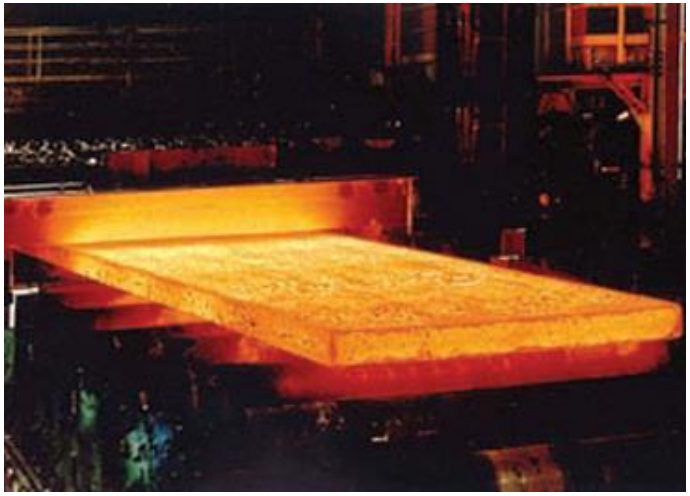
Metal Forming Processes

An overview

Forming of cast products



Classification of forming processes

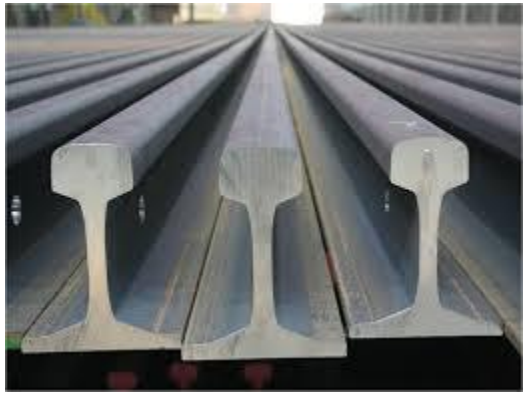
- Bulk forming processes

  Ex: Rolling, Forging, Extrusion, Drawing etc.

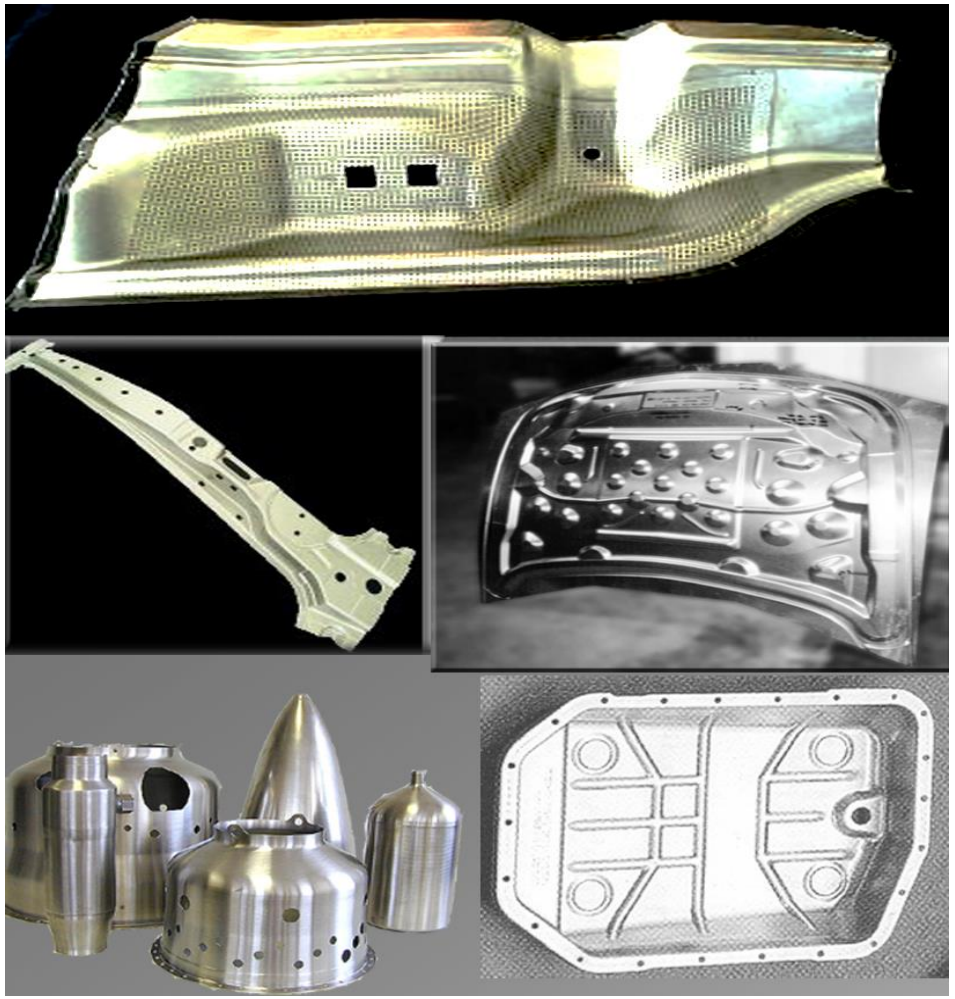
- Sheet metal forming processes

  Ex: Deep drawing, Stretching, Bending etc.

Products of Bulk Forming Processes



Products of Sheet Metal Forming



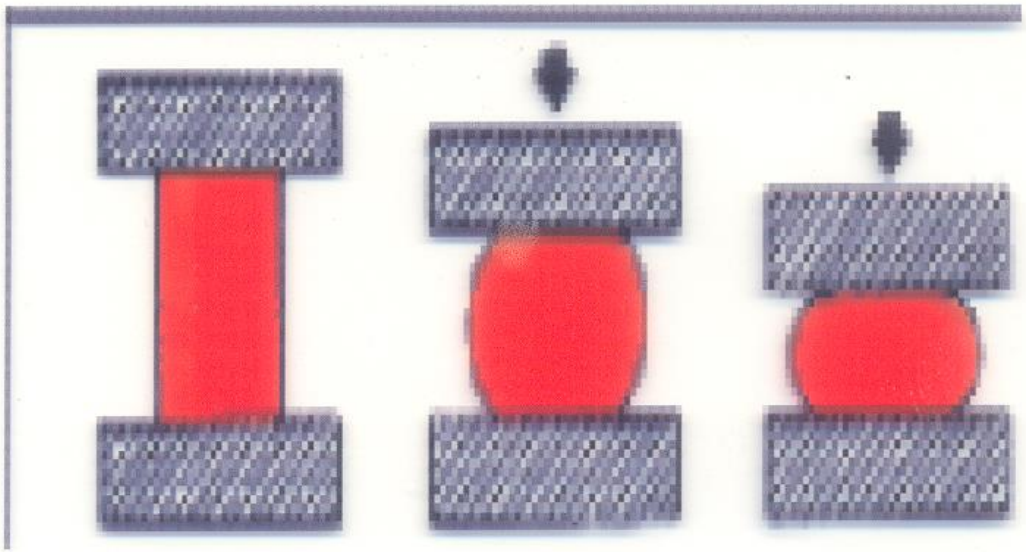
Classification of Metal Forming Processes

Based on the temperature of working:

- Cold working : < 0.3 T_m
- Warm Working: 0.3-0.5 T_m
- Hot working: above 0.5 T_m

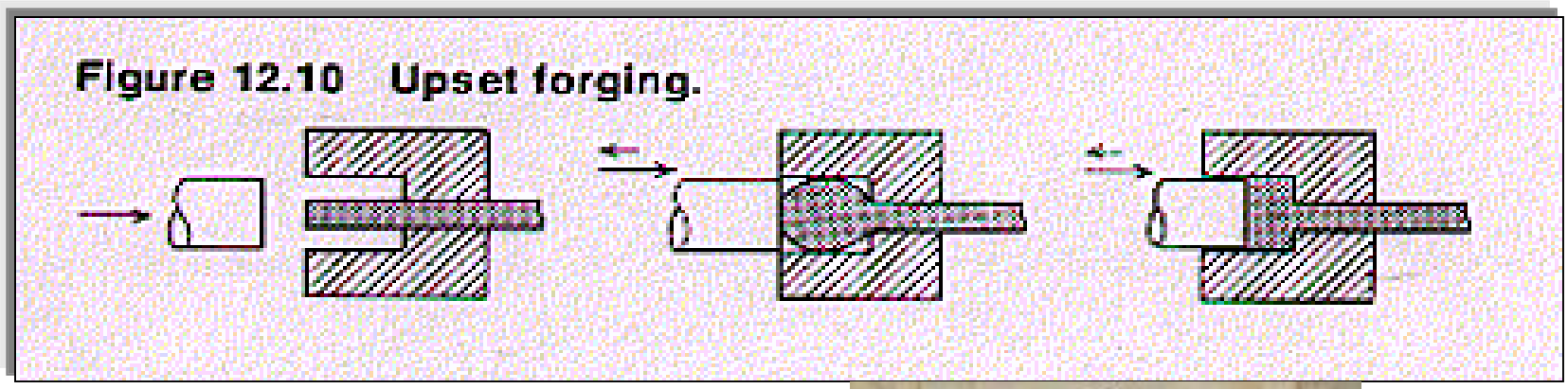
Forging

- Pressing or repeated hammering of metal between two dies.
- Open die forging and closed die forging



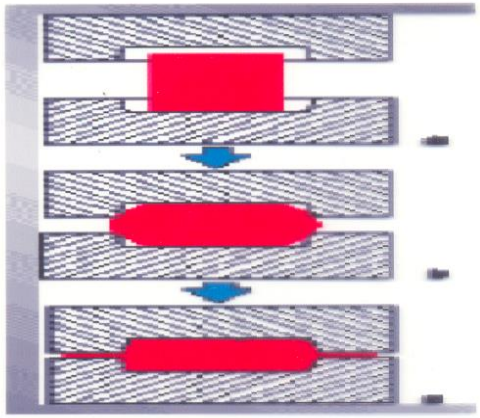
Video Upsetting
Video open die forging

Upsetting



- Product examples
  - Bolts
  - Nails
  - Engine valves

Closed die forging



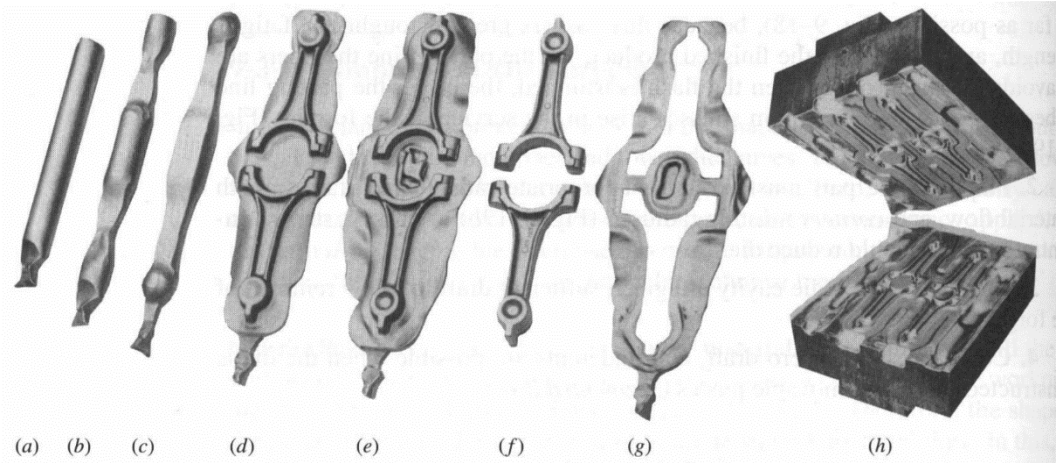


Figure 9–20 Hammer forging two connecting rods: (*a*) bar stock; after (*b*) fullering, (*c*) "rolling," (*d*) blocking, (*e*) finishing, (*f*) trimming; (*g*) the flash; and (*h*) the forging dies. (*Courtesy Forging Industry Association, Cleveland, Ohio.*)

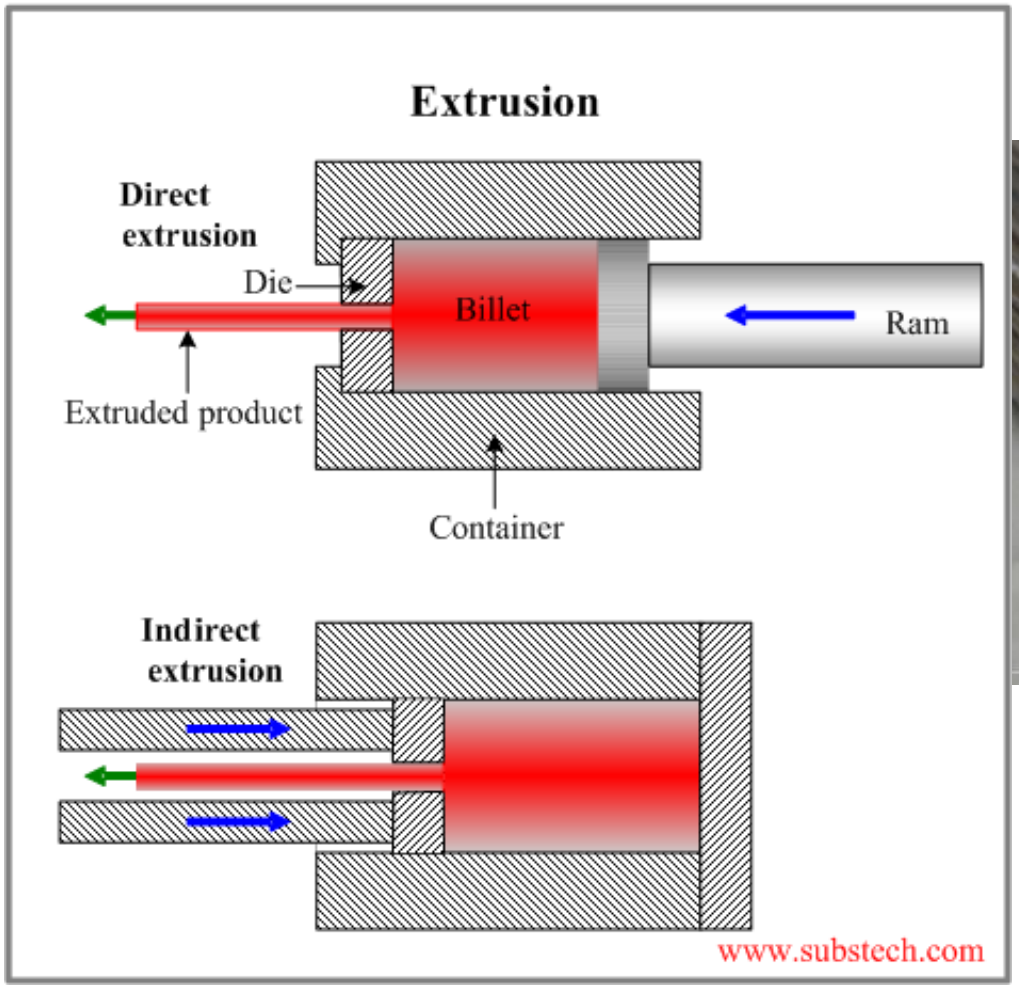
Video Closed die forging

Forging Machines

Drop hammer

Mechanical and Hydraulic Presses

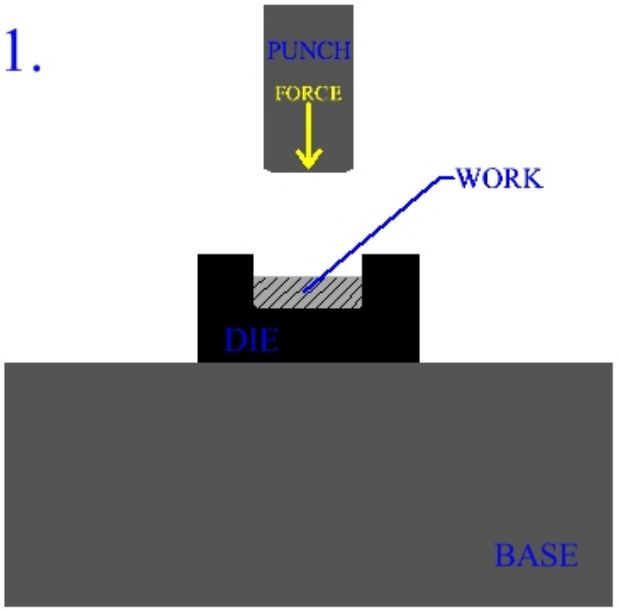
Extrusion of rods



Extrusion of cans

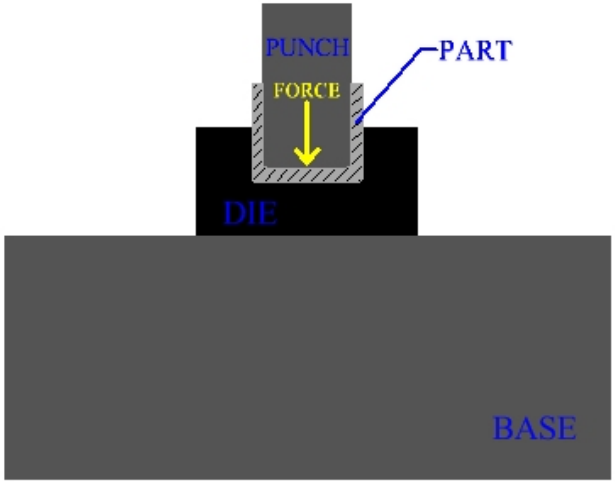
IMPACT EXTRUSION

1.



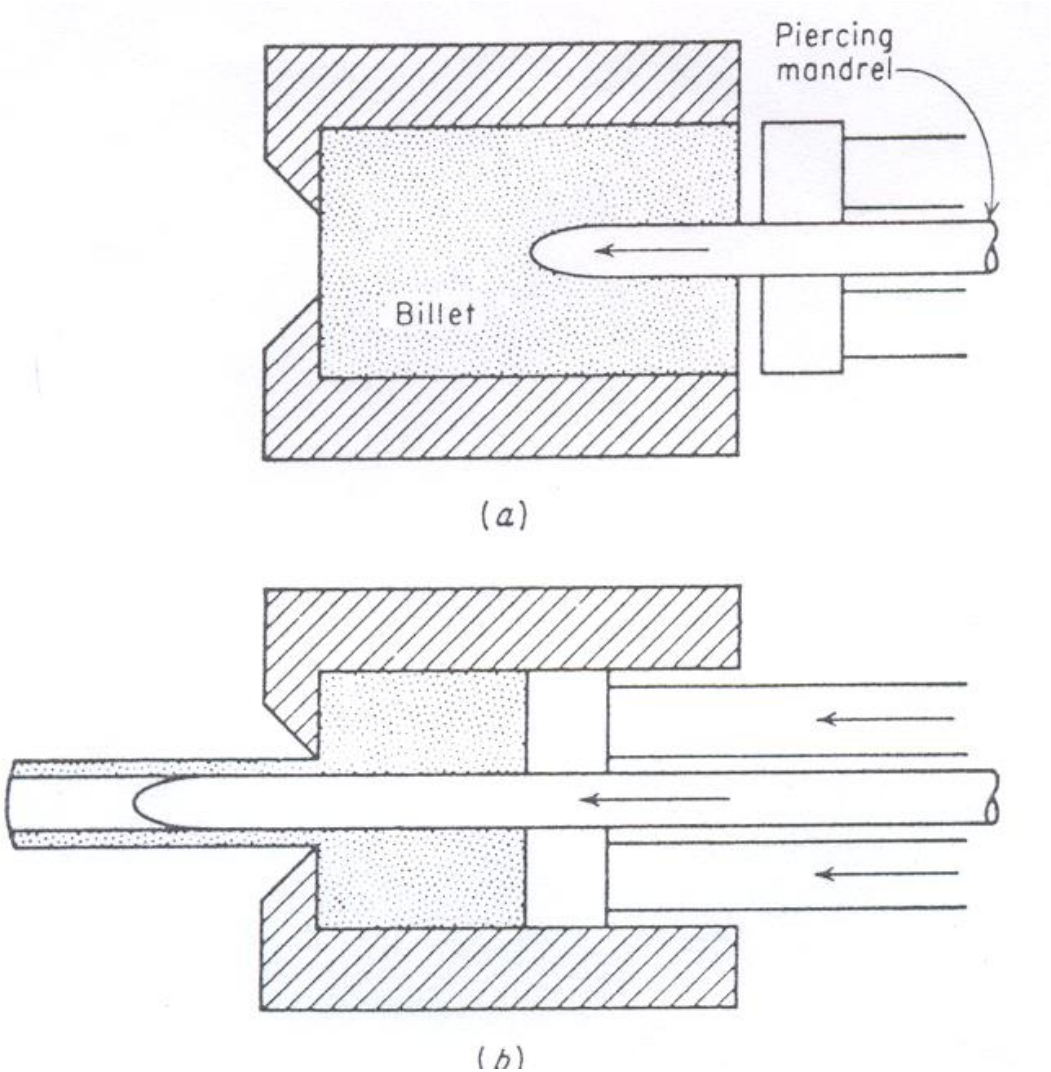
PUNCH APPROACHES WORK
AT A HIGH VELOCITY

2.

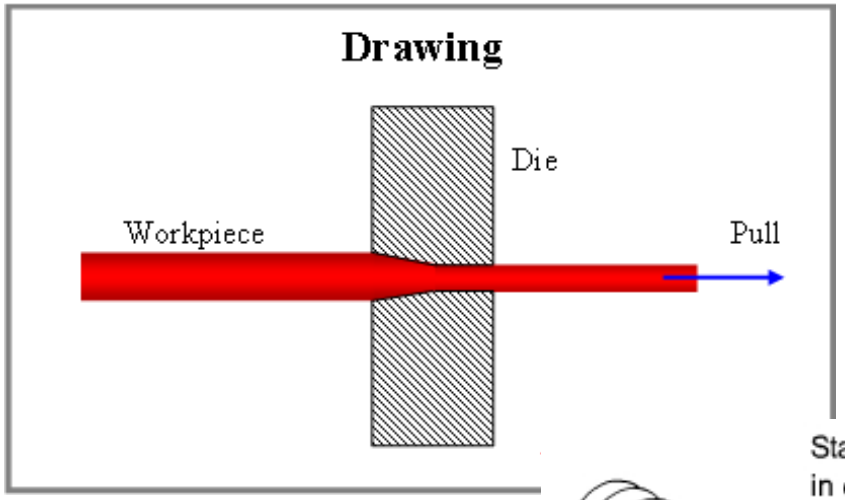


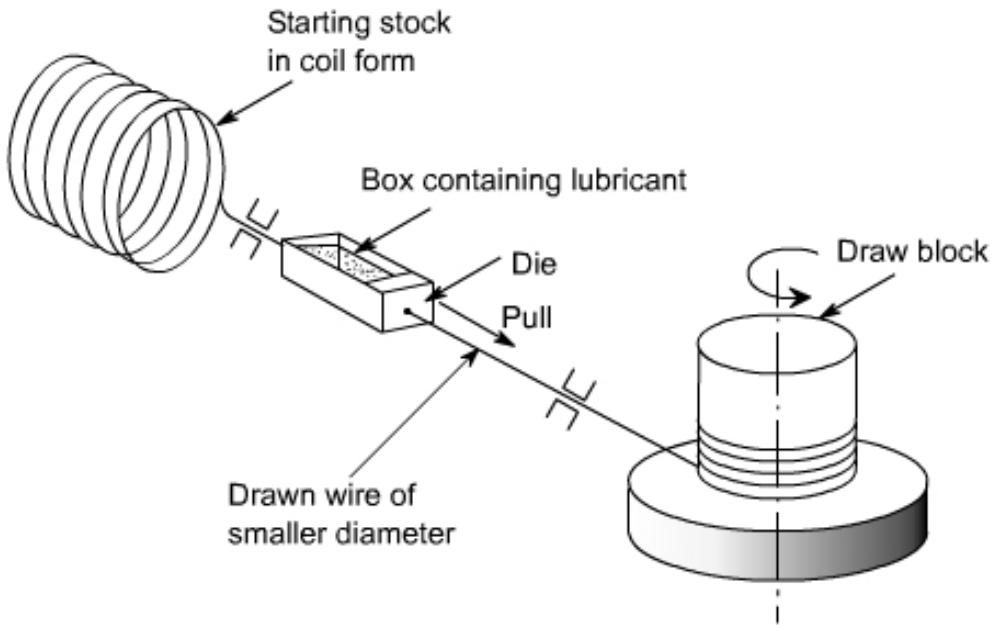
PART IS FORMED BY THE
IMPACT WITH WORK

Extrusion of tubes



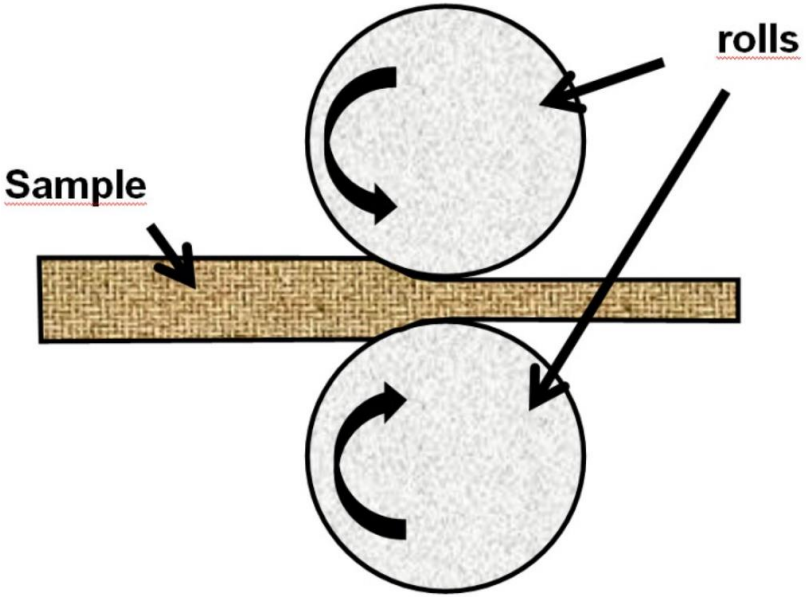
Rod/Wire Drawing

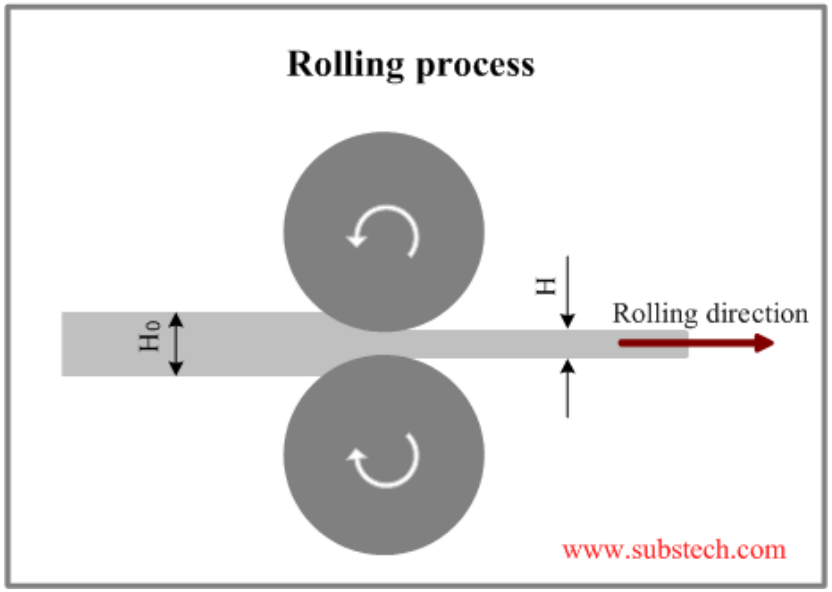




Video Wire drawing

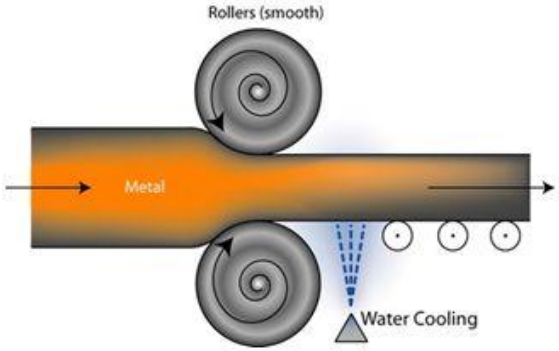
Rolling


rolls
Sample


Rolling process
H
H₀
Rolling direction
www.substech.com

Hot Rolling & Cold Rolling

- The principal rolling processes are hot rolling and cold rolling.
- Hot rolling is the most common method of refining the cast structure of ingots and billets to make primary shapes.
- Bars of circular or hexagonal cross section like I beams, channels, and railroad rails are produced in great quantity by hot rolling with grooved rolls.
- Cold rolling is most often a secondary forming process that is used to make bar, sheet, strip and foil with superior surface finish and dimensional tolerances.



Rolling

Video rolling

Hot rolling

Cold rolling

Sheet Metal Forming

- Flat thin sheet metal blanks are converted into useful products by applying force using suitable tools.

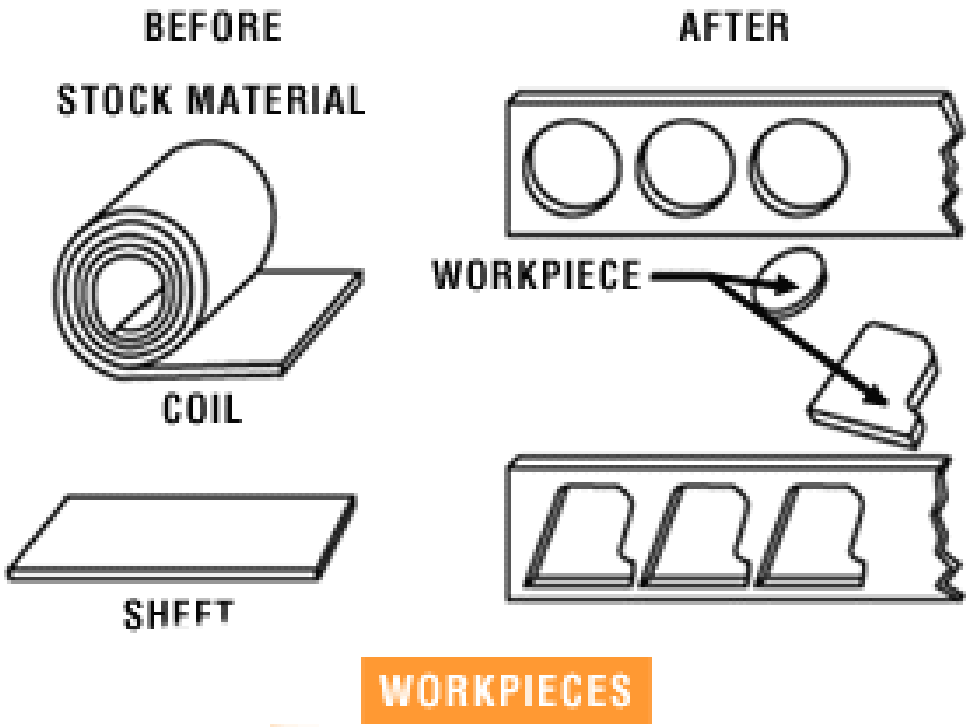
- Typical shapes produced are:
  - parts with single or multiple curves,
  - contoured parts with/without flanges,
  - cup and box shaped parts with vertical/sloped walls etc.

- Commonly used sheet materials are:

Low carbon steel, Galvanised steel, Stainless steel, Al and Ti alloys, Special alloys

Shearing

Blanking

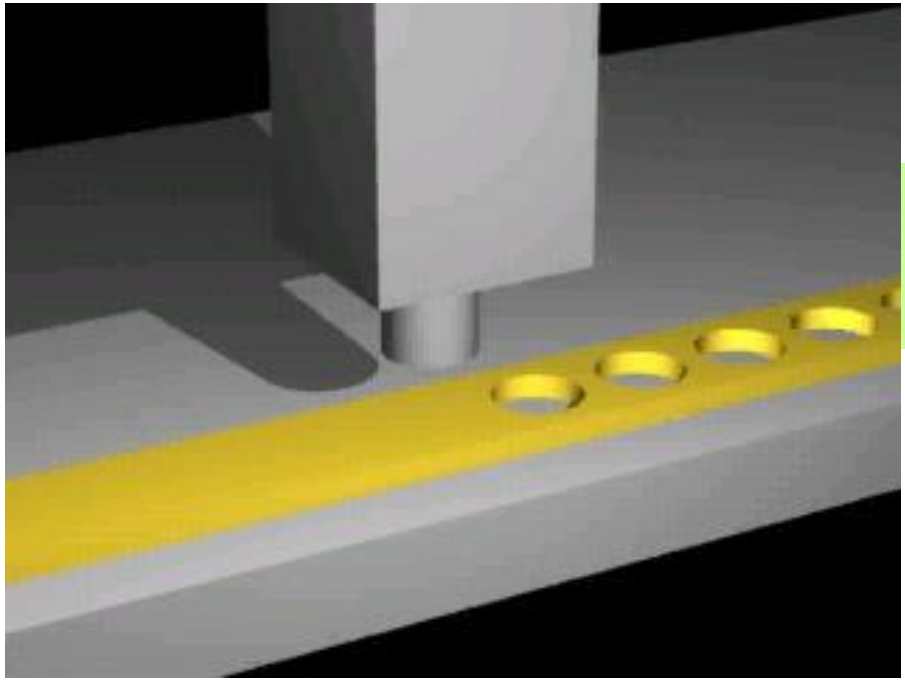


A piece of sheet metal or a blank is removed from the primary metal strip or sheet by shearing.

punch-out: workpiece
remaining strip: scrap

Shearing

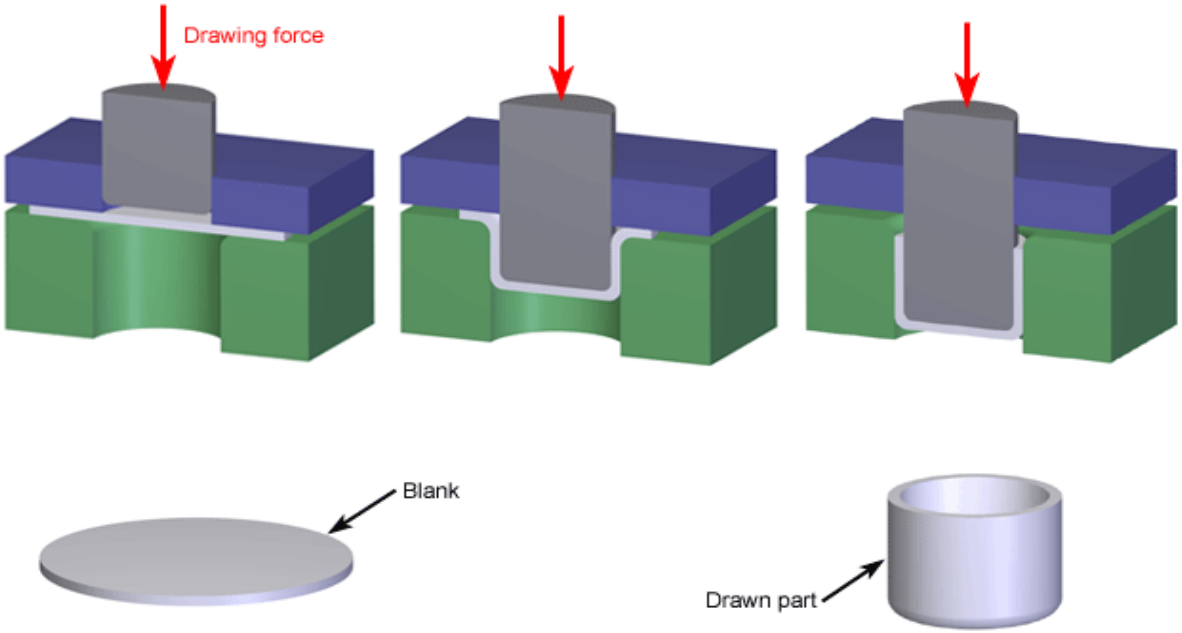
Piercing/Punching



punch-out: scrap
remaining strip: workpiece

Deep Drawing

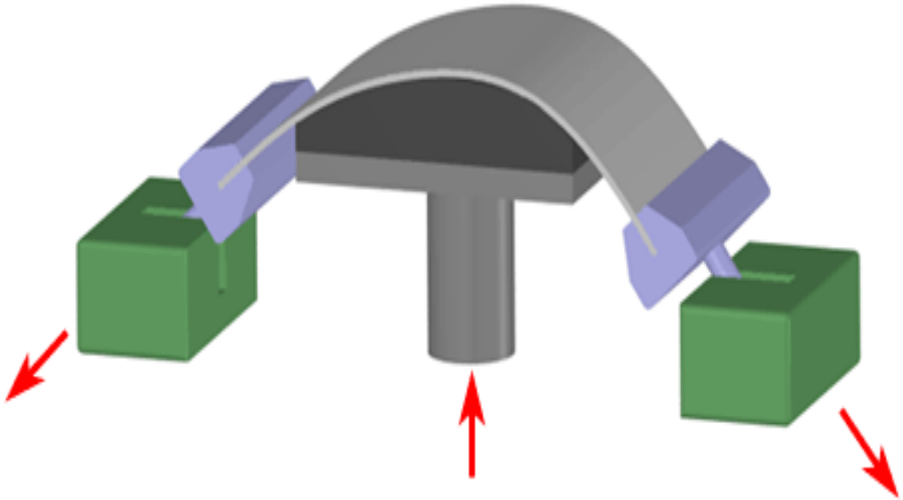
video



Bath tubs,
Oil sumps,
LPG cylinders,
Automotive body panels,
kitchen sinks, utensils

Video deep drawing

Stretch forming

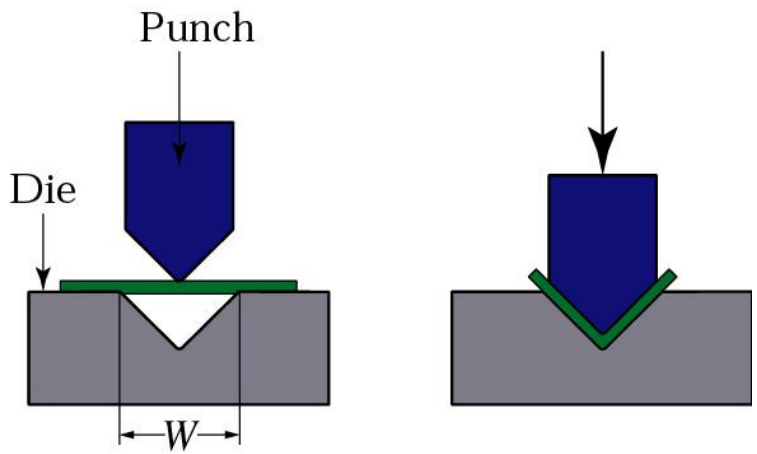


Aircraft parts of large radius of curvature, Cups with hemispherical bottom, Complex automobile body panels.

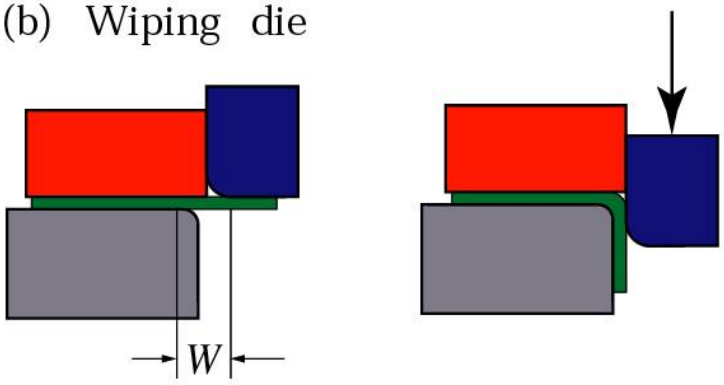
Video hydroforming

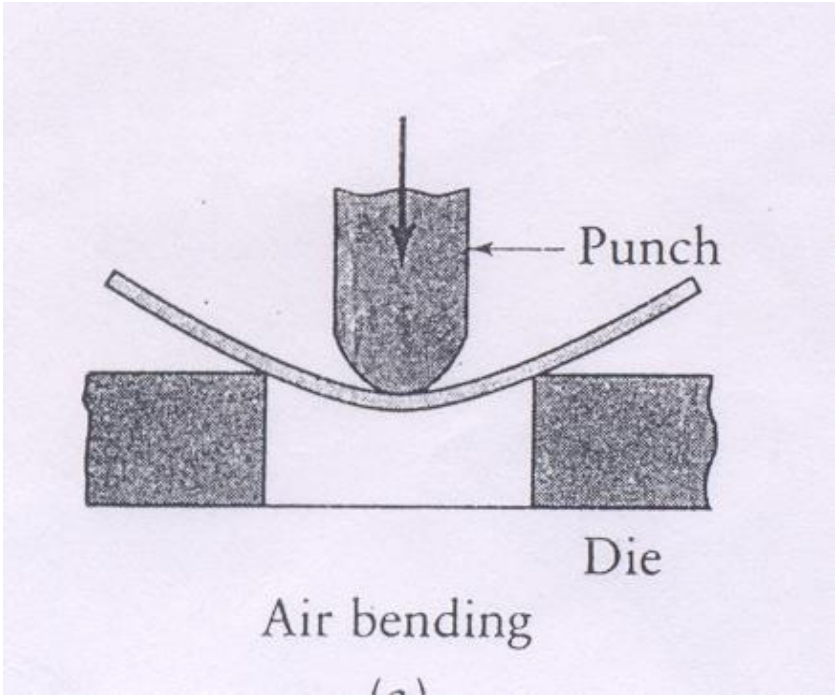
Bending Processes

(a) V die

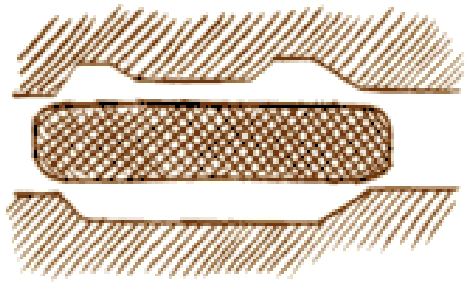


(b) Wiping die

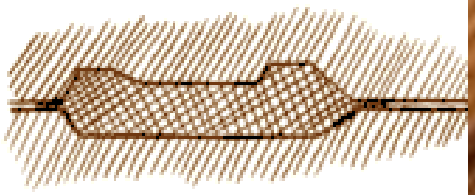




Coining and Embossing



Before



After

COINING

Used to produce coins, medals, and other products where exact size and fine details are required.

Embossing: used for decorative items, wall hangings