

## SHEET METAL OPERATIONS

- It is the cheapest & fastest way of the complete manufacture of a component.
- Sheet metal is considered to be a plate with thickness less than about 5 mm.

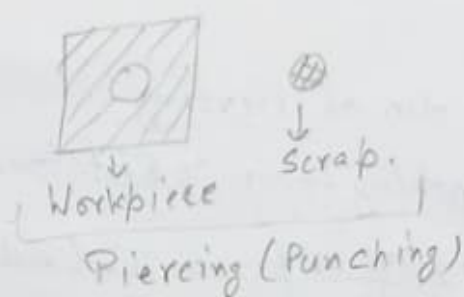
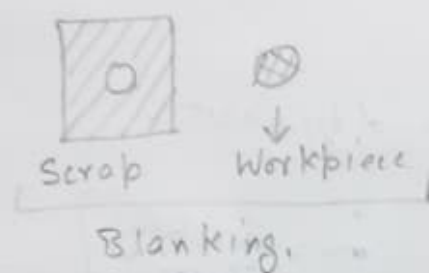
### CLASSIFICATION OF PRESS TOOL OPERATIONS

Stress induced		Operations.
1)	Shearing	Blanking. Shearing. Piercing. Trimming. Shaving. Notching. Nibbling.
2)	Tension	Stretch forming.
3)	Compression	-Coining. Sizing. Ironing. Hobbing.
4)	Tension & Compression.	Drawing. Spinning. Bending. Forming. - Embossing.

Slitting, Perforating, Lancing, Steel Rule

## PIERCING (PUNCHING) and BLANKING

- Both are shearing operations.
- In blanking, the piece being punched out becomes the workpiece and any major material plate should be left on the remaining strip.
- In piercing (punching), the punch-out is the scrap and the remaining strip is the workpiece.
- Both done on some form of mechanical press.



CLEARANCE <sup>(c)</sup>: The opening must be larger than punch and known as "clearance".

Process	Punch Size	Die Size	Clearance On
Punching.	Hole size	Hole size + 2c	Die.
Blanking.	Hole size - 2c	Hole size	Punch.

$$\text{clearance } (c) = 0.0032 \pm \sqrt{T}$$

$T$  = Shear strength of the material  
 $\text{N/mm}^2 (\text{MPa})$ .

$t$  = thickness (mm)

Total clearance between punch and die size will be twice.

# If the allowance for the material is 0.075 given then  
 $c = 0.075\% \text{ thickness of the sheet.}$

# If clearance is 1% given then.

$c = 0.01\% \text{ thickness of the sheet.}$

## Punching Force and Blanking Force:

$$F_{max} = L \times T$$

$L$  = Length of the sheet  
rectangular = ~~length~~ ~~breadth~~,  
Circle =  $\pi d$ .

## Capacity of Press for Punching and Blanking:

Press capacity will be =  $F_{max} \times C$

[where  $C = 1.1$  to  $1.75$ ]  
                    ↓                    ↓  
                    Soft                Hard.

## Minimum dia of Piercing:

Punching force  $\geq$  Resistance offered by sheet.

$$\sigma_c \left( \frac{\pi}{4} d^2 \right) = T_s (\pi d t)$$

$$\left[ d_{min} = \frac{4 t T_s}{\sigma_c} \right]$$

[ $\sigma_c$  = Crushing Stress]

## Force required with shear on Punch.

$$F_{shear} = \frac{F_{max} \times \text{penetration}}{\text{Shear} + \text{penetration}}$$

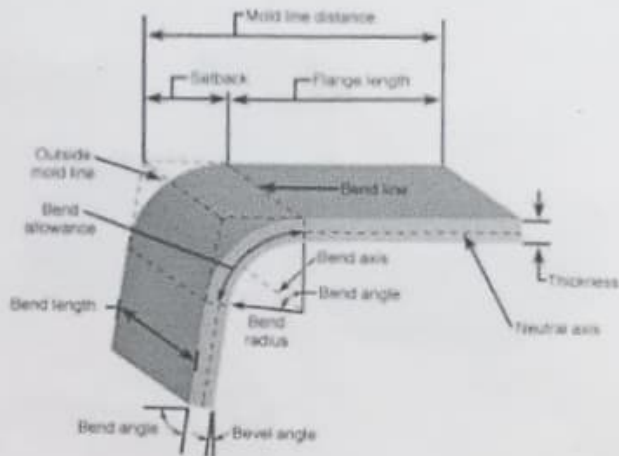
$$F = \frac{F_{max} \times \text{penetration of punch as a fraction}}{\text{Shear on the punch or die (mm)}}$$

## FILE BLANKING:

Dies are designed that have small clearance and pressure pads that holds the material while it is sheared.

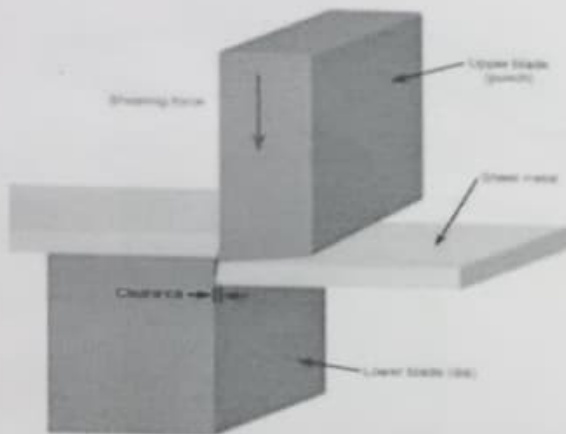
The final result is blanks that have extremely close tolerances.

## Bending



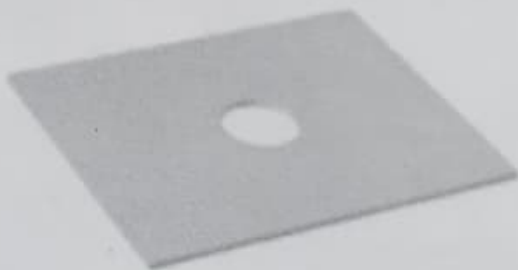
- ▶ Bending is a metal forming process in which a force is applied to a piece of sheet metal, causing it to bend at an angle and form the desired shape.

## Shearing



- ▶ Shearing is defined as separating material into two parts.
- ▶ It utilizes shearing force to cut sheet metal.

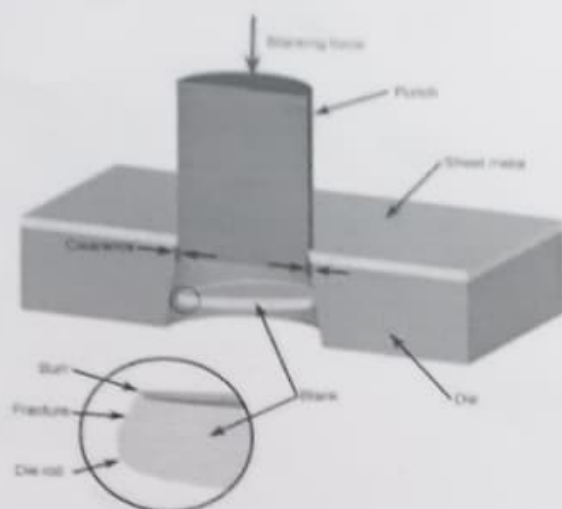
## Punching or Piercing



- ▶ The typical punching operation, in which a cylindrical punch pierces a hole into the sheet.

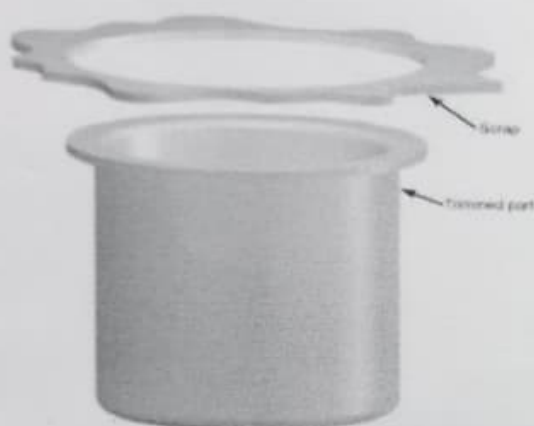


## Blanking



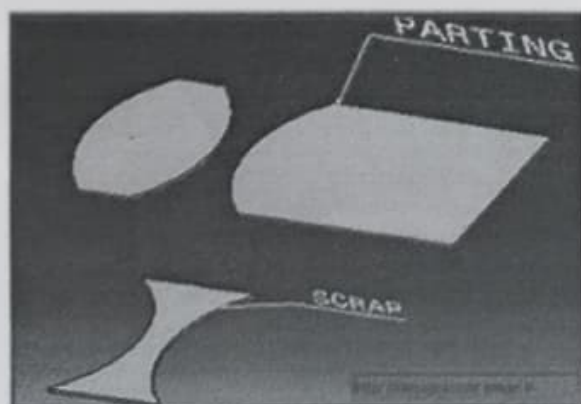
- ▶ A piece of sheet metal is removed from a larger piece of stock.
- ▶ This removed piece is not scrap, it is the useful part.

## Trimming



- ▶ Punching away excess material from the perimeter of a part, such as trimming the flange from a drawn cup.

## Parting



- ▶ Separating a part from the remaining sheet, by punching away the material between parts.

## Slitting



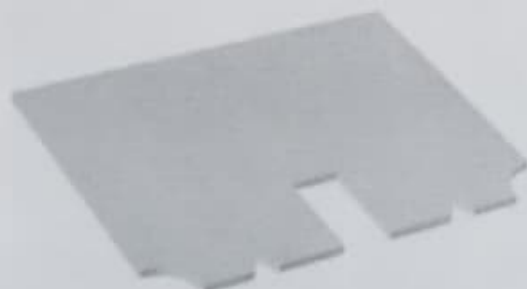
- ▶ Cutting straight lines in the sheet. No scrap material is produced.

## Lancing



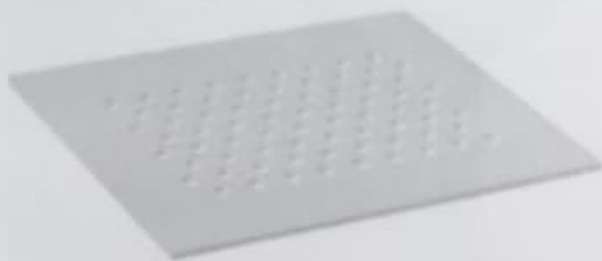
- ▶ Creating a partial cut in the sheet, so that no material is removed. The material is left attached to be bent and form a shape, such as a tab, vent, or louver.

## Notching



- ▶ Punching the edge of a sheet, forming a notch in the shape of a portion of the punch.

## Perforating



- ▶ Punching a close arrangement of a large number of holes in a single operation.

## Nibbling



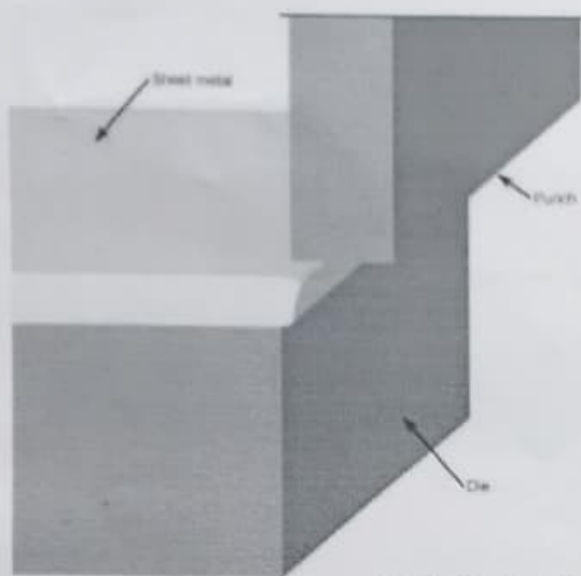
- ▶ Punching a series of small overlapping slits or holes along a path to cut-out a larger contoured shape.

## Embossing



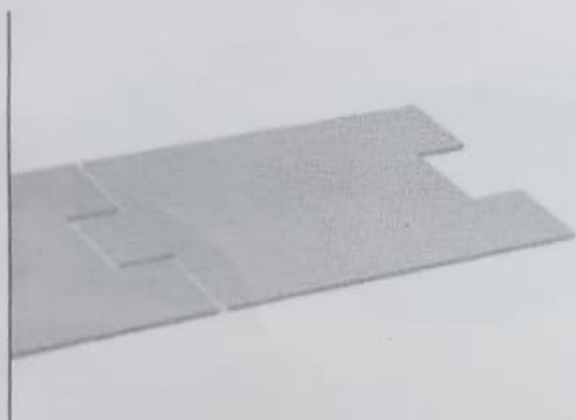
- ▶ Certain designs are embossed on the sheet metal.
- ▶ Punch and die are of the same contour but in opposite direction.

## Shaving



Shearing away minimal material from the edges of a feature or part, using a small die clearance. Used to improve accuracy or finish. Tolerances of  $\pm 0.025$  mm are possible.

## Cutoff



Cutoff – Separating a part from the remaining sheet, without producing any scrap.

The punch will produce a cut line that may be straight, angled, or curved.

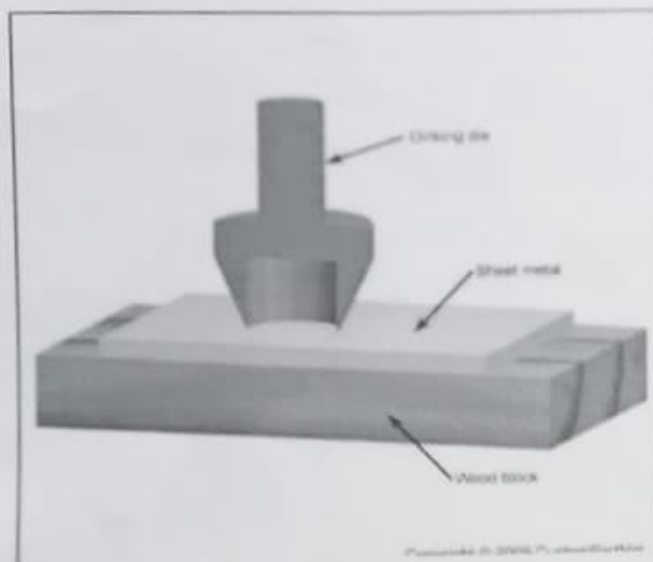
## Coining



- ▶ Similar to embossing with the difference that similar or different impressions are obtained on both the sides of the sheet metal.

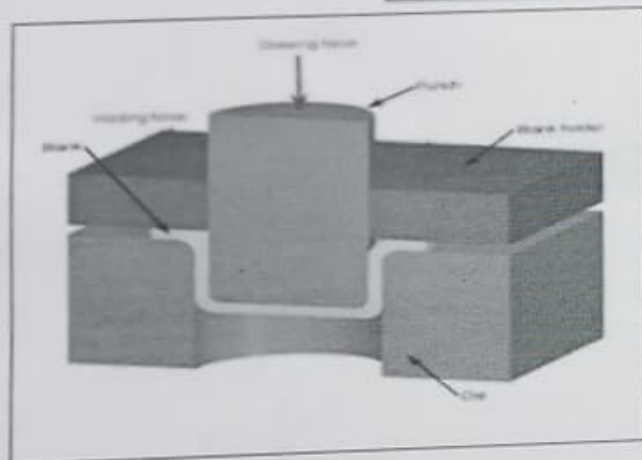


## Dinking



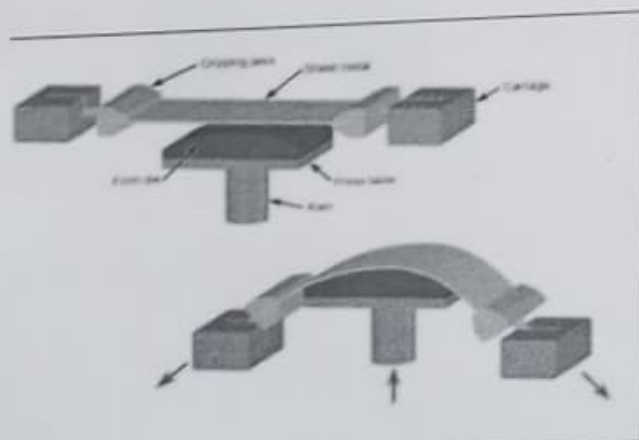
Dinking – A specialized form of piercing used for punching soft metals. A hollow punch, called a dinking die, with beveled, sharpened edges presses the sheet into a block of wood or soft metal.

## Deep Drawing



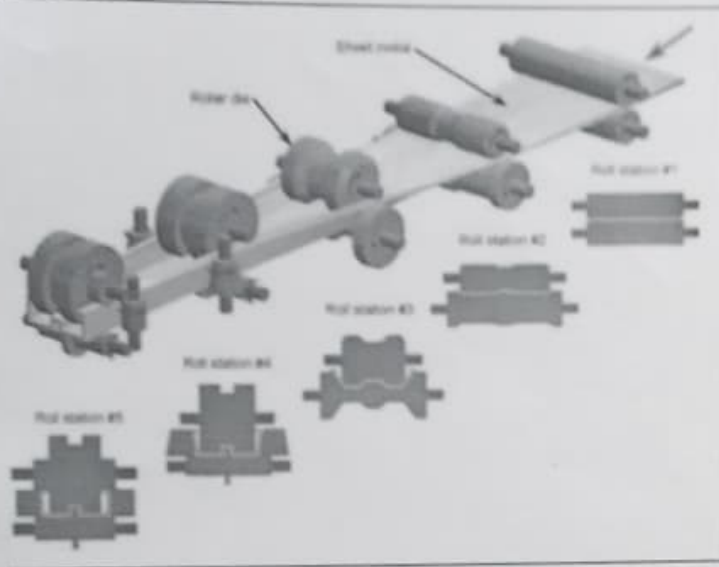
- ▶ Deep drawing is a metal forming process in which sheet metal is stretched into the desired shape.
- ▶ A tool pushes downward on the sheet metal, forcing it into a die cavity in the shape of the desired part.

## Stretch Forming



- ▶ Stretch forming is a metal forming process in which a piece of sheet metal is stretched and bent simultaneously over a die in order to form large bent parts.

# Roll Forming



**Roll forming** is a continuous bending operation in which a long strip of sheet metal is passed through sets of rolls mounted on consecutive stands, each set performing only an incremental part of the bend, until the desired cross-section profile is obtained.

Roll forming is ideal for producing constant-profile parts with long lengths and in large quantities.

## Ironing

- Makes wall thickness of cylindrical cup more uniform

