Materials Manufacturing (EDPT 601)

Tutorial 3 (Metal Forming Processes)

Sheet metal forming

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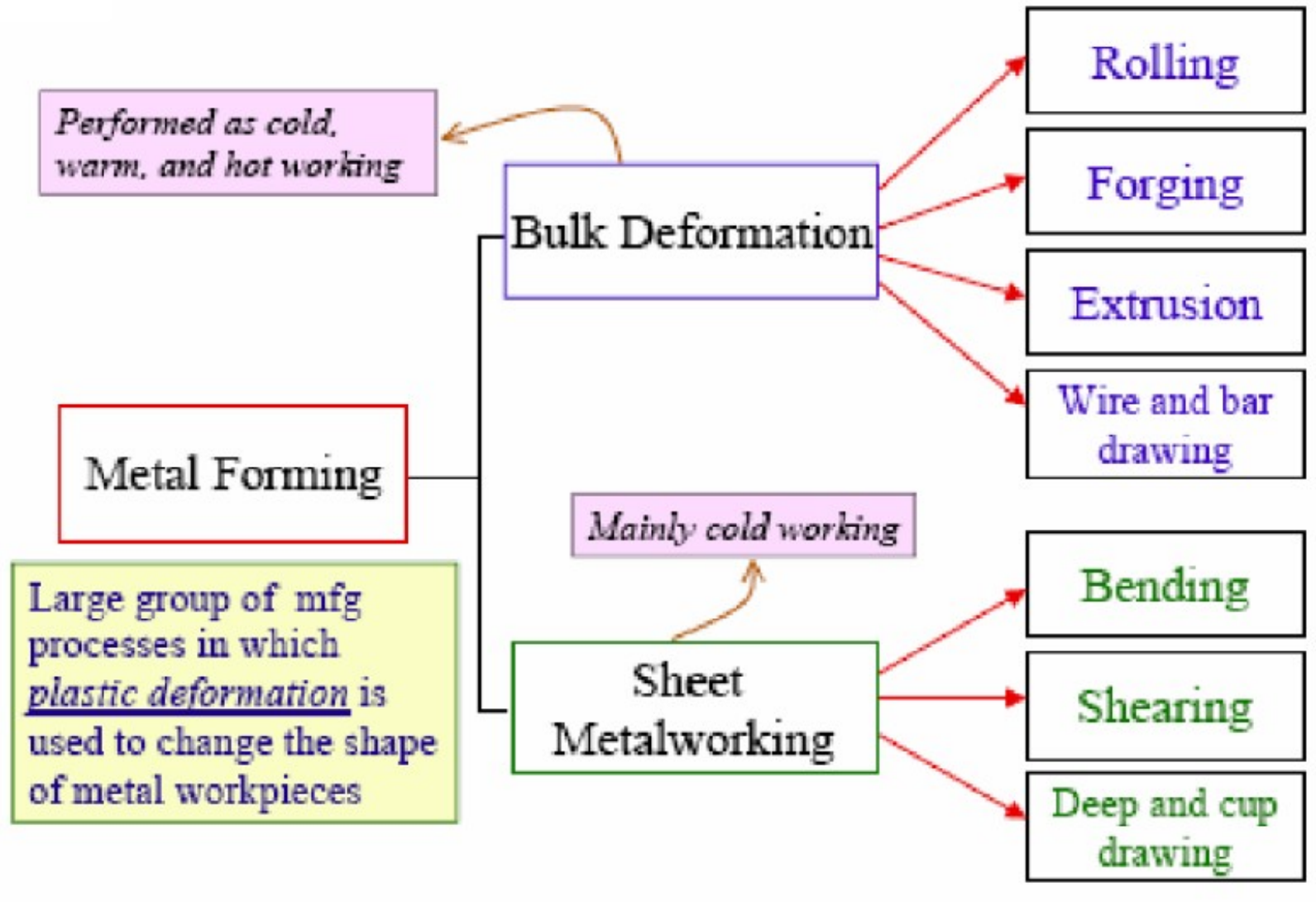
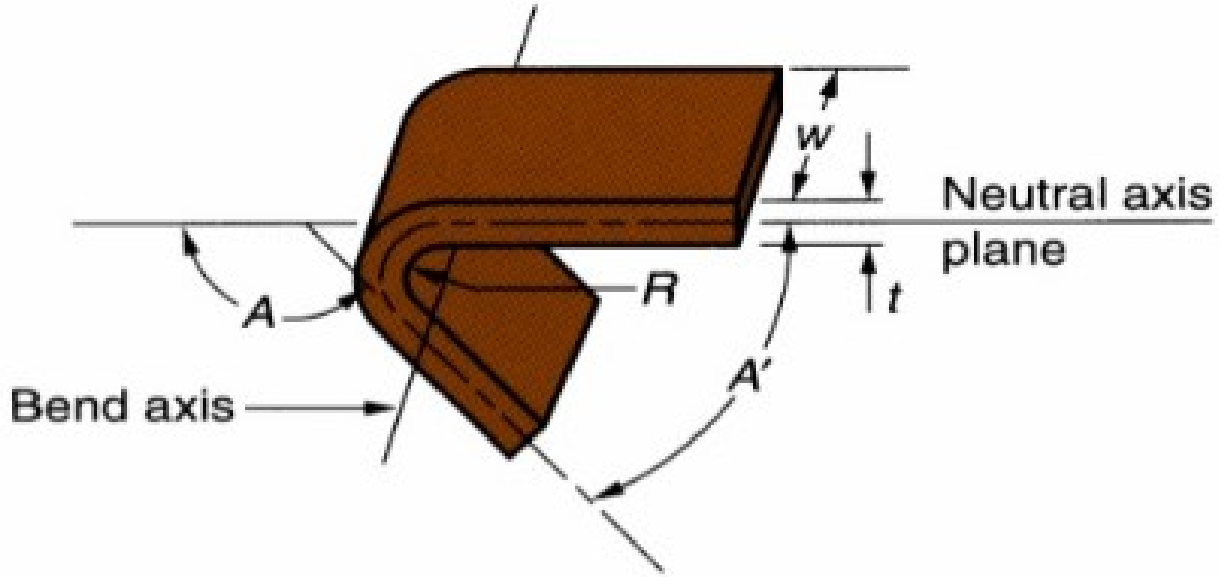
Classification of metal forming processes



Sheet metal forming processes

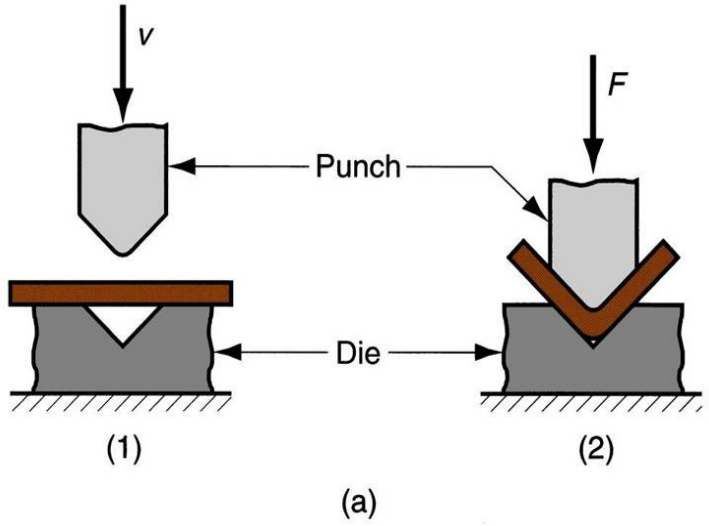
1. Bending

- It is the process of deforming or straining of a sheet metal around a straight or linear axis to take a permanent bend.
- The sheet metal is subjected to compression (on inside of neutral plane) as well as tension (on outside of neutral plane)



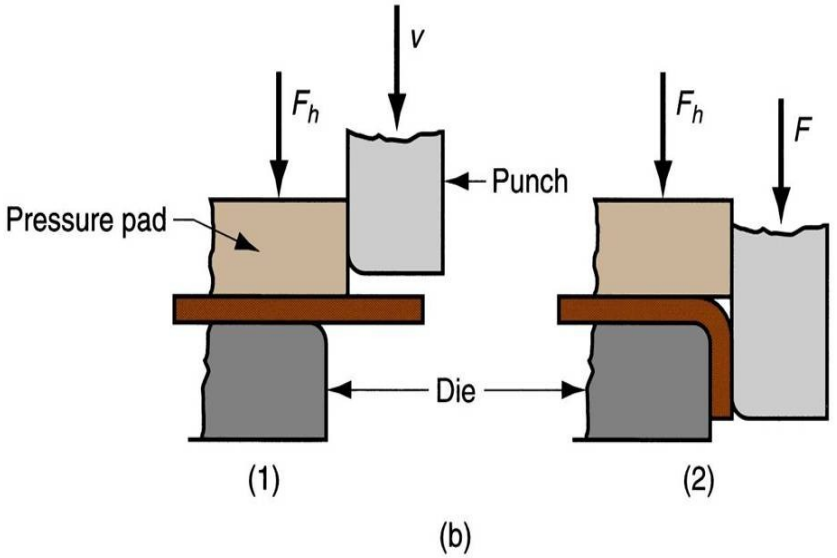
Types of bending

1. V-bending



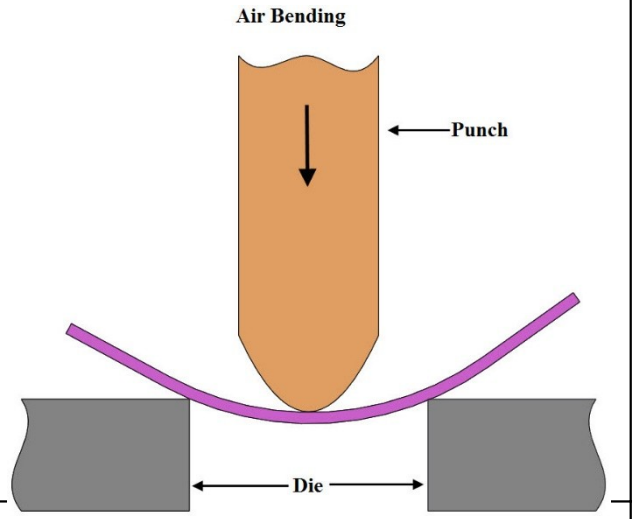
- For low production
- Simple and inexpensive

2. Edge bending



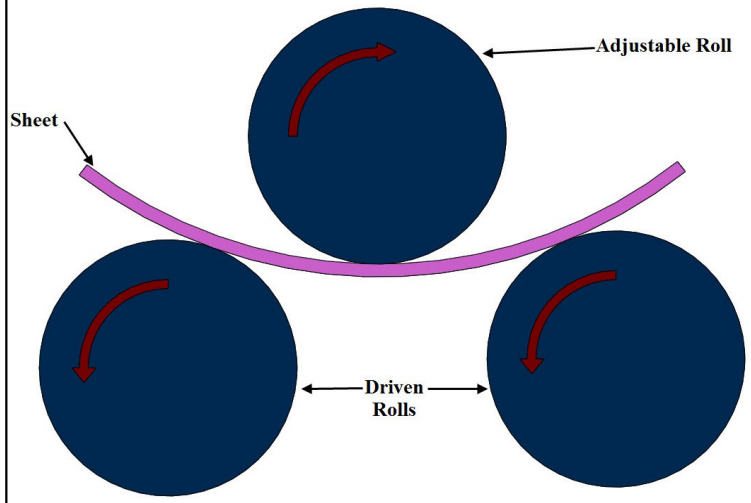
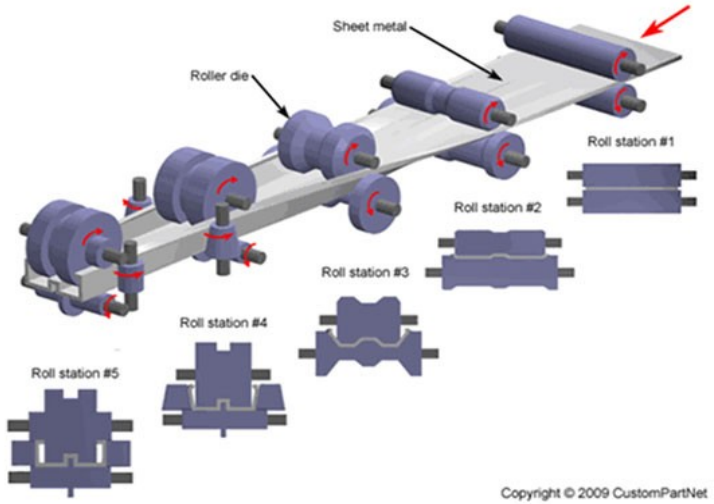
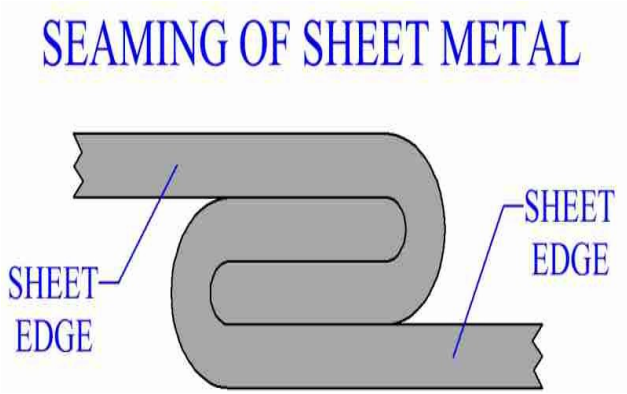
- For high production
- Dies are more complicated and costly
- Requires pressure pad

3. Air bending



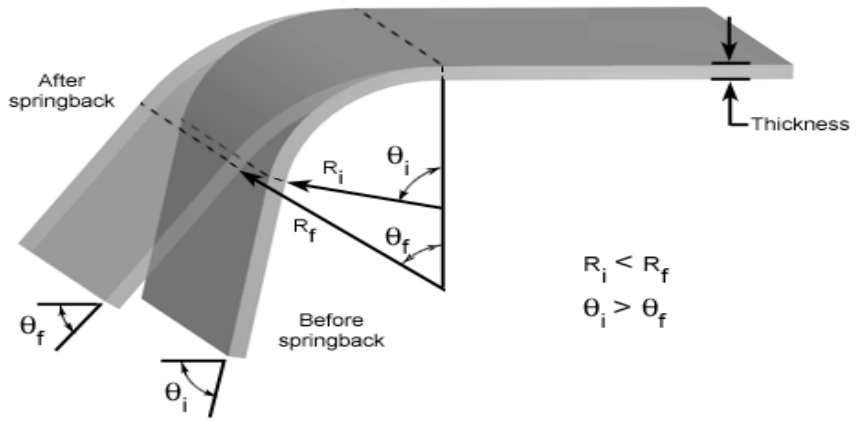
- Flexible and requires relatively low forces
- Less precise than other bending operations.

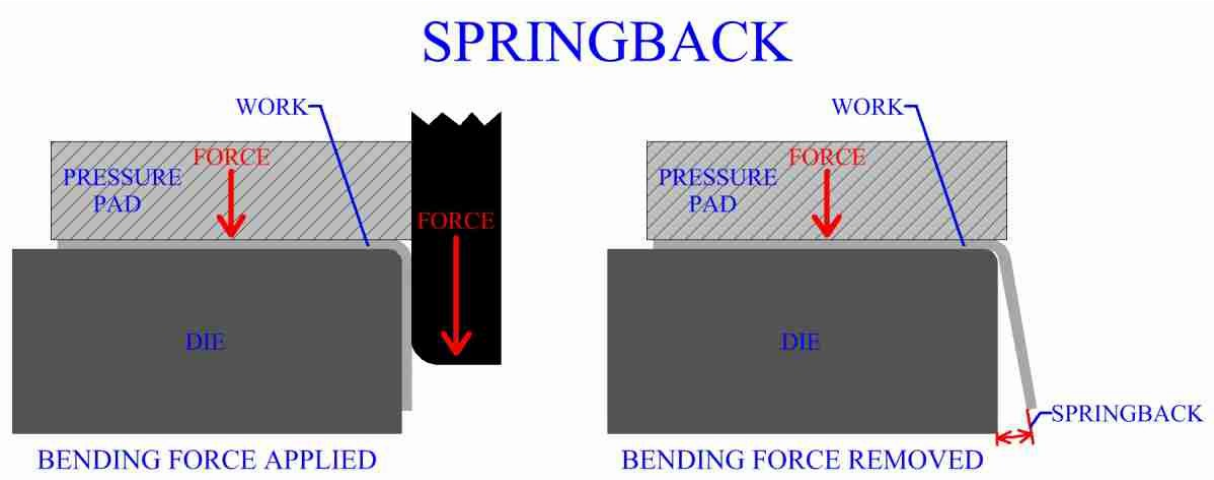
Types of bending

4. Roll bending	5.Roll forming	6. Seaming
		
• Continuous process • For sheets, pipes, plates and beams.	• Transforms flat sheets into complex sections through progressive bending operations.	• Commonly used in food industry on canned foods and used in automotive industry.

Spring-back

- also known as elastic recovery, is the result of metal tending to return to its original shape after undergoing compression and tension (stretching).
- Reasons: when bending pressure is removed, elastic energy remains in bent part, causing it to recover partially towards its original shape.

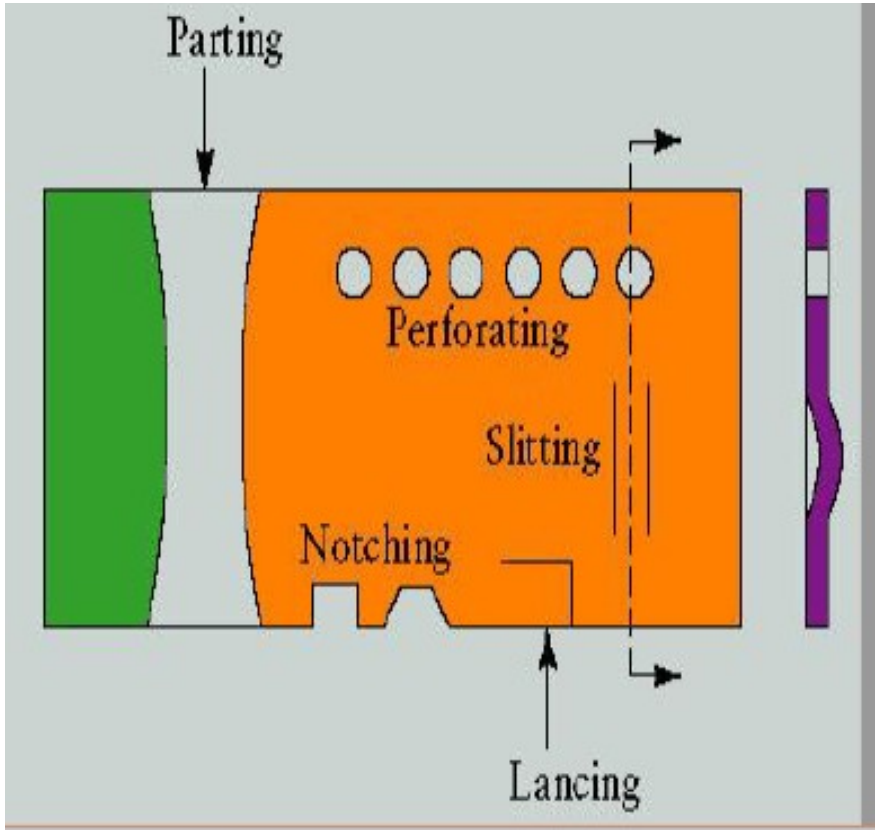




2. Shearing

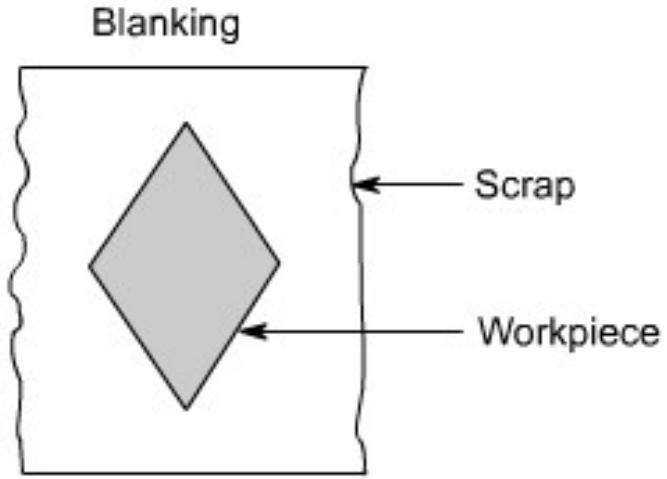
There are several operations performed based on shearing:

1. Piercing (punching)
2. Blanking
3. Perforating
4. Parting
5. Notching
6. Lancing
7. Slitting
8. Nibbling

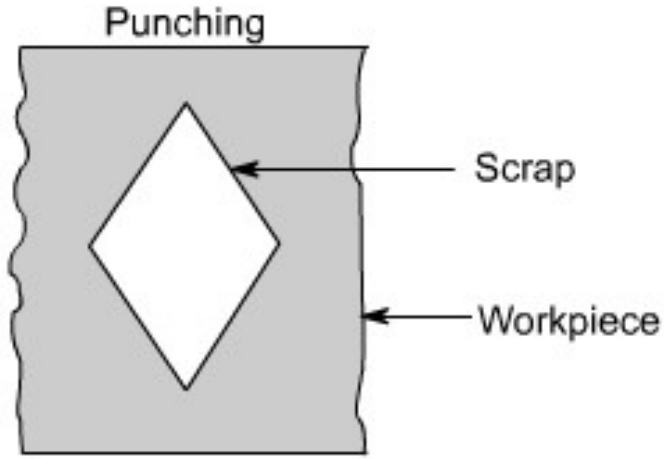


Piercing and blanking

- Blanking: Sheared slug (part) is the required part and the rest of the sheet is discarded as scrap

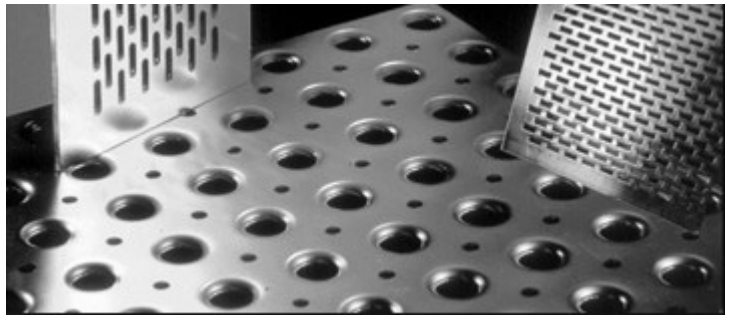


- Piercing (Punching): Sheared slug (part) is discarded as scrap.



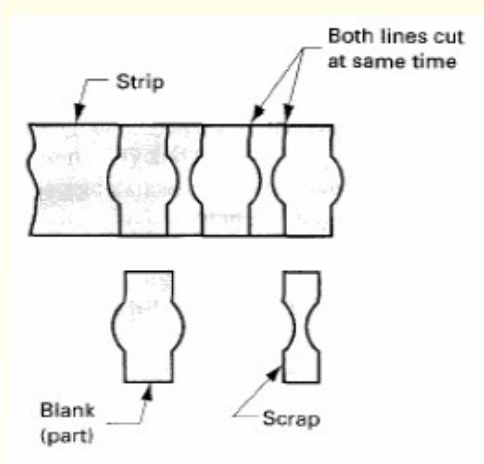
Perforating

Punching a number of holes in a sheet.



Parting

Shearing the sheet into two or more pieces.

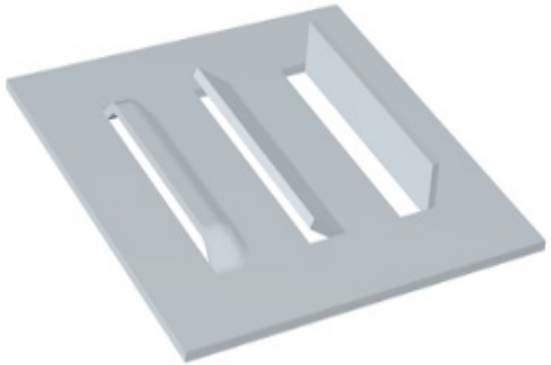


Notching

Removing pieces from the edges.

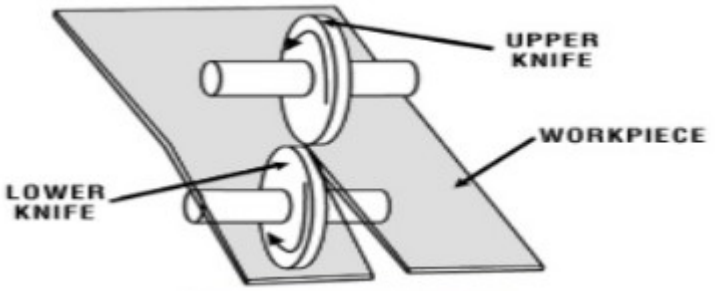
Lancing

Portion of a hole is cut while the remaining is bent to a desired shape.



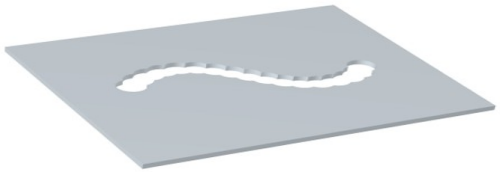
Slitting

Shearing operation using circular blades that follow straight or circular paths.

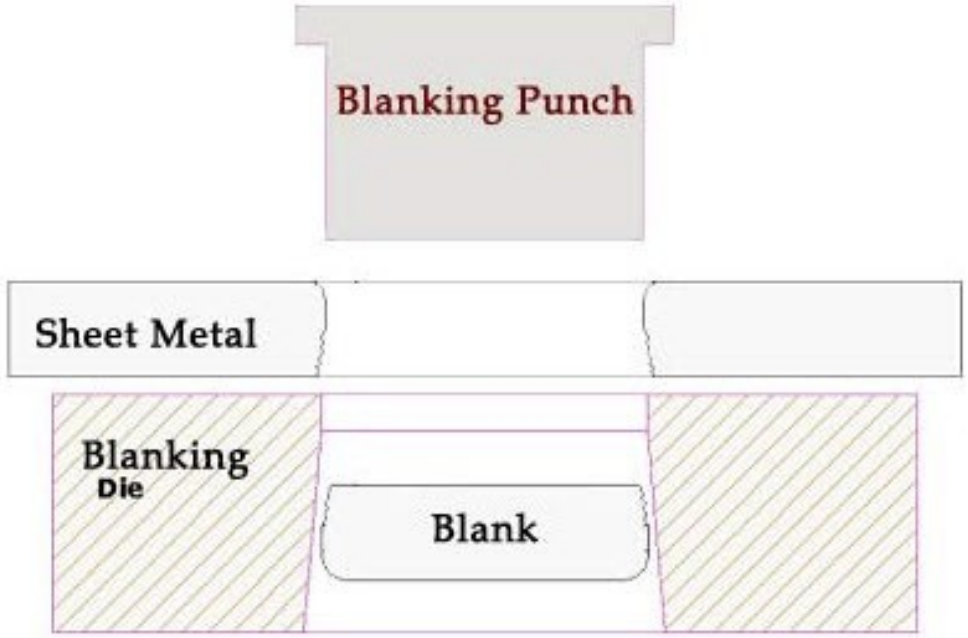


Nibbling

Shearing process that utilizes series of overlapping cuts to make complex shapes.

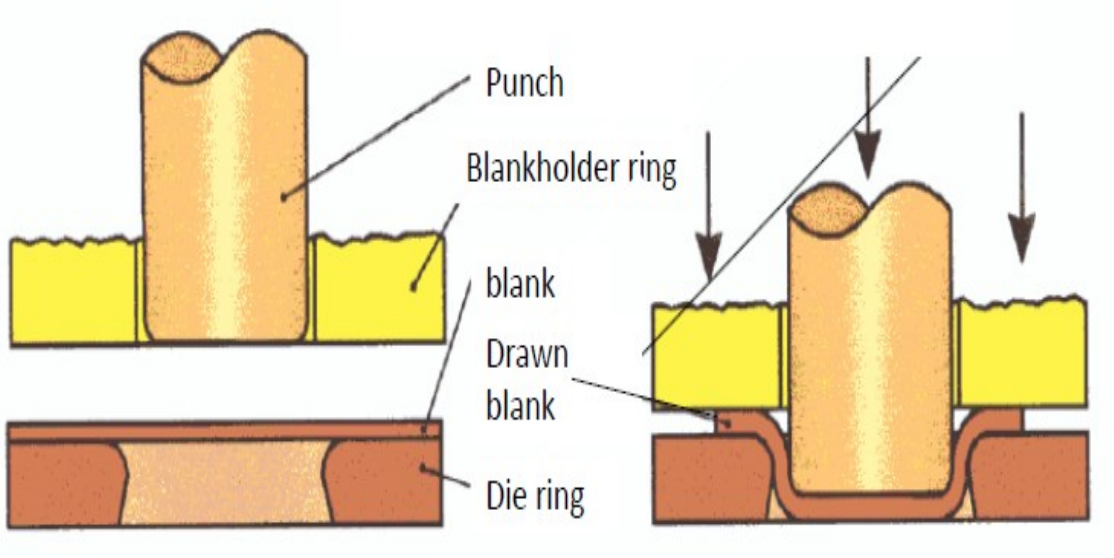


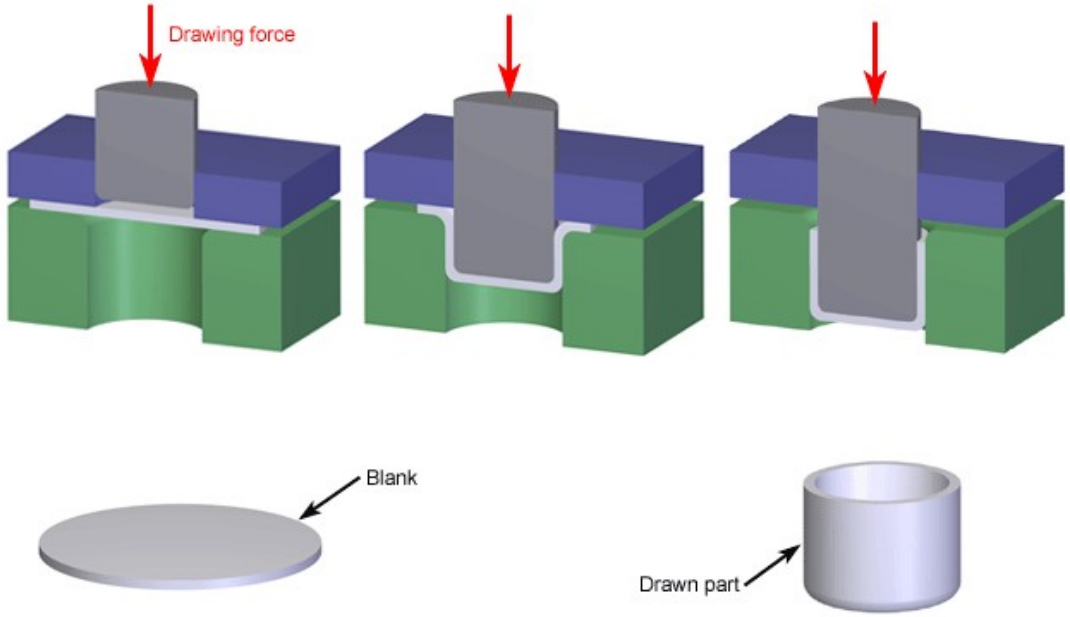
Punching dies



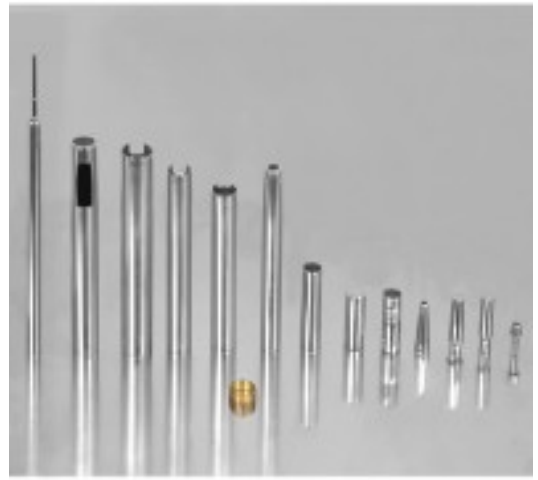
3. Deep drawing

- A flat blank is formed into a cup by forcing a punch against the center portion of a blank that rests on a die ring.

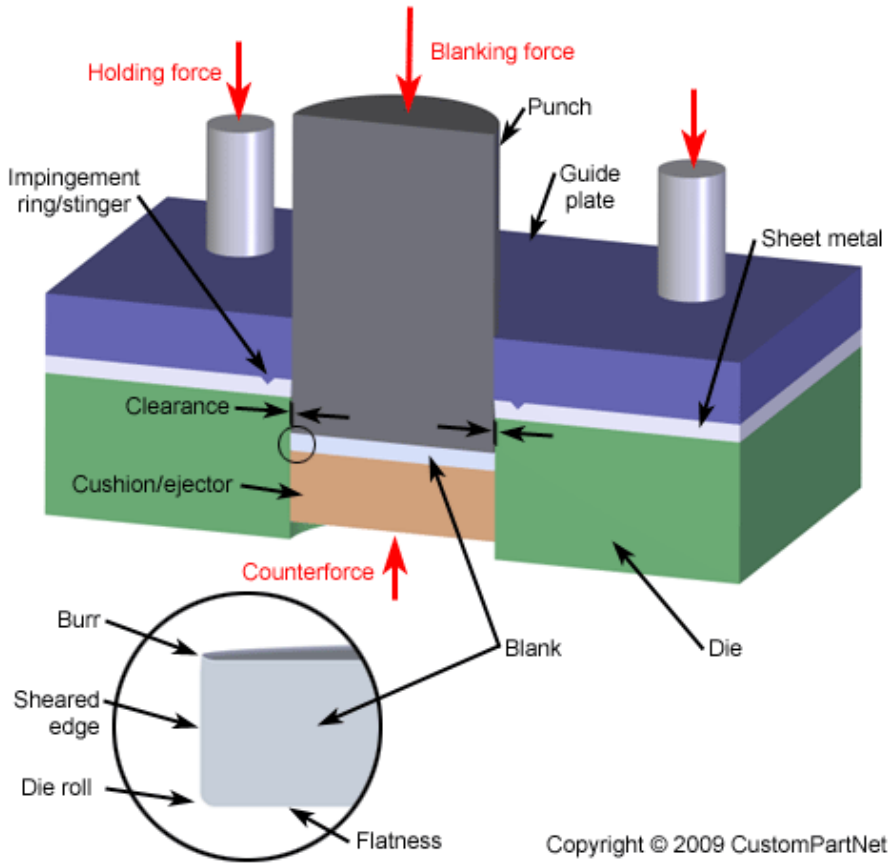


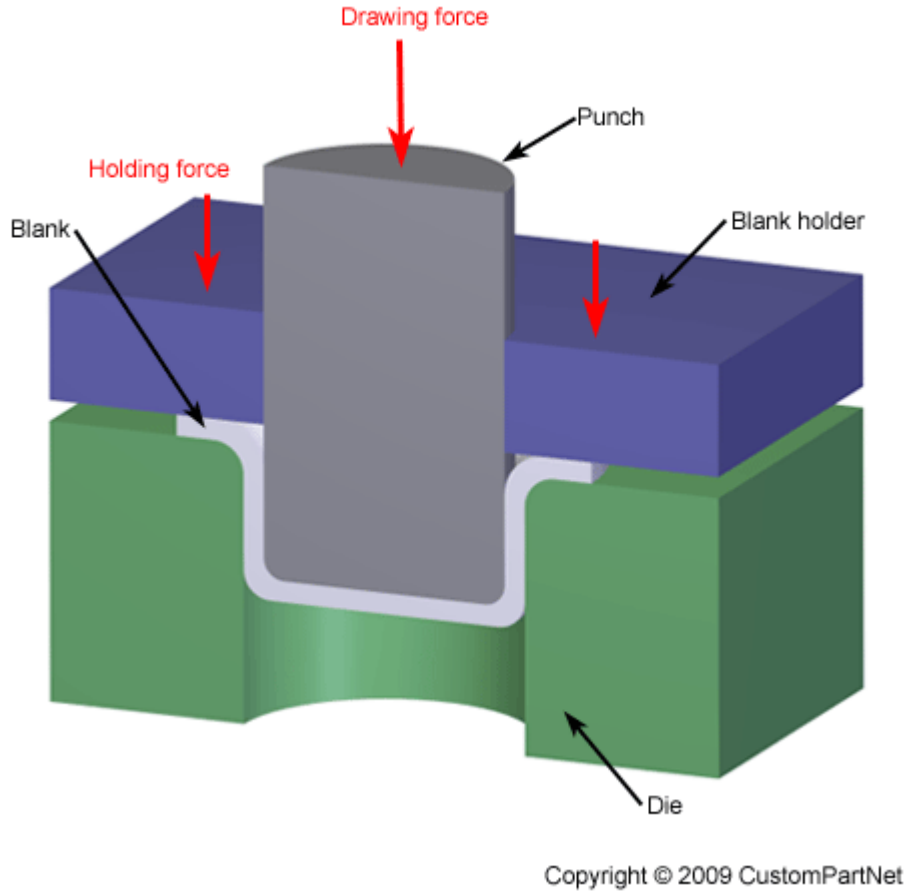


Deep drawn products



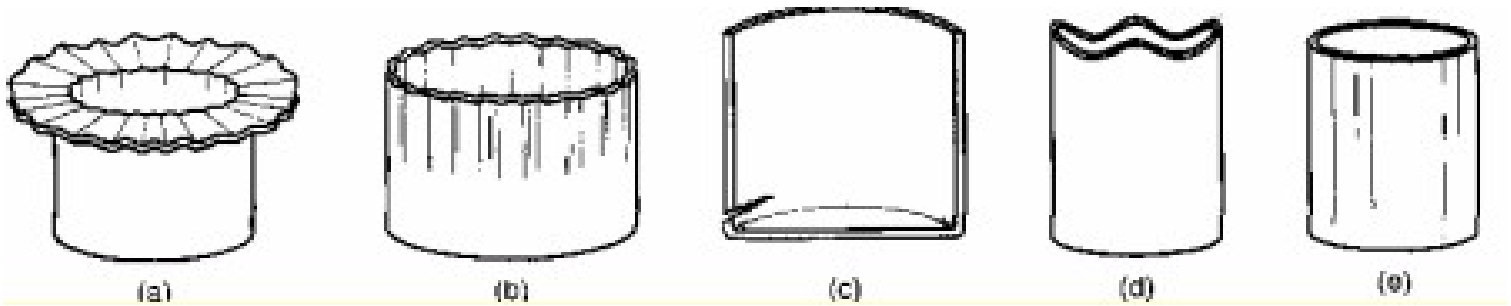
Shearing and deep drawing dies





Clearance between punch and die is greater than material thickness

Deep drawing defects



a) Flange wrinkling: small holding force.
b) Wall wrinkling: insufficient holding force, wrinkling initially occurring on the flange.
c) Tearing: high stress and sharp die corners.
d) Earing: anisotropy of the material.
e) Surface scratches: Die or punch not having a smooth surface, insufficient lubrication.