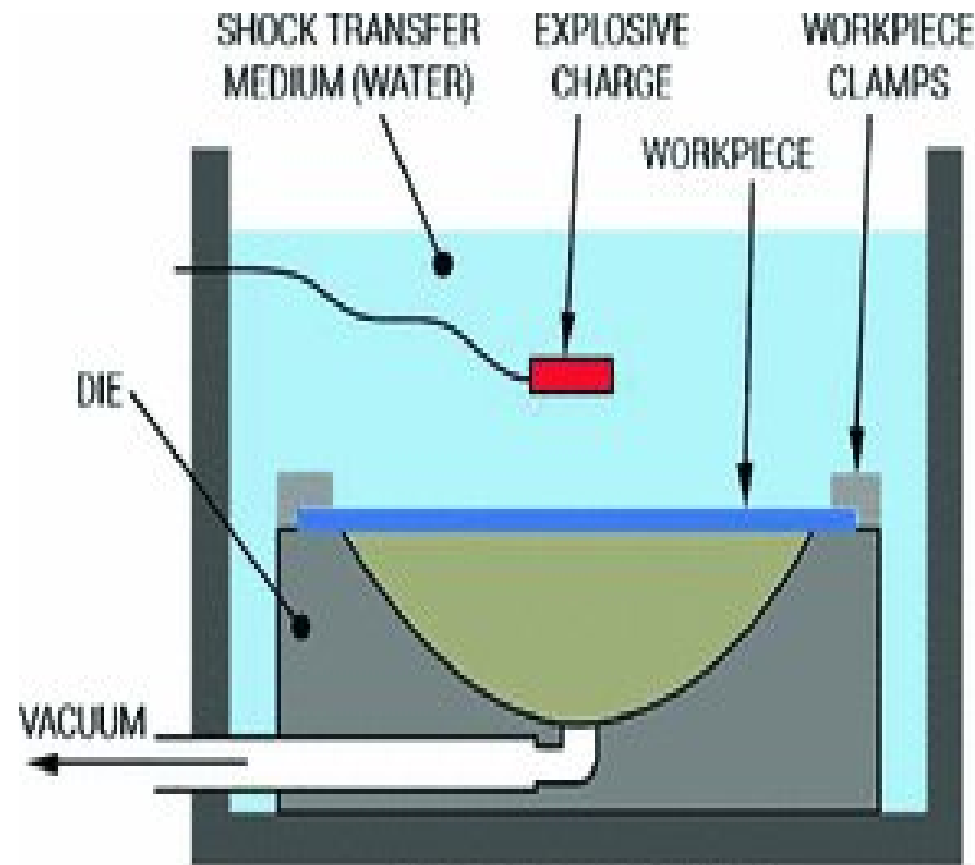
❑ Swaging can transform a piece of metal into a desired shape through hammering

EXPLOSIVE FORMING

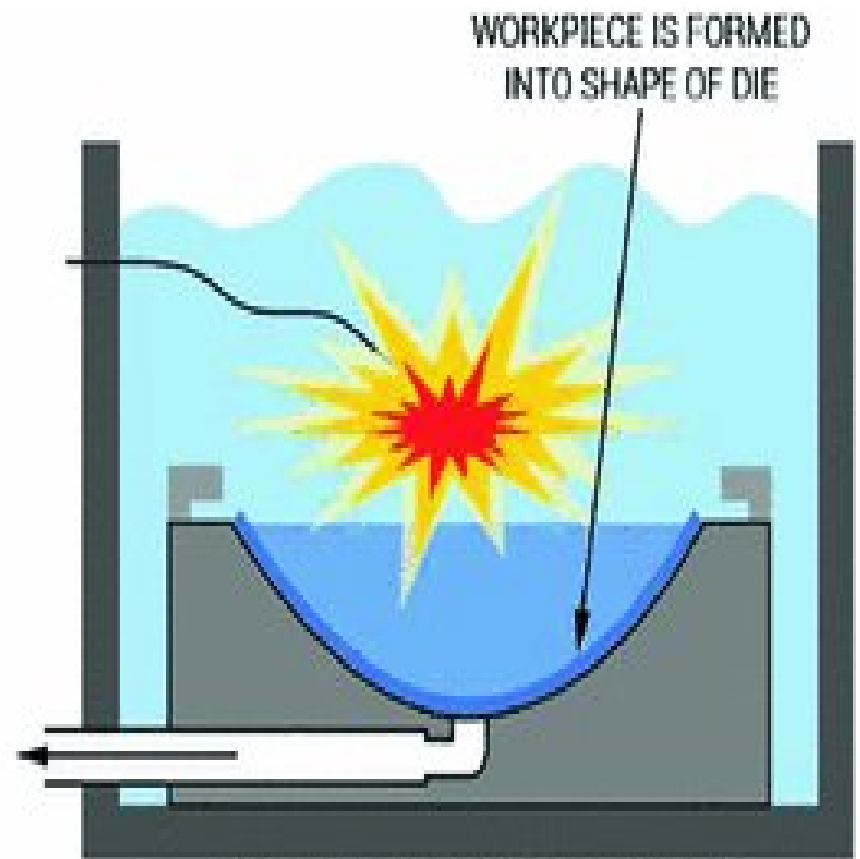
❑ Explosive forming is a metalworking technique in which an explosive charge is used instead of a punch or press.

❑ Explosive forming has been mainly used in aerospace and aircraft industry to produce large parts for which conventional tooling costs are high.

❑ Explosives are located at a predetermined distance from the workpiece,

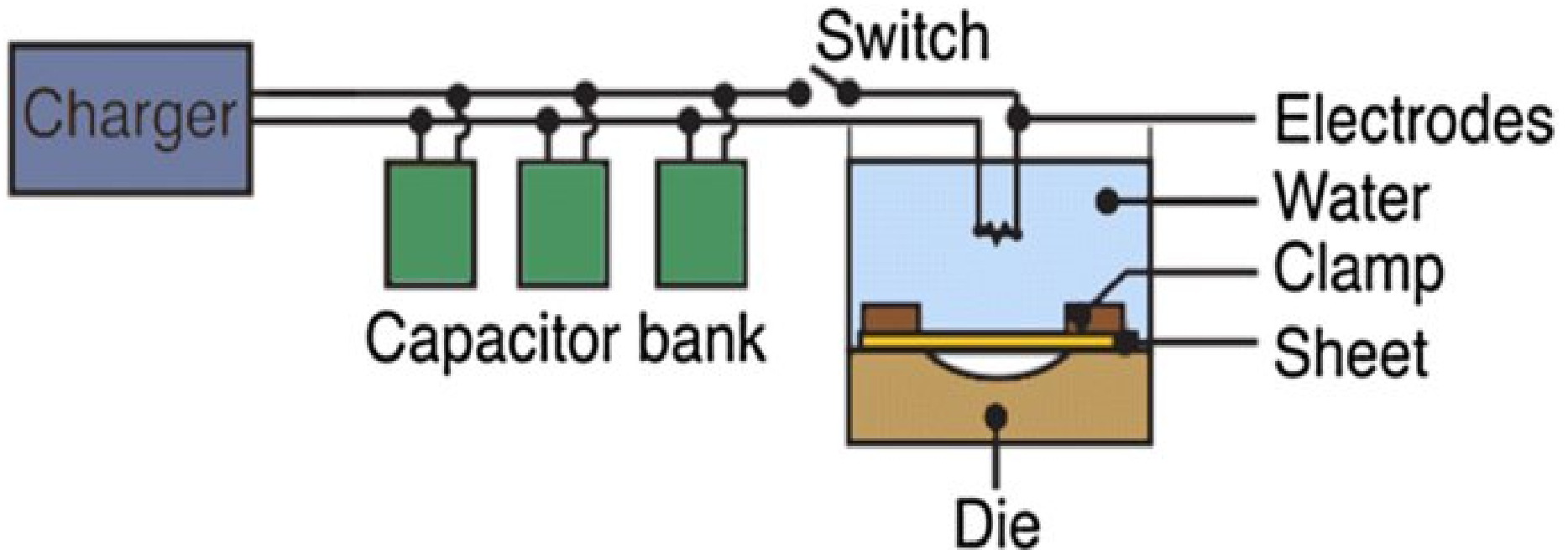


BEFORE FORMING



DURING/AFTER FORMING

Electro-hydraulic forming (EHF) is one of the high-speed forming process that uses high-voltage discharge in liquid. Shockwave resulting from the discharge is generated between two electrodes in liquid and it deforms the blank into the die.

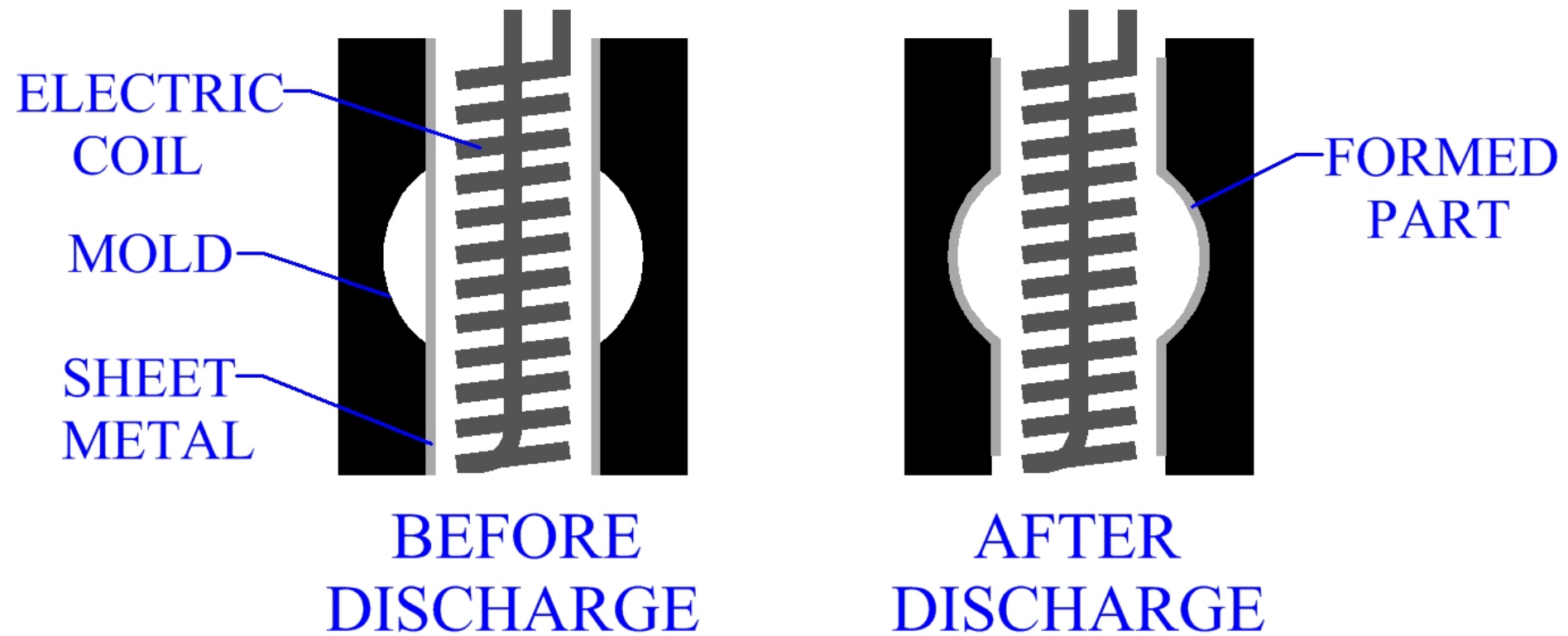


ELECTRO-MAGNETIC FORMING

Electromagnetic forming (EMF) is a high-speed, contact-free forming process that utilizes a strong, pulsed magnetic field to plastically form components made of materials with high electrical conductivity such as aluminum, magnesium, copper and its alloys.

This intensive high current creates electromagnetic forces between the coil and the workpiece which accelerates the workpiece towards a single side die. The workpiece is shaped to the die, perforated and cut into the required shape, in a single operation.

ELECTROMAGNETIC FORMING



RUBBER PAD FORMING

- ❑ Rubber pad forming (RPF) is a metalworking process where sheet metal is pressed between a die and a rubber block, made of polyurethane.**
- ❑ Under pressure, the rubber and sheet metal are driven into the die and conform to its shape, forming the part.**
- ❑ The rubber pads can have a general purpose shape, like a membrane**

