UNIT 50: ADVANCED MANUFACTURING TECHNOLOGY

Unit code : **R/615/1518**
Unit level : **5**
Credit value : **15**

Tutor : Mr PM Subramanian

CONTENT

01 ADVANCED MANUFACTURING PROCESSES (AMT) & APPLICATIONS

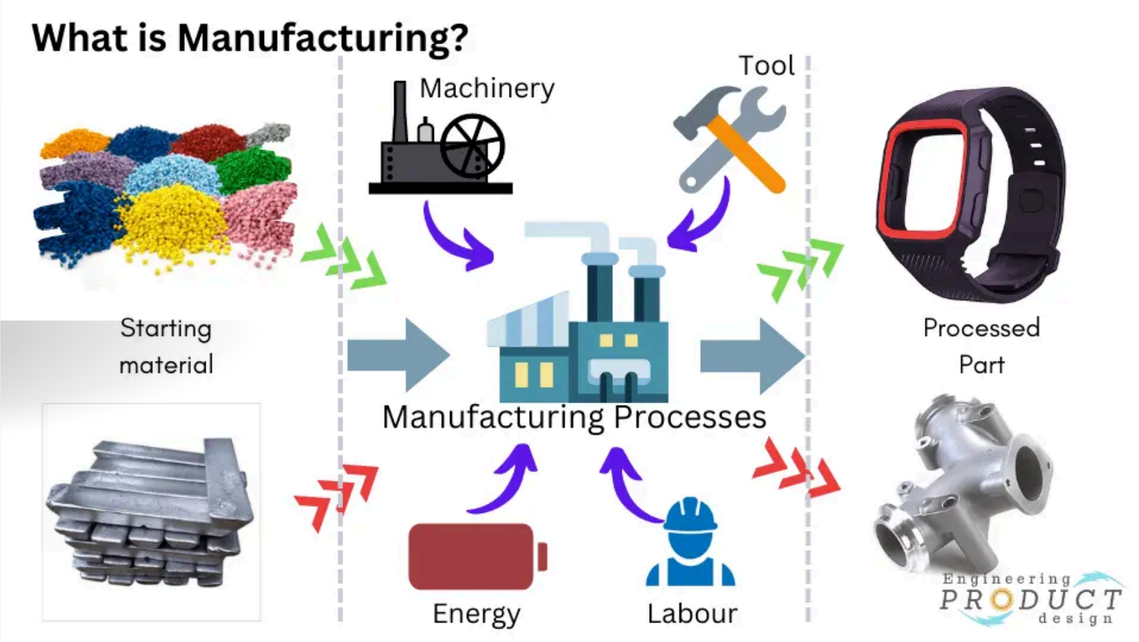
02 ADAPTIVENESS OF ADVANCED MANUFACTURING PROCESSES

03 INTRODUCING AMT - EXISTING MANUFACTURED PRODUCT AND PROCESS

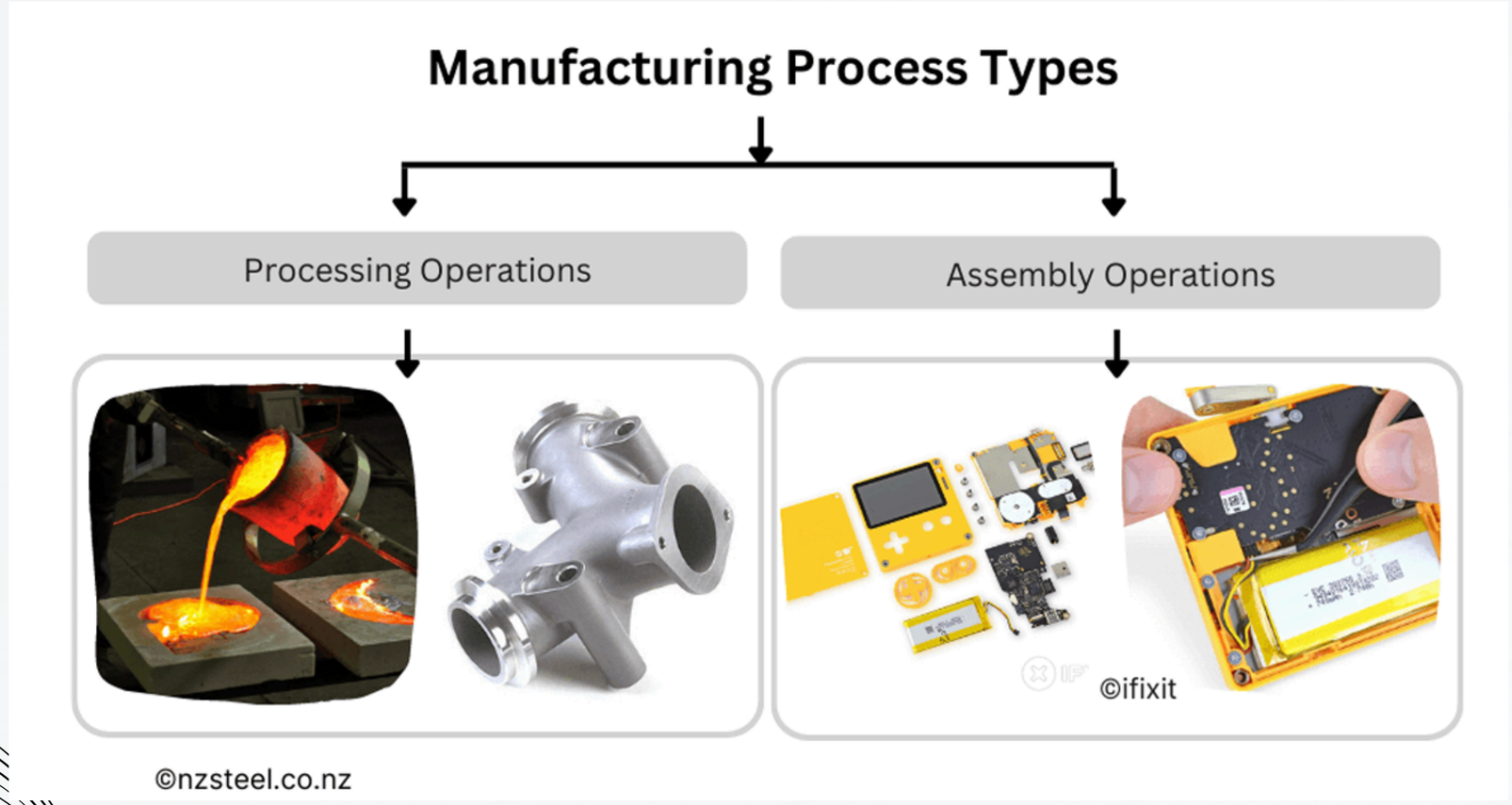
04 INDUSTRIAL REVOLUTION

TRADITIONAL MANUFACTURING PROCESSES

- Pressing and Forming
- Casting and Moulding
- Joining and Soldering
- Mixing
- Final assembly
- Packaging,
- Material Handling
- Quality Control/Inspection

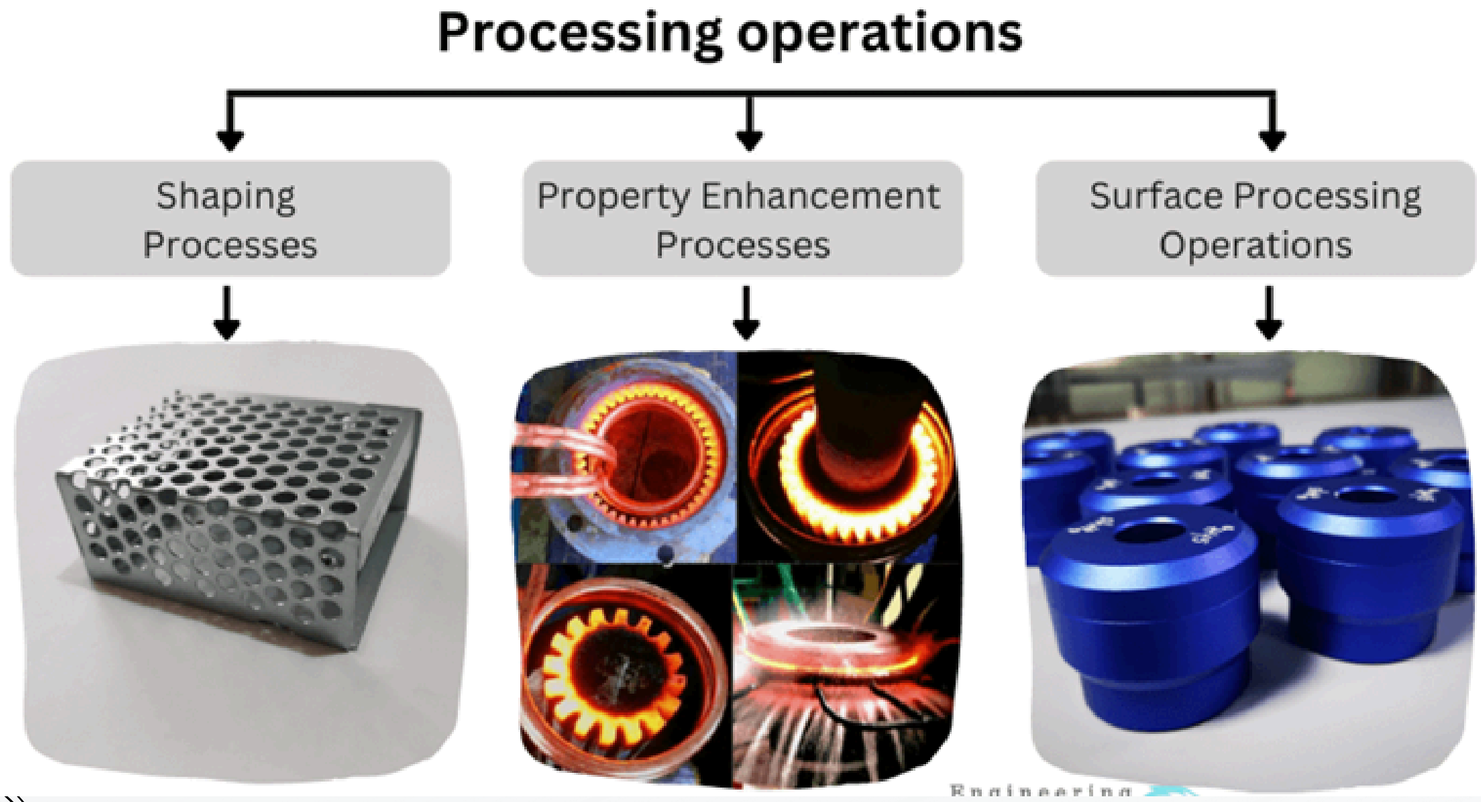


TRADITIONAL MANUFACTURING PROCESSES

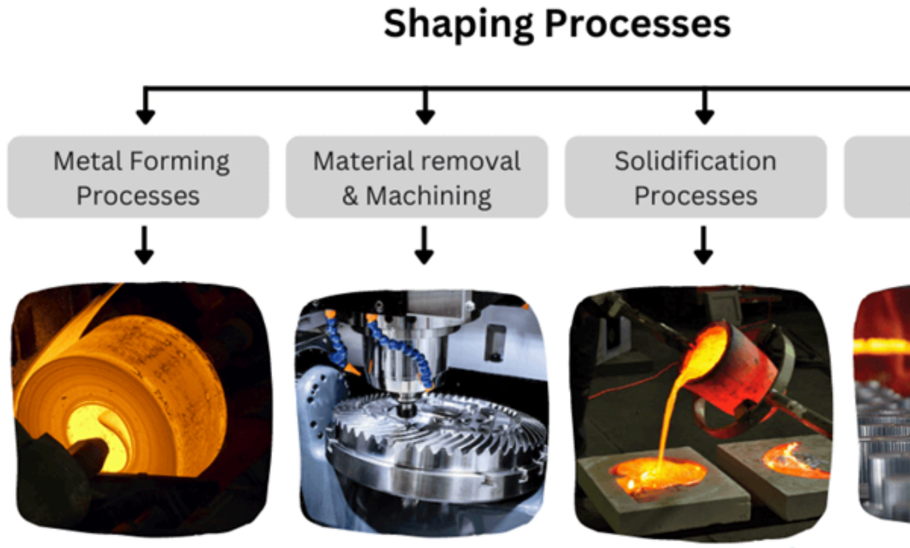


- Shape ,
- property,
- appearance,
- surface texture
- Energy

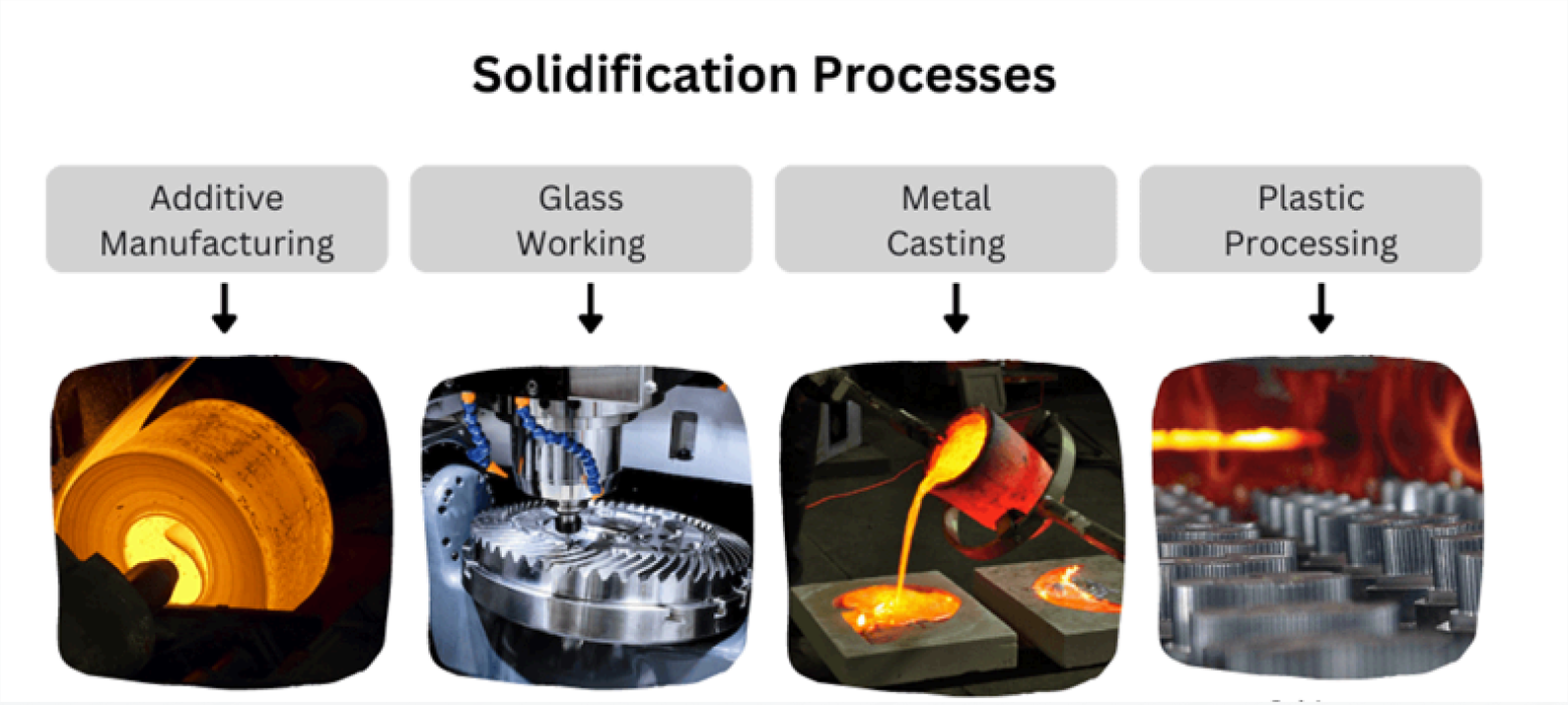
TRADITIONAL MANUFACTURING PROCESSES



- Casting +Machining
- Shaping Process
  - Geometry by Heat
  - Mechanical Force

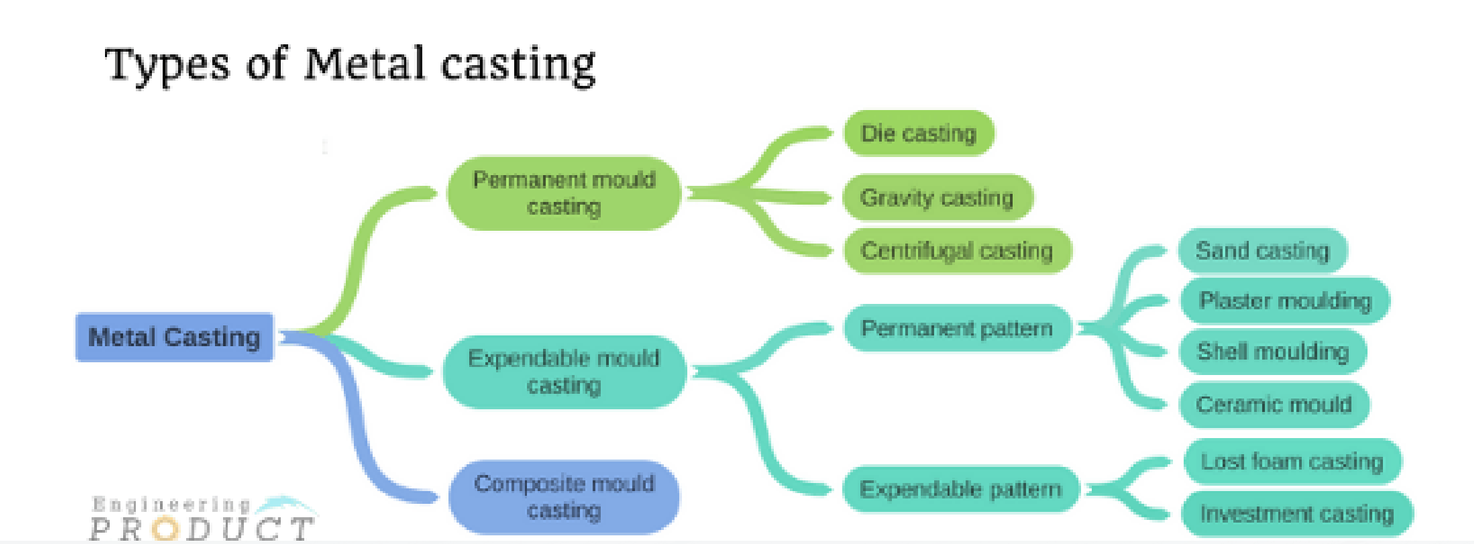


TRADITIONAL MANUFACTURING PROCESSES



- Melting - Liquid
- Cools - Solidification
- metal, plastic, ceramic, and Glass.
- Mould
- New AM- material is heated and added layer by layer to create a 3D object

TRADITIONAL MANUFACTURING PROCESSES



- Pouring Molten Metal - Gravity or Force
- complex part geometries with both external and internal shapes

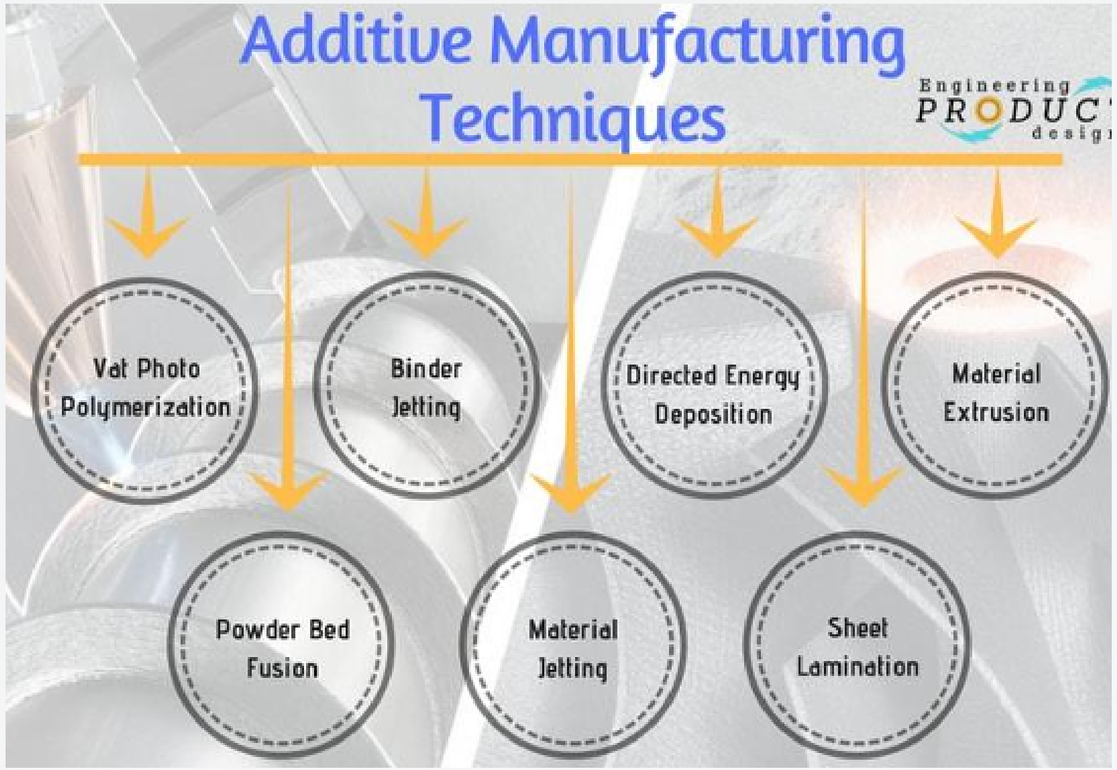
TRADITIONAL MANUFACTURING PROCESSES



- Glass -processed by melting and shaping
- moulds or blowing
- Blowing -inflating molten glass with a blowpipe to form a sort of glass bubble
- Shapes - flat sheets, plates, rods, tubing, bottles, vases, eyeglasses and glass fibres



TRADITIONAL MANUFACTURING PROCESSES

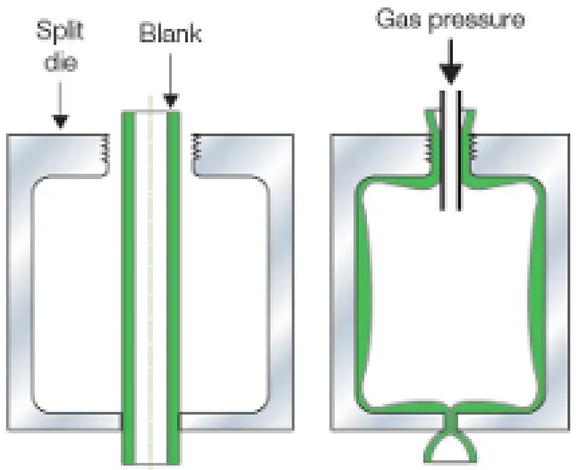


- **CAD-generated 3D model - 3D Part**
- **Adding layer upon layer of material and fusing them- 3D Printing**

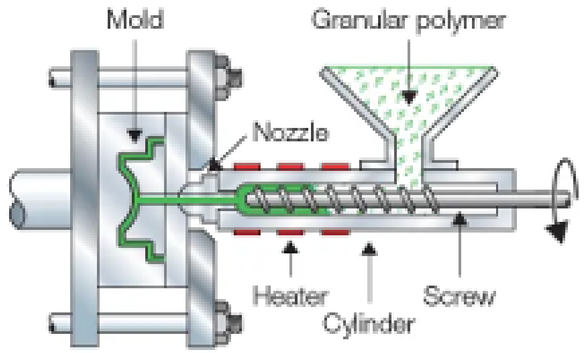
a. **Stereolithography SLA, Direct Light Processing DLP, Continuous Direct Light Processing (CDLP)**
b. **Selective Laser Sintering SLS, Selective Laser Melting SLM, Direct Metal Laser Sintering DMLS**
c. **Binder Jetting**
d. **PolyJet technology, NanoParticle Jetting NPJ, Drop-On Demand DOD**
e. **Laser-based DED, Electron beam-based DED, Plasma or Electric arc-based DED**
f. **Laminated Object Manufacturing LOM, Composite Based Additive Manufacturing CBAM)**
g. **Fused deposition modelling FDM**

TRADITIONAL MANUFACTURING PROCESSES

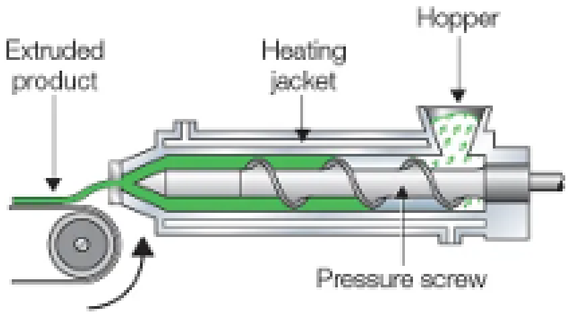
Plastic processing



Blow moulding(©Michael F Ashby)



Injection moulding(©Michael F Ashby)

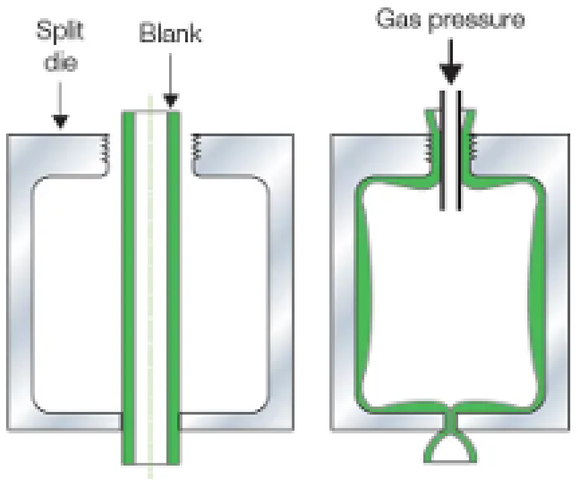


Polymer extrusion(©Michael F Ashby)

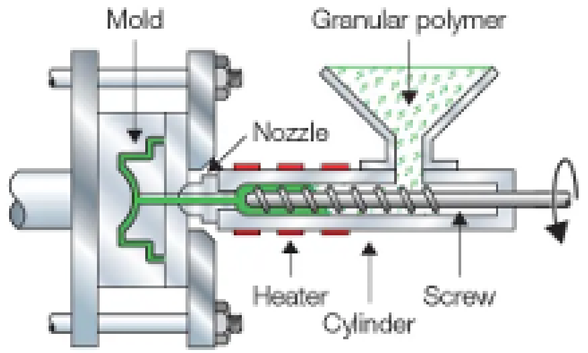
- raw materials to finished products - forming in desired shapes
- Raw Plastics - resin, granules, pellets, powders, sheets, preforms, or fluids
- additives- improve properties and processability.
- Secondary Process - welding, adhesive bonding, machining, and surface decoration

TRADITIONAL MANUFACTURING PROCESSES

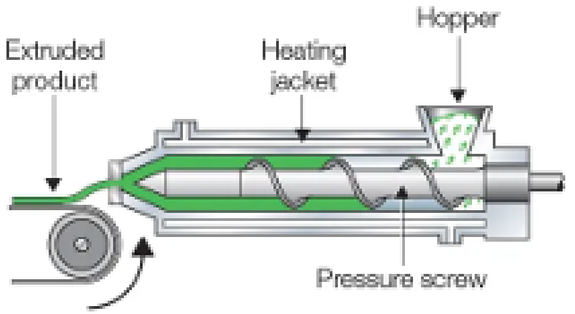
Plastic processing



Blow moulding(©Michael F Ashby)



Injection moulding(©Michael F Ashby)

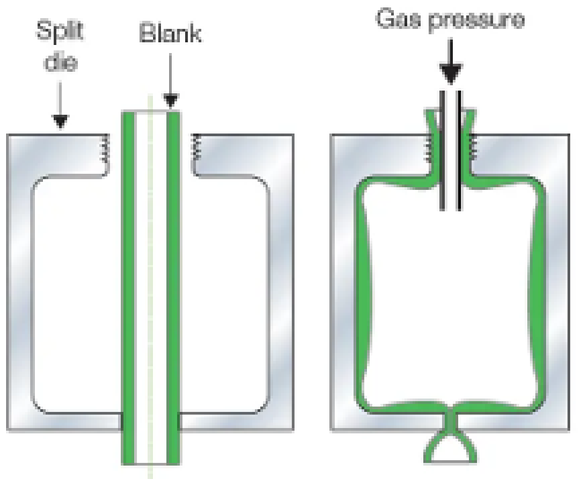


Polymer extrusion(©Michael F Ashby)

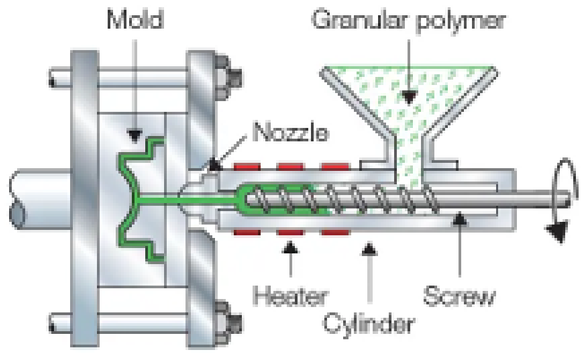
- Injection Moulding -Melt & Injects Polymer-Complex Shapes
- Reaction injection moulding - reactive liquid components
- Liquid Injection Moulding - liquid silicone rubber to a mould with Heat
- Blow Moulding - Inflates heated plastic to mould cavity - hollow parts like bottles.

TRADITIONAL MANUFACTURING PROCESSES

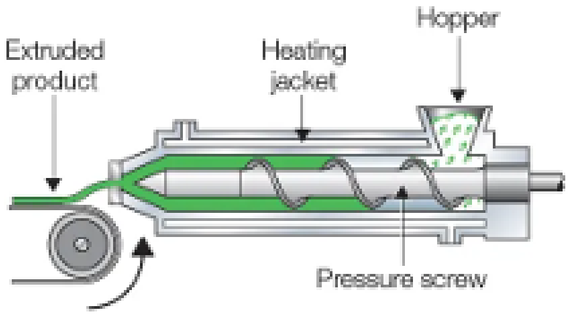
Plastic processing



Blow moulding(©Michael F Ashby)



Injection moulding(©Michael F Ashby)

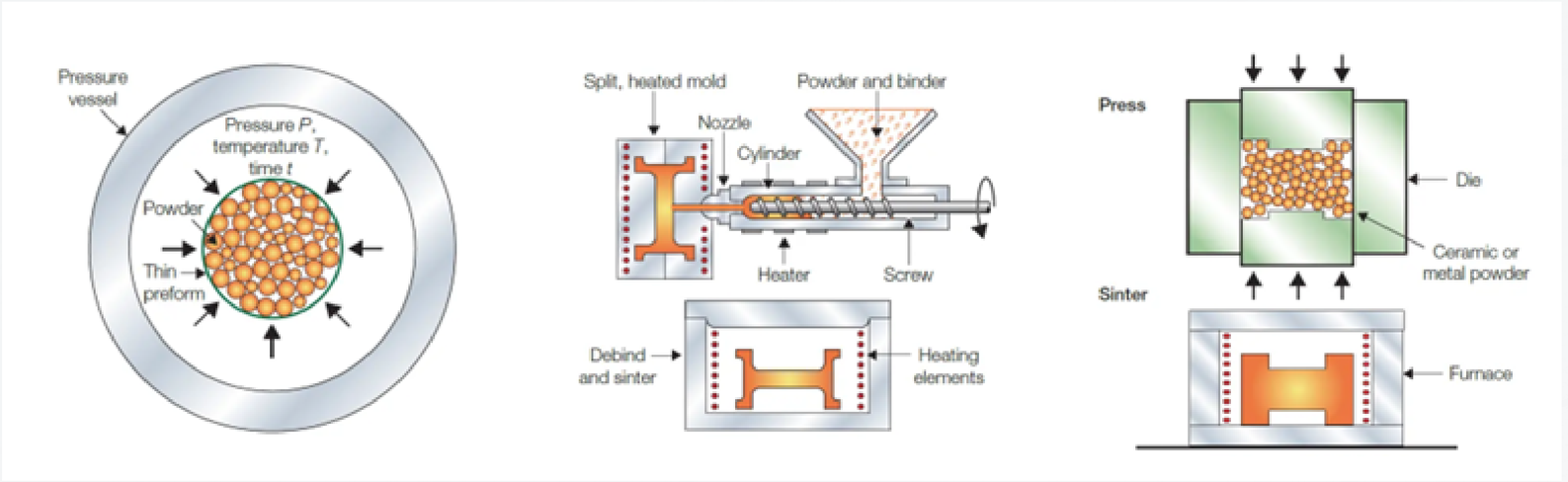


Polymer extrusion(©Michael F Ashby)

- Polymer Extrusion - Forces melted polymer - shaped die- continuous profiles or sheets.
- Compression Moulding - Presses heated polymer to mould high pressure - shape and solidify
- Transfer Moulding - Transfers pre-heated polymer -closed mould cavity for intricate designs
- Thermoforming - Heats plastic sheets-moulds them shapes. Vacuum and Pressure forming

TRADITIONAL MANUFACTURING PROCESSES

Particulate processing – Powder metallurgy



Hot Isostatic pressing

Powder injection moulding (PIM)

Die pressing and sintering(

- PM - Heating Compacted Metal Powders- Temp< MP,Complex 3D Parts
- Metal or Ceramic Powders

TRADITIONAL MANUFACTURING PROCESSES

Particulate processing – Powder metallurgy

- Press & Sinter Process -
  - Compacts Powder to shape , sinters it at high temperatures to bond particles

- Cold Isostatic Pressing (CIP) -
  - uniform pressure,mould submerged in a fluid-dense, isotropic parts.

- Hot Isostatic Pressing (HIP)-
  - High pr & Temp- Densify Powders,Improve Properties

- Powder Injection Molding (PIM)- Powder- Binder Mixture,High Precision Parts

TRADITIONAL MANUFACTURING PROCESSES

Particulate processing – Powder metallurgy

- Metal Injection Moulding (MIM)
  - metal powder mixed with a binder, precision components

- Powder Rolling
  - compresses and elongates powder into sheets,rolling mills at elevated temperatures

- Powder Extrusion
  - forces powder through a die at high temperatures - long shapes or profiles& sintering

- Powder Forging
  - presses powder , forges,heated-density and mechanical properties

TRADITIONAL MANUFACTURING PROCESSES

Particulate processing – Powder metallurgy

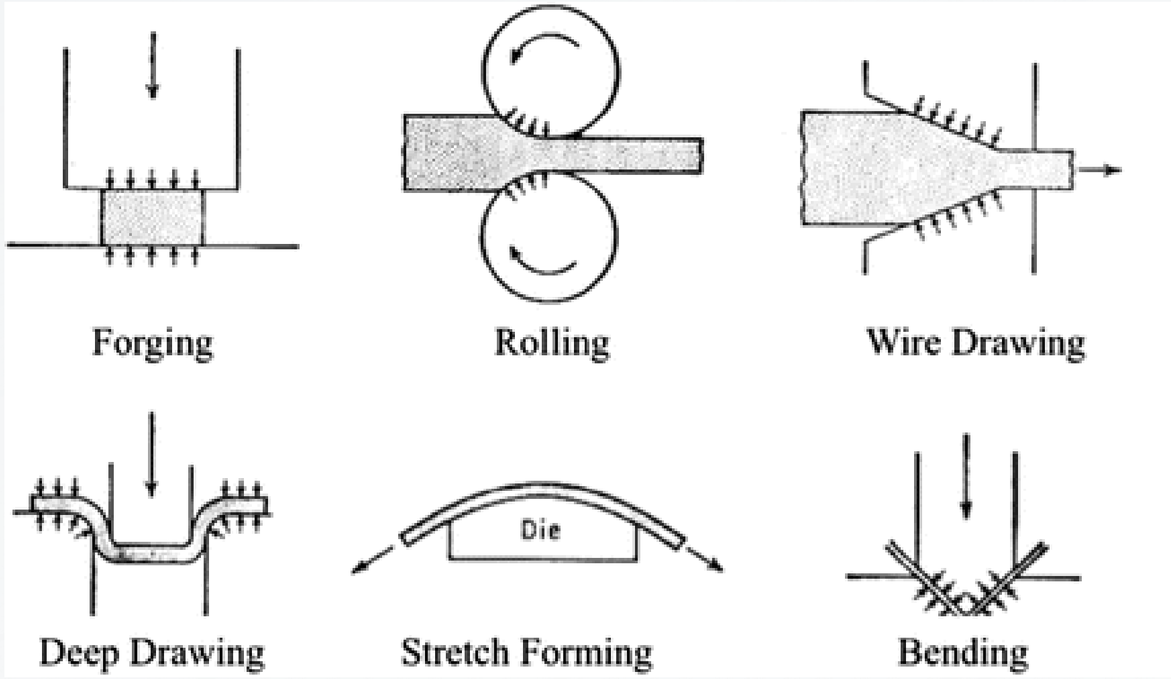
- Hot Pressing
  - compacts powder with heat,dense, solid parts

- Spark Sintering
  - electric current and pressure properties and reducing processing time

TRADITIONAL MANUFACTURING PROCESSES

Metal Forming

- plastic deformation
- malleable metal .
- sufficiently ductile to prevent fracture
- forces larger than the material's yield strength
- mould and deform the workpiece.



Two types of Metal forming

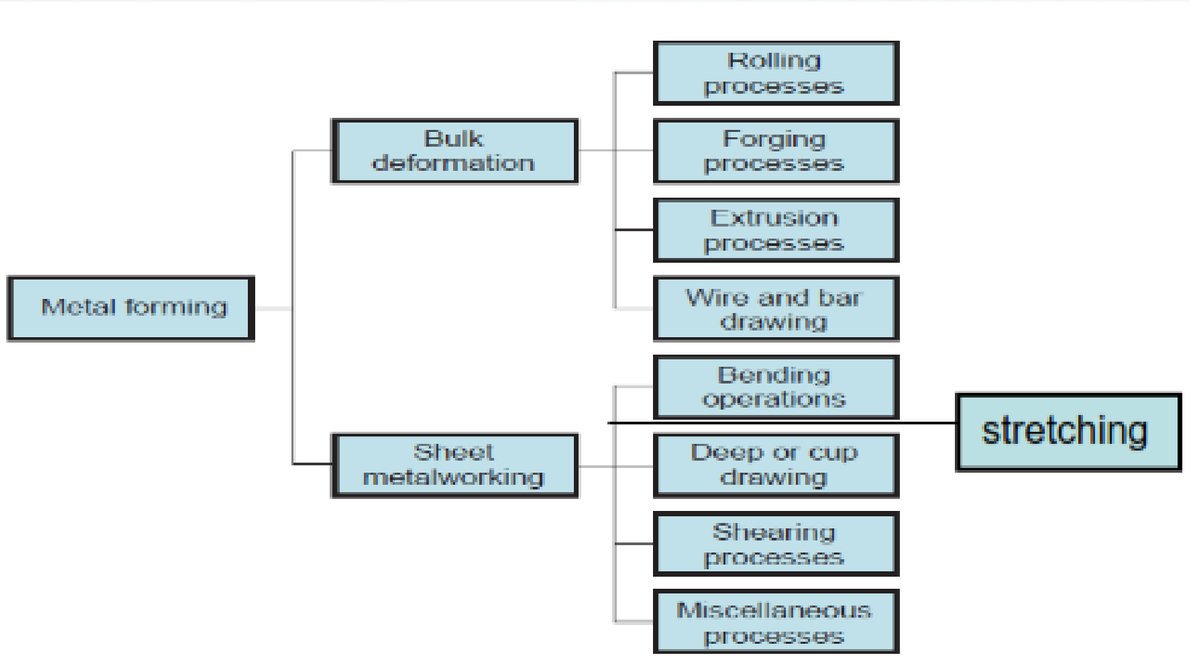
1. **Bulk deformation**
2. **Sheet metalworking or Sheet metal forming**

TRADITIONAL MANUFACTURING PROCESSES

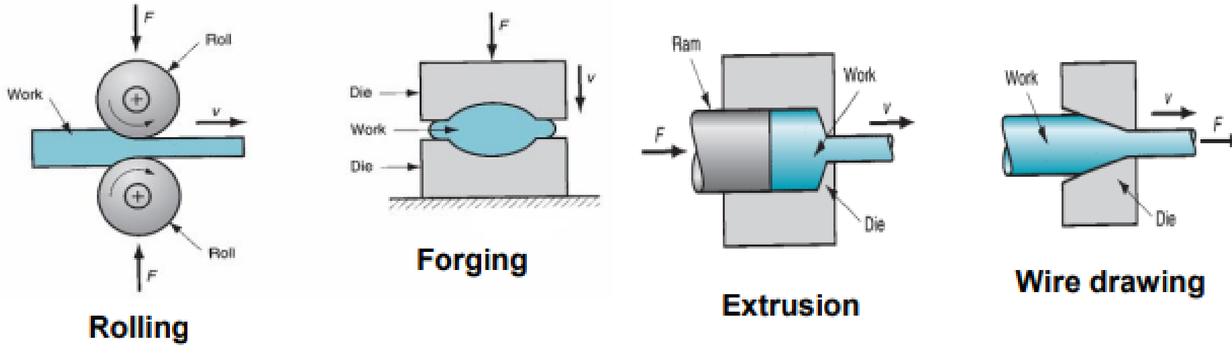
Metal Forming

Bulk deformation processes

- significant deformations and shape changes
- small surface area-to-volume ratio.
- bulk - low area-to-volume ratio.
- Cylindrical billets and rectangular bars .
- heat before forming to a temperature below the MP - ductility



General classification of metal forming processes



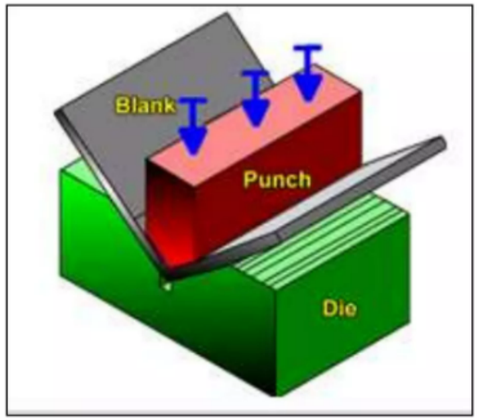
TRADITIONAL MANUFACTURING PROCESSES

Metal Forming

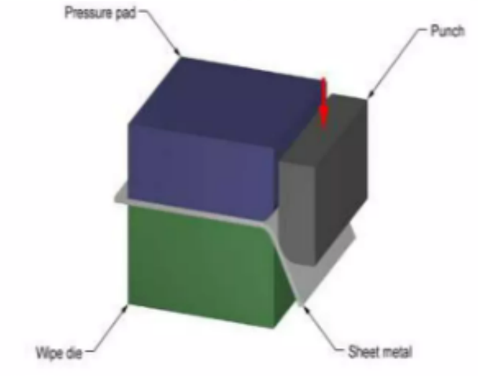
Sheet metalworking

- cutting and forming - thin metal sheets, strips, and coils.
- Bending,
- sheet metal drawing,
- shearing or Cutting

V-Bending



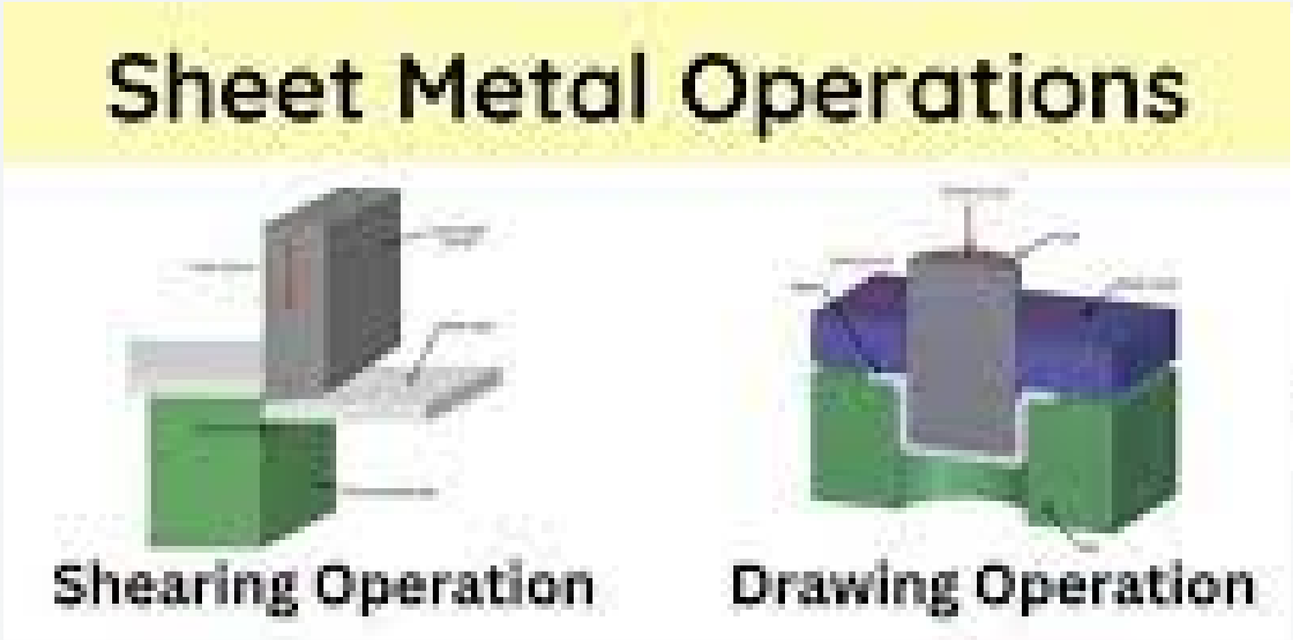
Edge or Wipe Bending



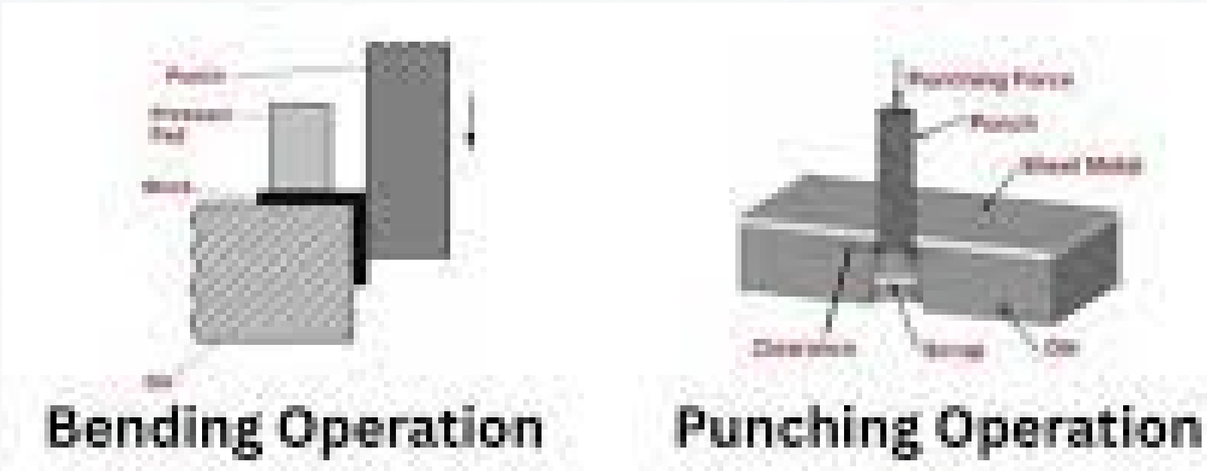
TRADITIONAL MANUFACTURING PROCESSES

Metal Forming

Sheet metalworking

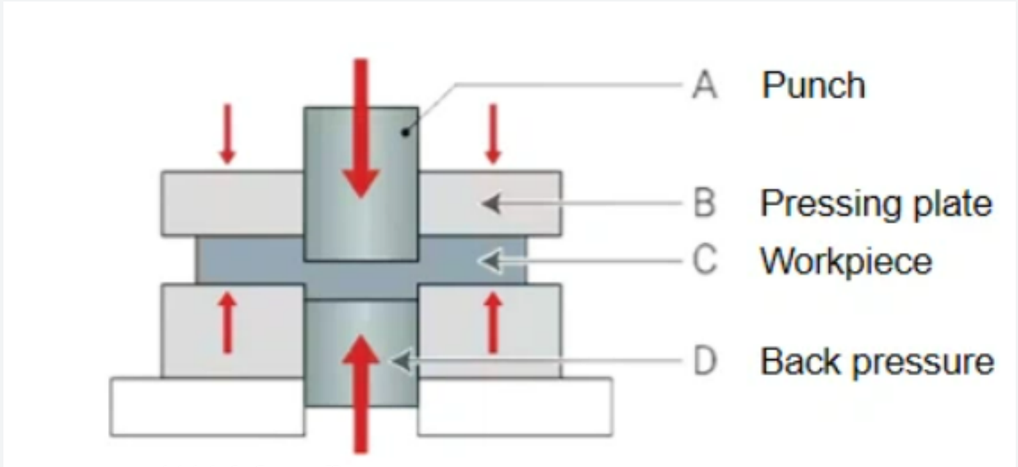


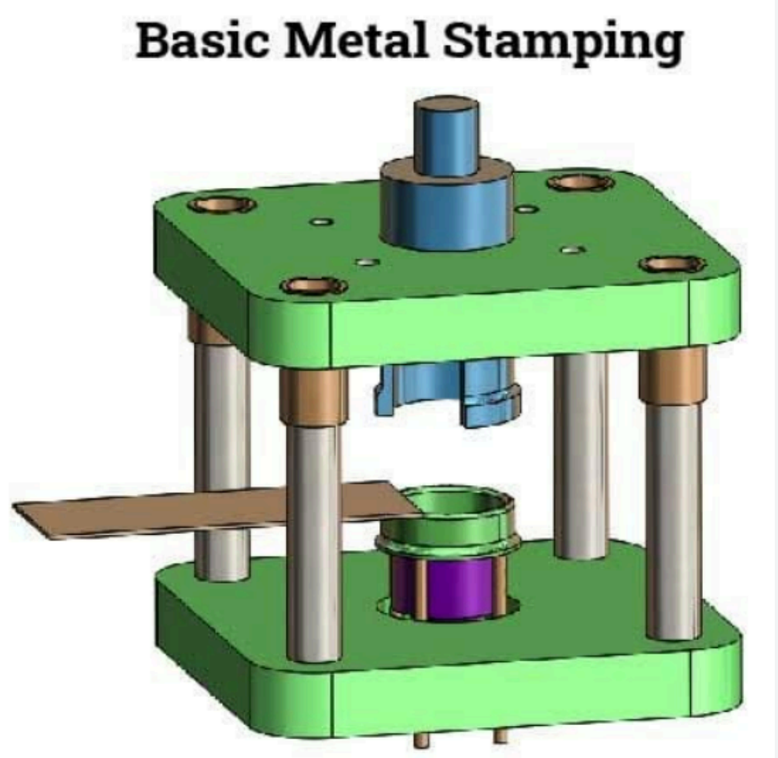




Pressing

- **Shaping Unheated Sheet Metal -Press.**
- **Complex Shapes - Car Body Panels, Aerospace Components, Electronic Enclosures**
- **Stamping Process**
- **Mass Production**
- **Tool and Die surface - metal into the desired shape.**







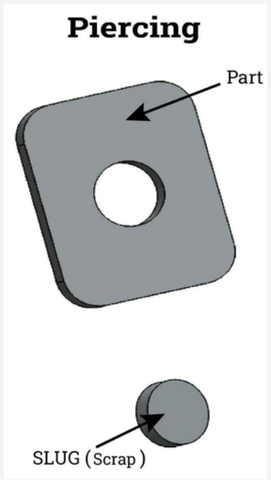
Pressing

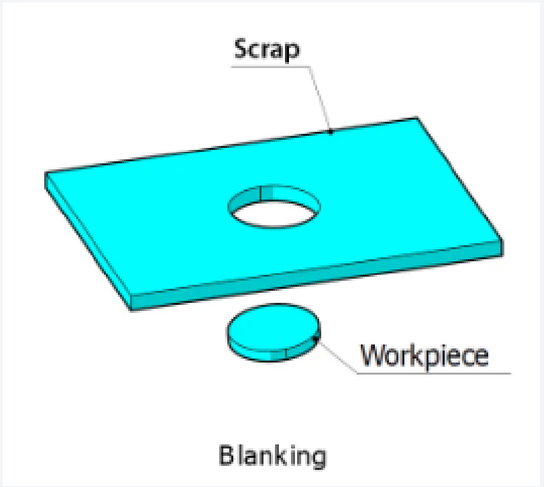
Punching-piece of metal is removed from the workpiece by a punch leaving a hole.

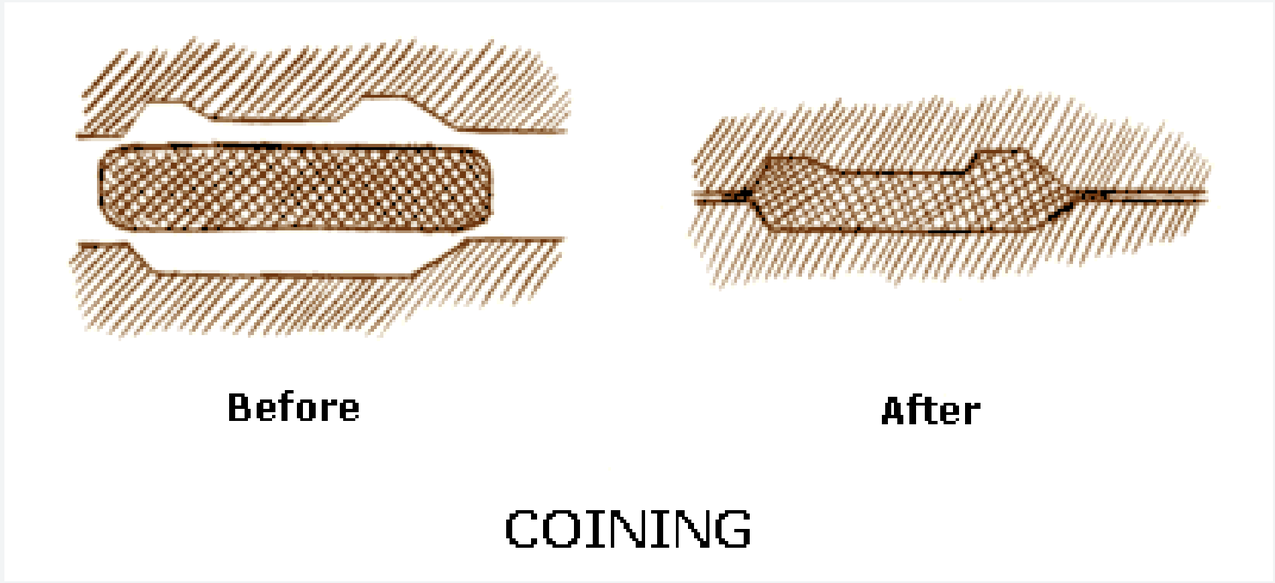
Blanking-workpiece removed from the primary metal,removed metal desired workpiece.

Bending-Metal is deformed or bent into a desired shape, L, U, or V

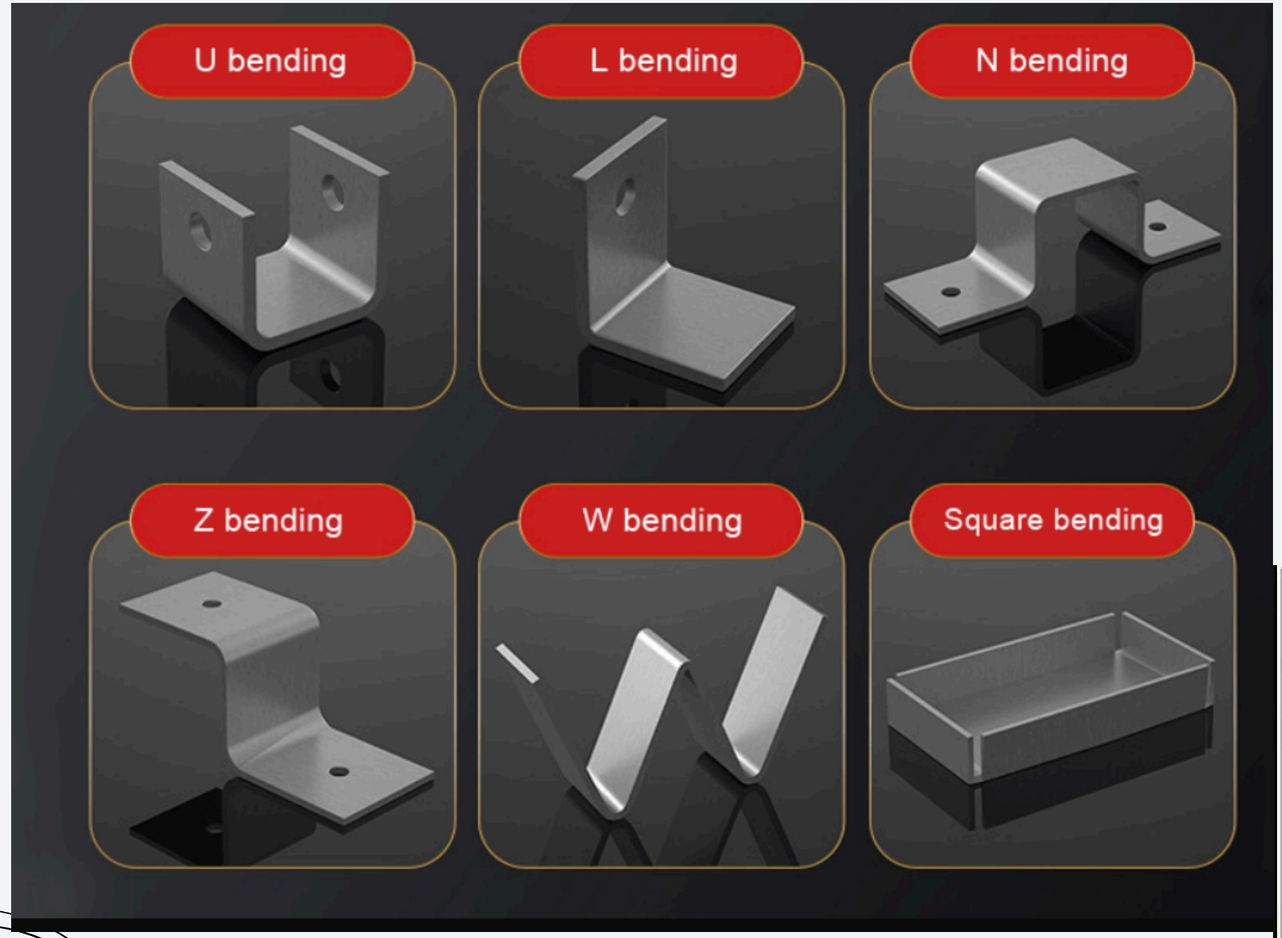
Coining-pattern is compressed into the metal by placing it between a die and a punch. to make coins.

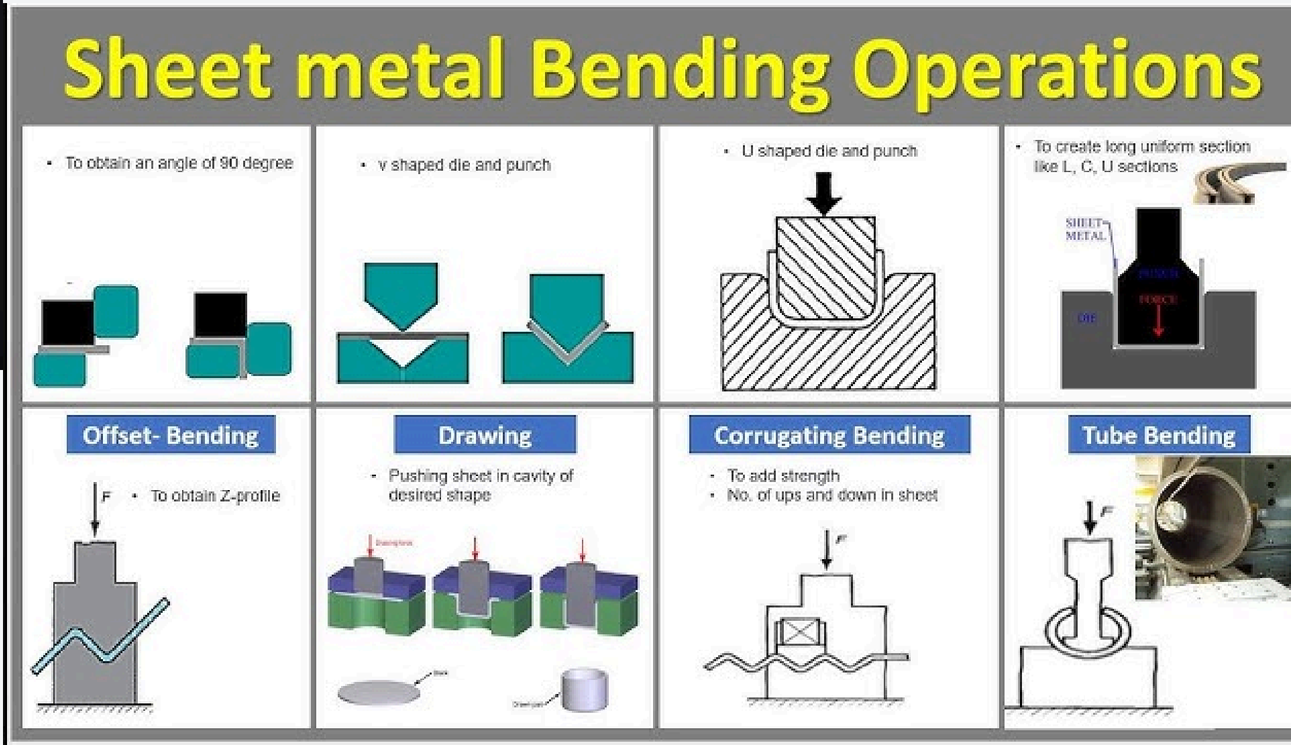






Pressing

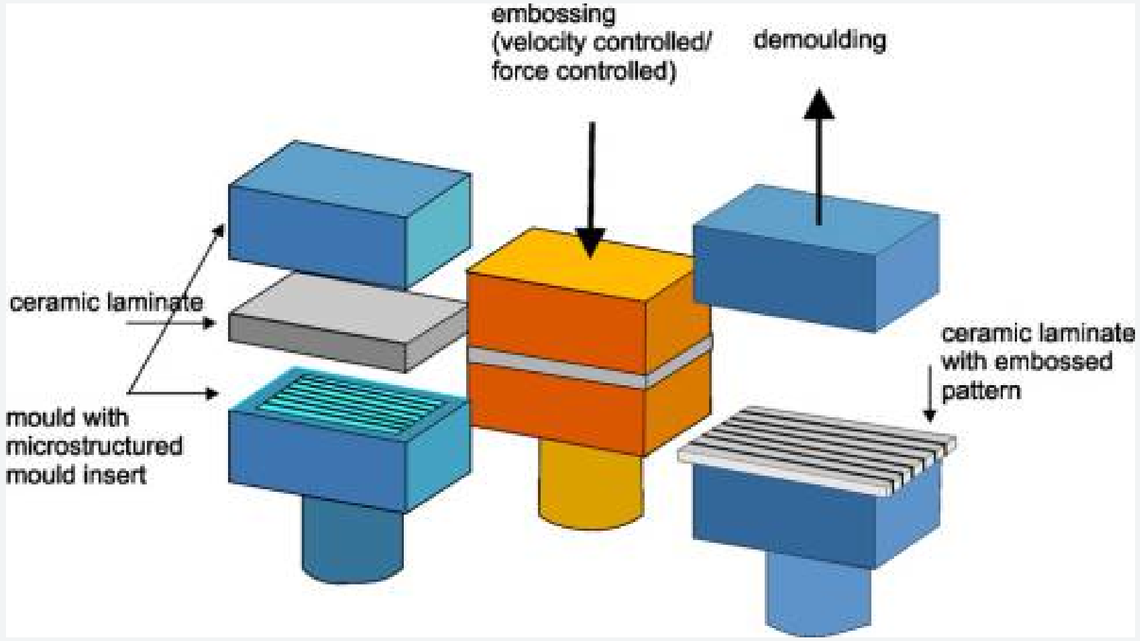

U bending
L bending
N bending
Z bending
W bending
Square bending

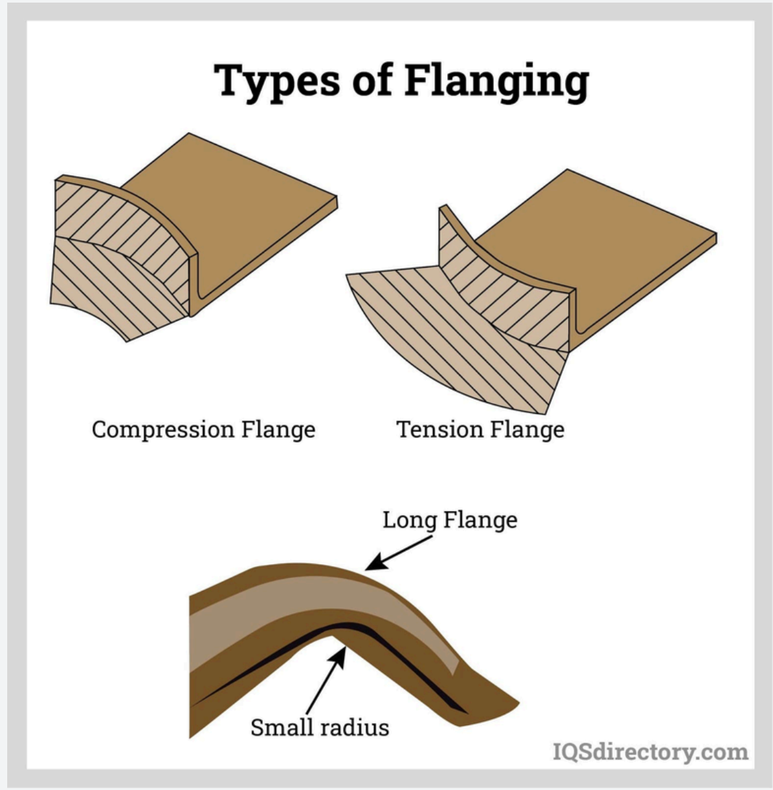

Sheet metal Bending Operations
To obtain an angle of 90 degree
v shaped die and punch
U shaped die and punch
To create long uniform section like L, C, U sections
SHEET METAL
PUNCH
FORCE
DIE
Offset- Bending
F
To obtain Z-profile
Drawing
Pushing sheet in cavity of desired shape
Corrugating Bending
To add strength
No. of ups and down in sheet
Tube Bending

Pressing

Embossing-raised or recessed design in metal -by pressing it against a die with the desired shape- decorative patterns.

Flanging-flange is introduced onto the metal using dies, presses, or specialized flanging machinery.

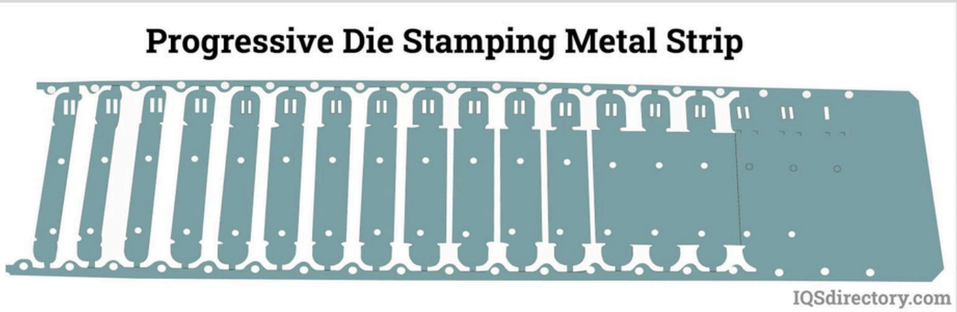




Pressing

Progressive Die Stamping -

- several dies activated
- continuous stream of parts.
- Uniform stress Distribution
- equal distance between them - progression.



ompound Die Stamping -

- strips of steel through a compound die, cuts or punches out a part in one stroke.
- knock-out mechanism ejects the part, msteel strip continues through the die.
- 1000 parts per hour, reducing labor costs and lead times.

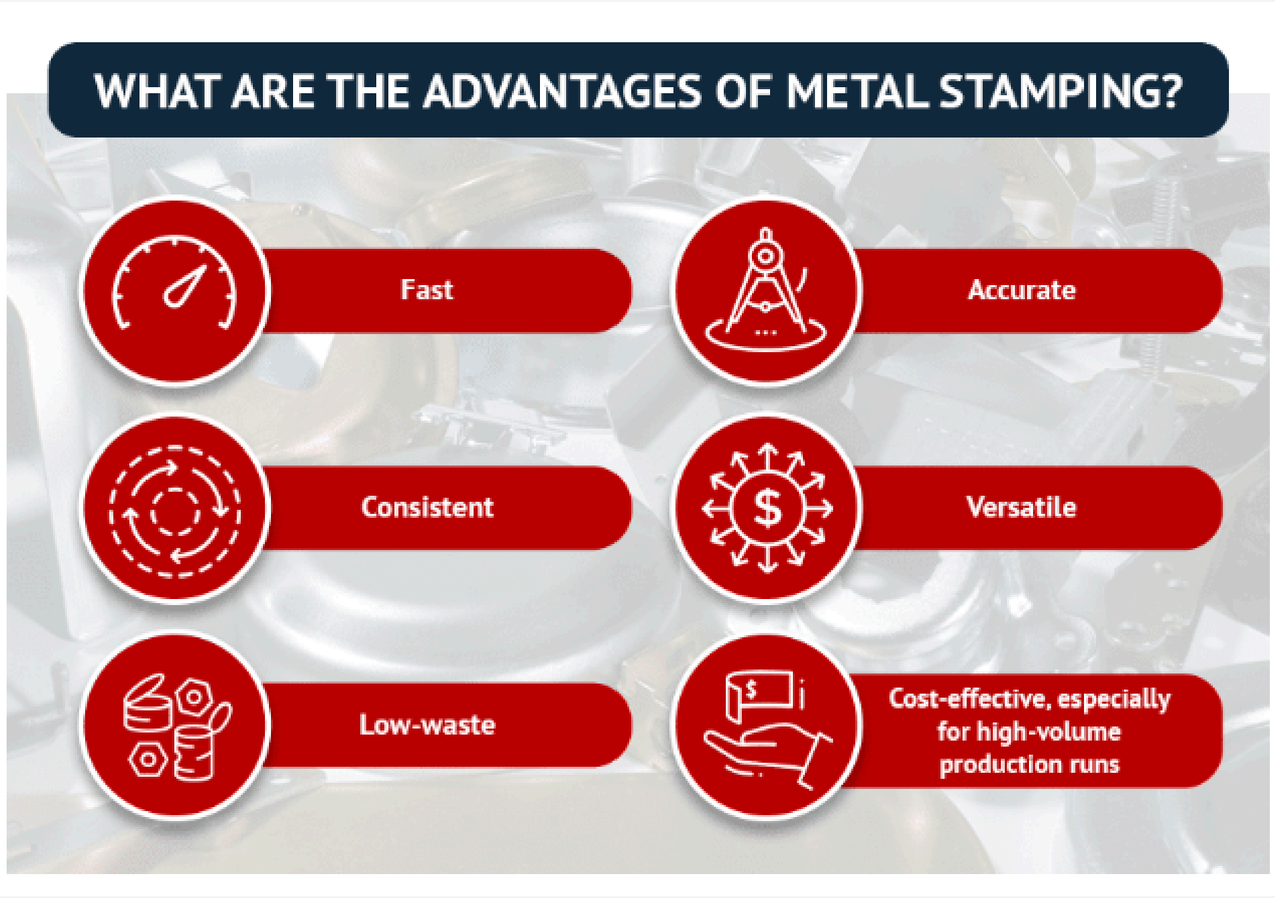
Fourslide Stamping four slides,four different tools, achieve multiple bends simultaneously

Deep Draw Stamping sheet metal blank into the die via a punch, depth of the drawn part exceeds its diameter.

Pressing

Short Run Stamping

- minimal upfront tooling expenses,
- prototypes or small projects,
- combination of custom tooling components and die inserts .
- to bend, punch or drill the part
- projects, fast turnaround



THANK'S

