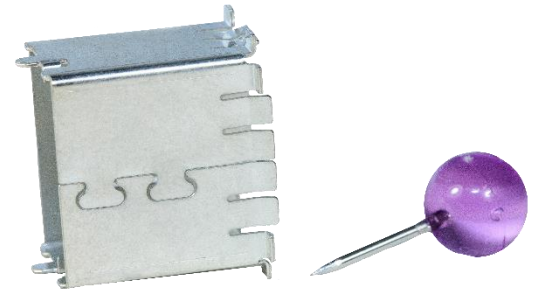


# Sheet Metal Simplified.

By: Mike Tummillo

[mtummillo@prismier.com](mailto:mtummillo@prismier.com)



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# The 2 Golden Rule's of Sheetmetal Parts

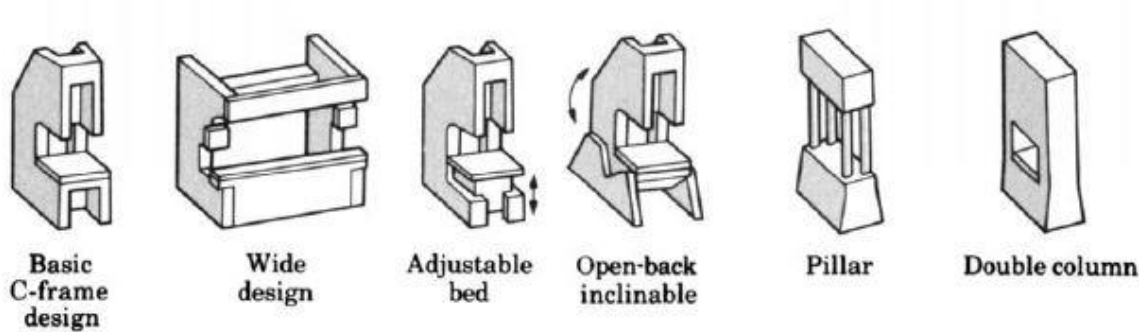
1. Parts are made out of flat stock
  - Sheet, Strip, or Coil Form
2. No matter how complex their final shape may be, the wall thickness must be uniform throughout.



# Metal Stamping or Fabrication?

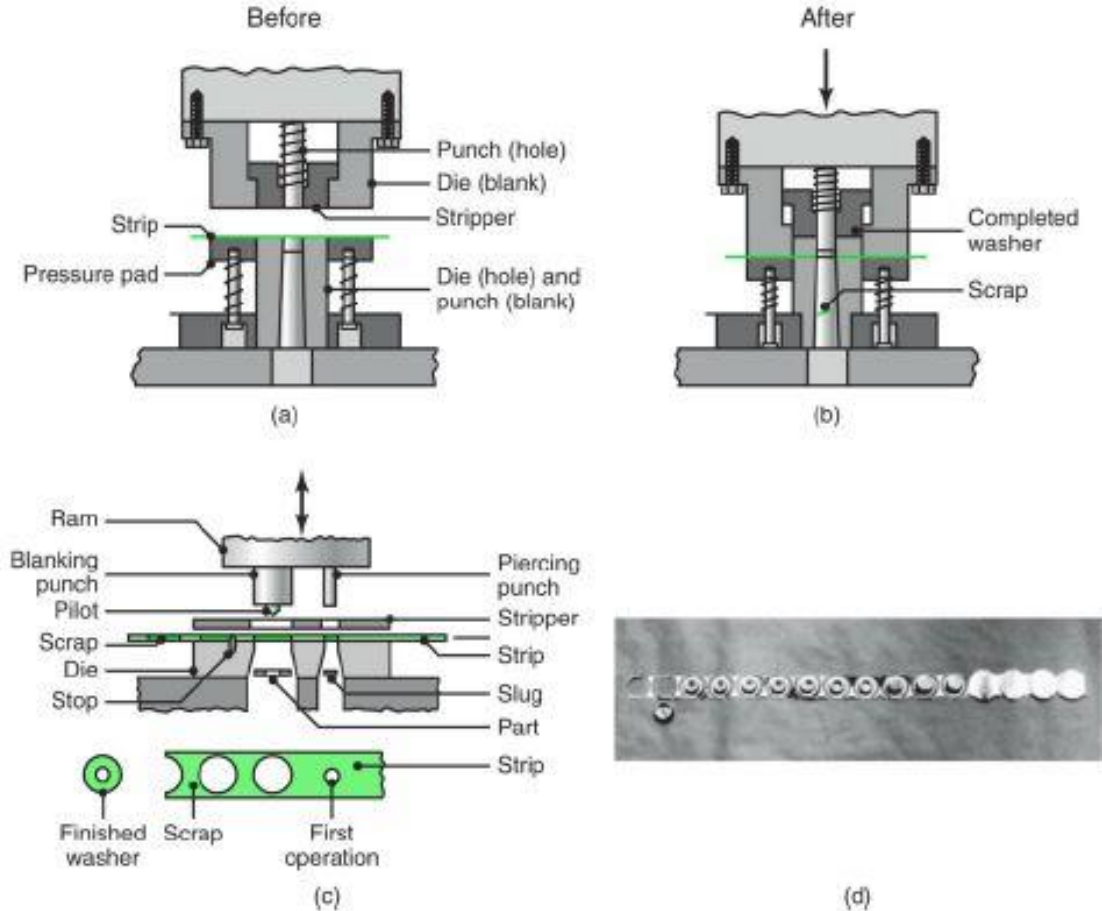


# What is Metal Stamping?



**Metal Stamping** is a process that use dies to transform flat **metal** sheets into shapes.

- Blanking tool
- Piercing tool
- Cut off tool
- Parting off tool
- Trimming tool
- Shaving tool
- Forming tool
- Drawing tool
- Progressive tool
- Compound tool
- Combination tool
- Transfer Tool

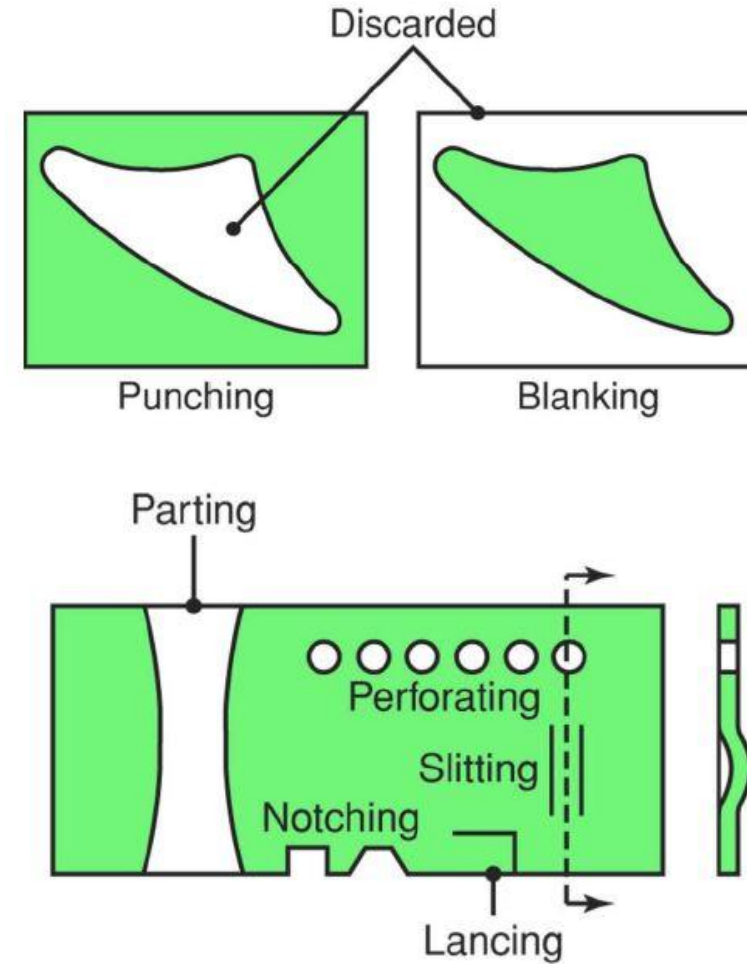
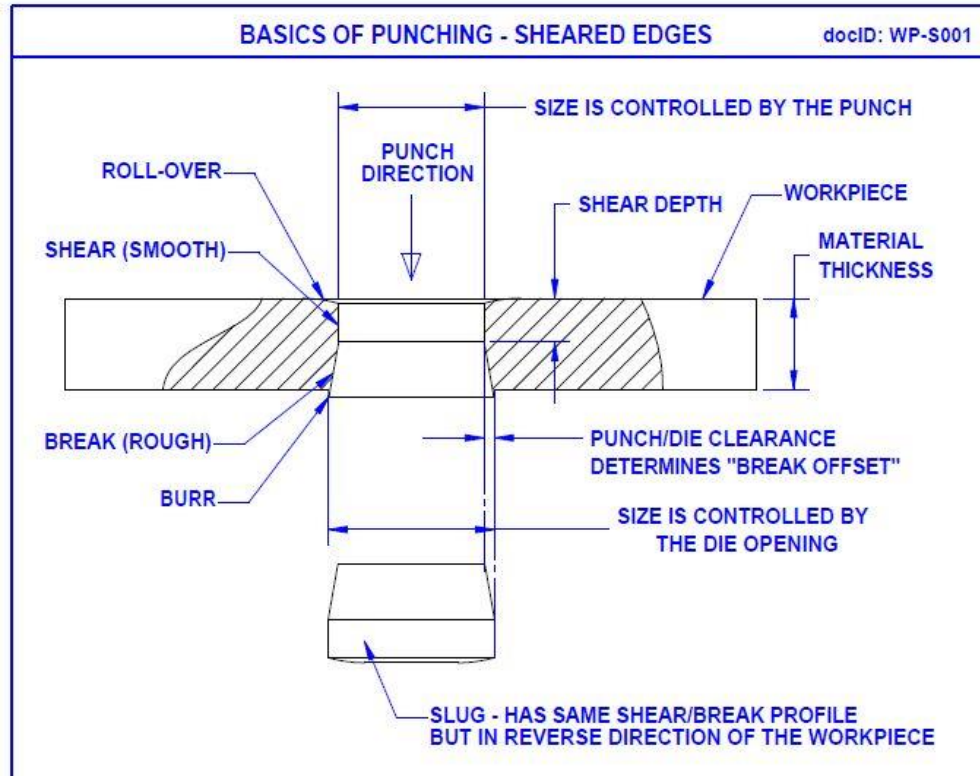


[Stamping Video](#)



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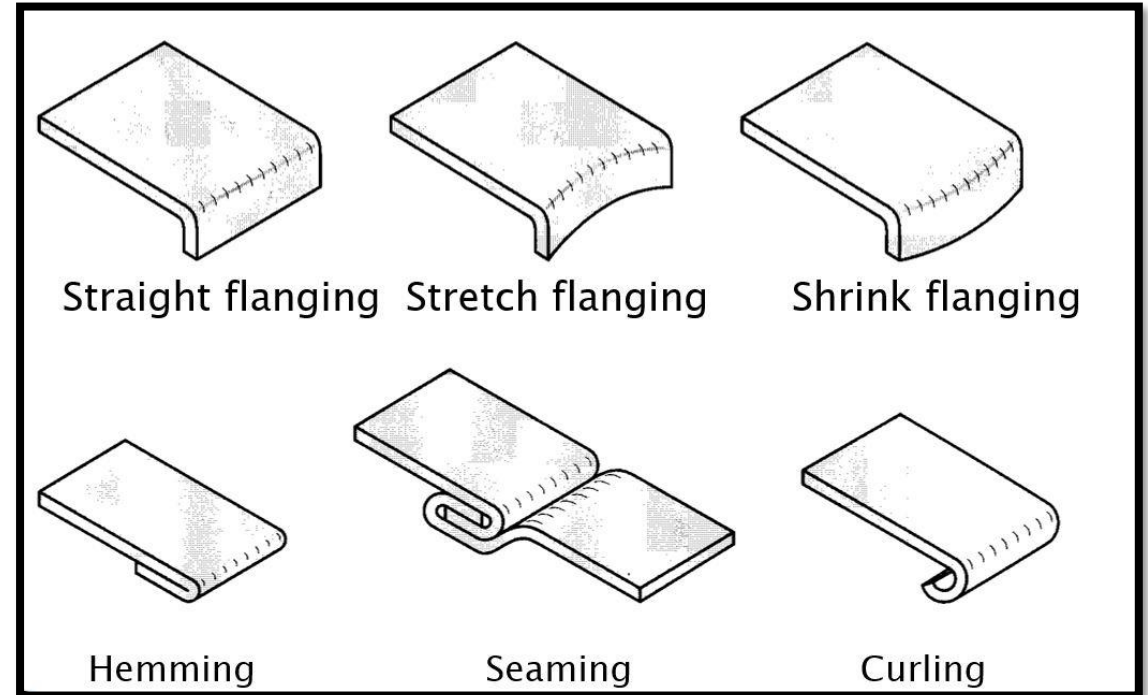
# What is Metal Stamping?





# What is Metal Stamping?

- Bending
- Shearing
- Blanking
- Punching
- Trimming
- Parting
- Slitting
- Lancing
- Notching
- Perforating
- Nibbling
- Embossing
- Shaving
- Cutoff
- Dinking
- Coining
- Deep Drawing
- Stretch Forming
- Roll Forming

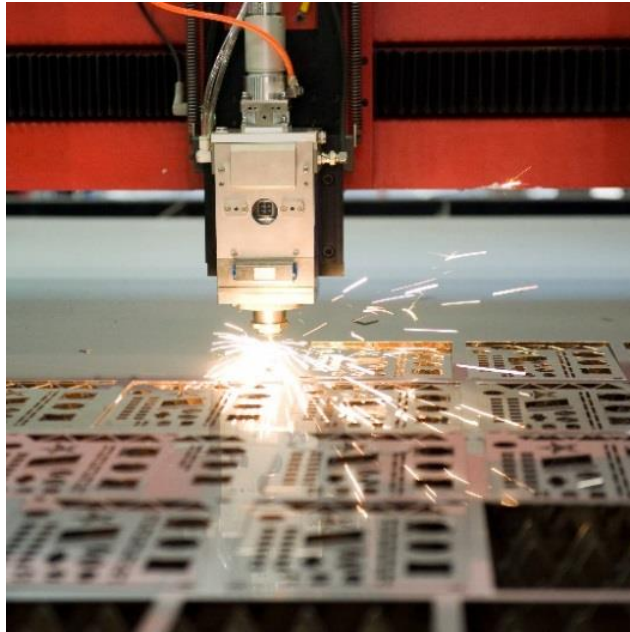


# What is Precision Sheet Metal Fabrication?

The basic **metal fabrication** process forms, shapes and joins **metal** together through the removal or deformation of the material.



[Pem Inserter](#) 0:33



CNC Laser



[CNC Turret](#)



CNC Turret Tooling



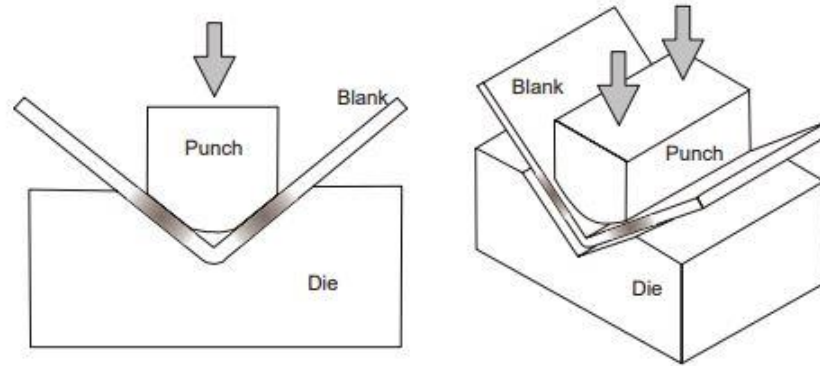
[Press Brake Forming](#)



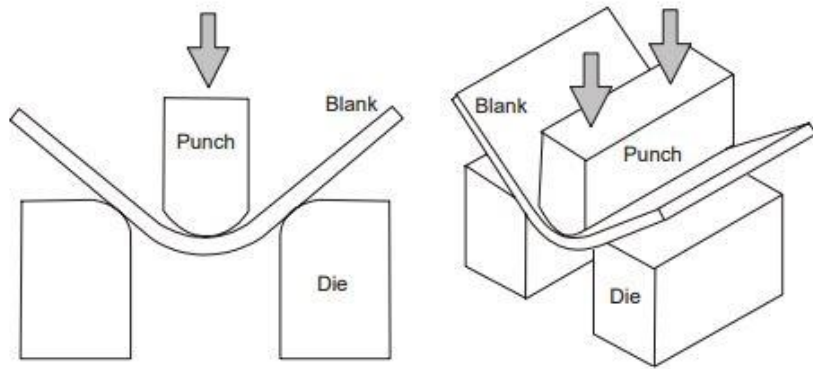
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# What is Precision Sheet Metal Fabrication?

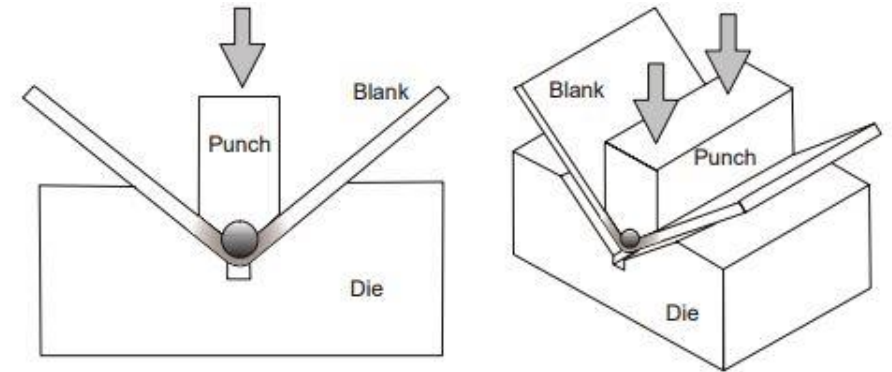
Bottom Bending



Air Bending

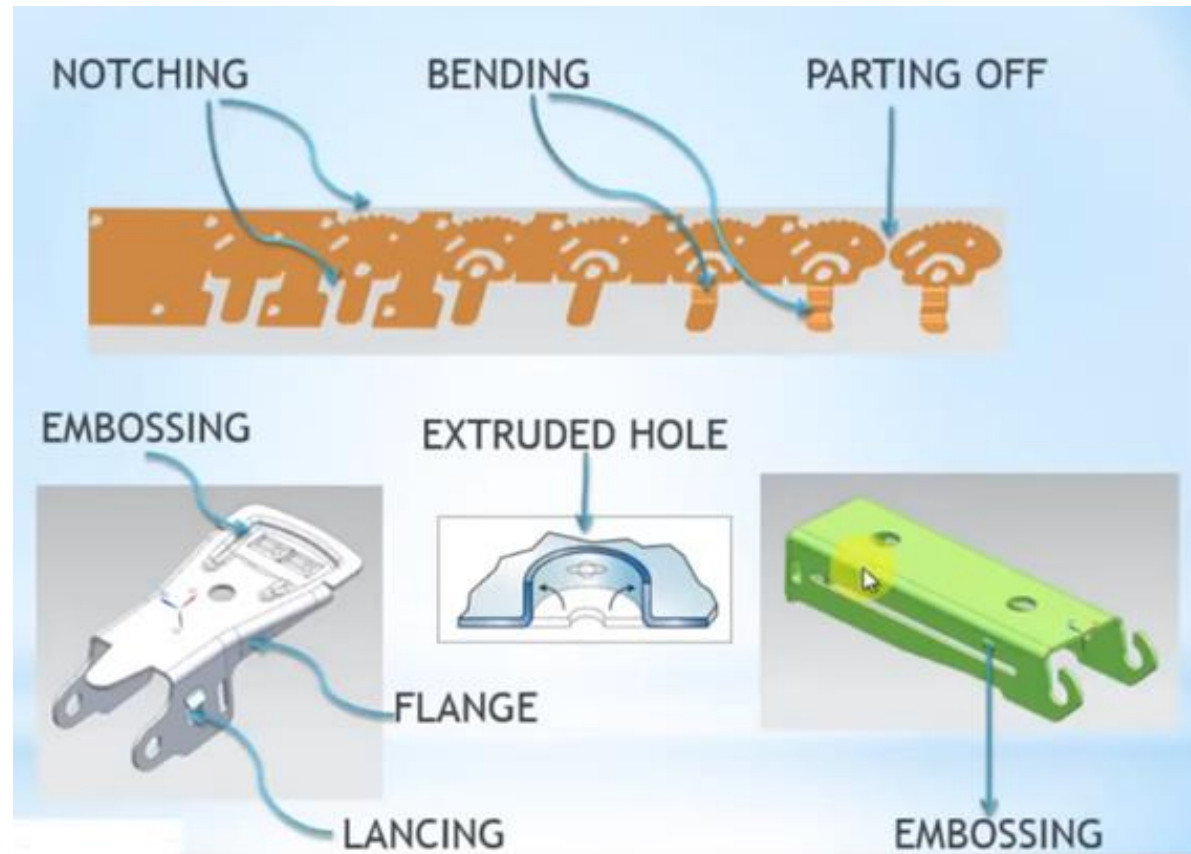


Coin Bending



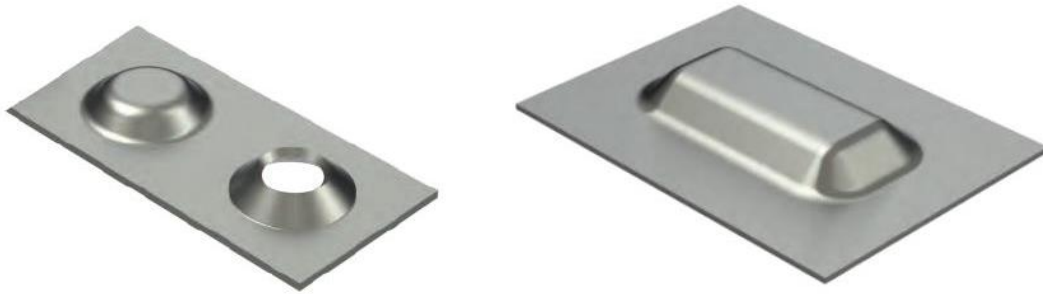


# Common Metal Stamping Features & Manufacturing Considerations



# Common Metal Stamping Features & Manufacturing Considerations

Emboss



Rib

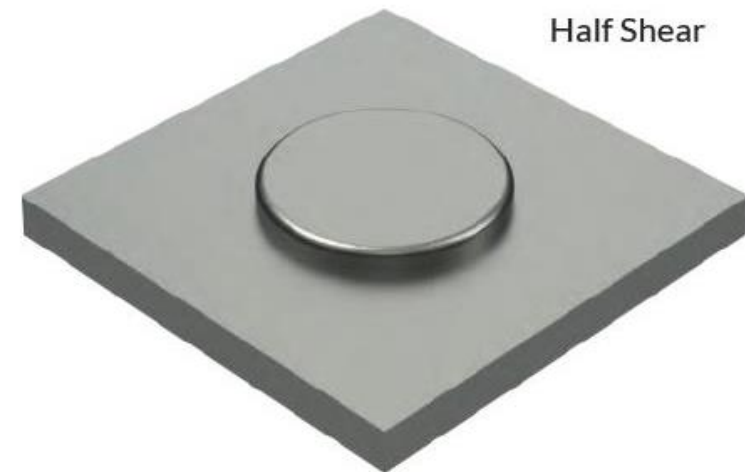


# Common Metal Stamping Features & Manufacturing Considerations

Coined  
Countersink & Counterbore



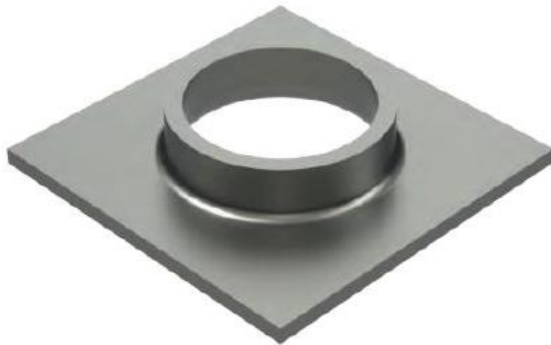
Half Shear/ Half Punch



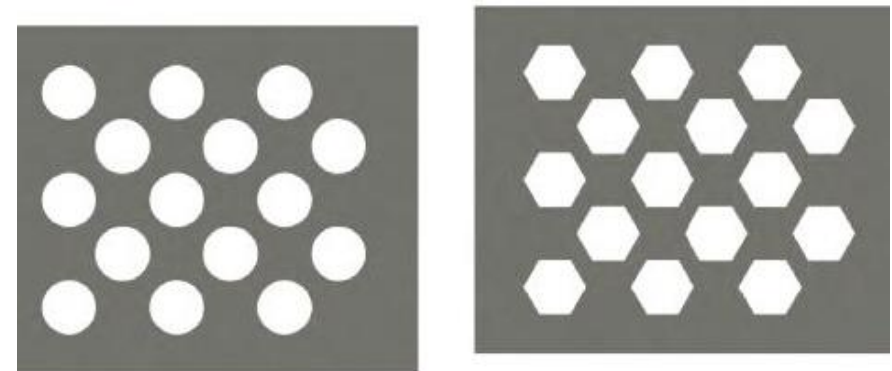
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# Common Metal Stamping Features & Manufacturing Considerations

Extrusion



Cluster Tool

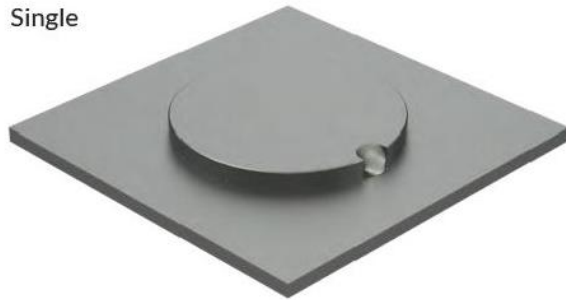




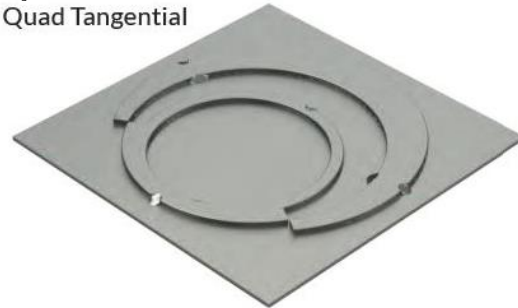
# Common Metal Stamping Features & Manufacturing Considerations

## Electrical Knockouts (Ekos)

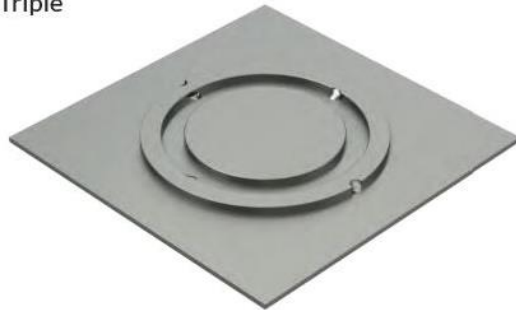
Single



Quad Tangential



Triple



## Louvers



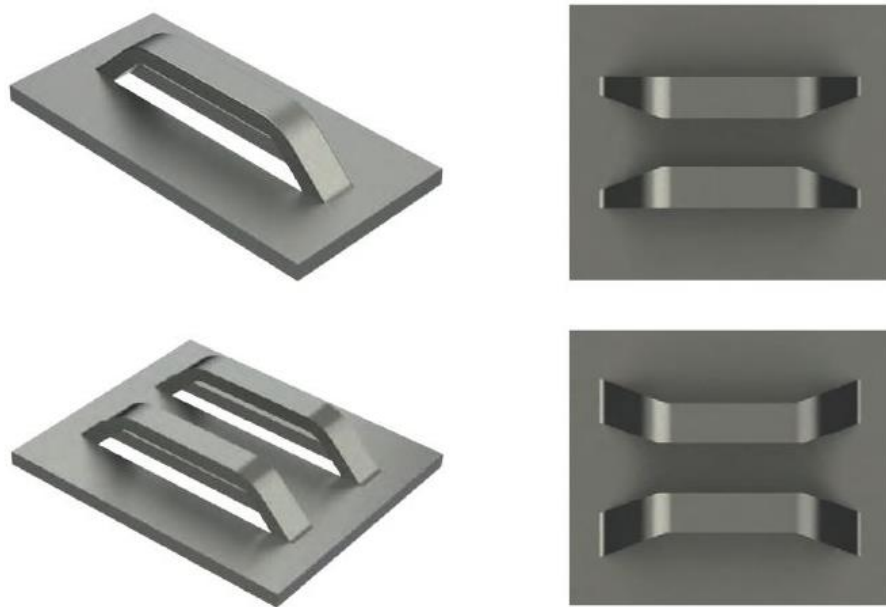
Louvers



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# Common Metal Stamping Features & Manufacturing Considerations

Bridge Lance



Lance/ Share Form

With extra bend



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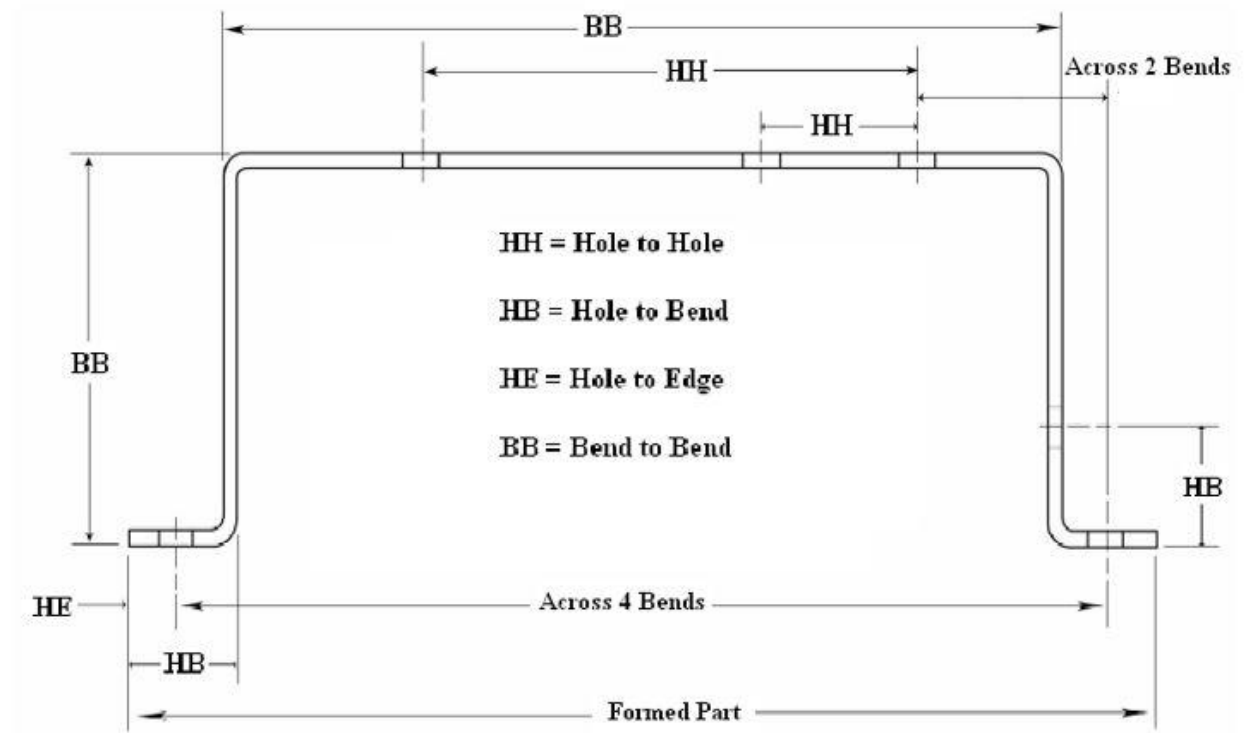
# Common Metal Stamping Features & Manufacturing Considerations

## SHEET METAL TOLERANCES

inches [mm]

Angular	± 1 degree
General dimension	±0.005 [0.12]
General hole diameters	±0.004 [0.10]
Edge to bend across 1 or 2 bends	±0.010 [0.25]
Edge to bend across more than 2 bends	±0.004 x (# of bends) [0.10 x (# of bends)]
Edge to edge across up to 2 bends	±0.015 [0.38]
Edge to edge across more than 2 bends	± 0.005 x (# of Bends) [0.12 x (# of bends)]
Hole center to edge	±0.005 [0.127]
Hole center to bend	±0.008 [0.20]
Hole center to hole center on same plane	±0.005 [0.125]
Press fit hardware center location to edge	±0.008 [0.20]
Press fit hardware center to press fit hardware center	±0.01 [0.25]

Bends are measured at base of bend to remove angular variation.



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# Common Metal Stamping Features & Manufacturing Considerations

## FORMED PARTS Form Heights

Figure 1

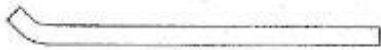
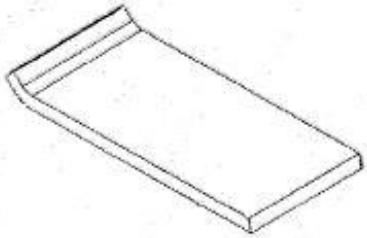
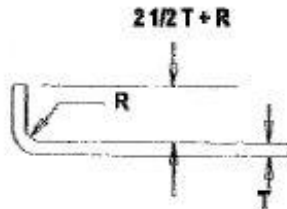
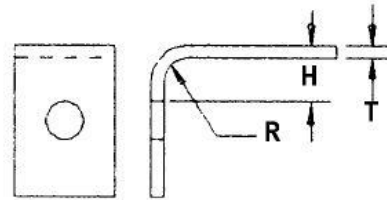


Figure 2

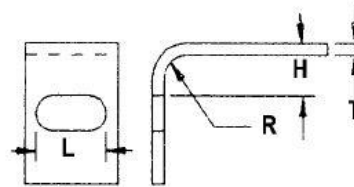


## PUNCHED HOLES Location in Relation to Bends

To maintain punched hole tolerances without distortion, when openings are in close proximity to bends, you should use the following guidelines.



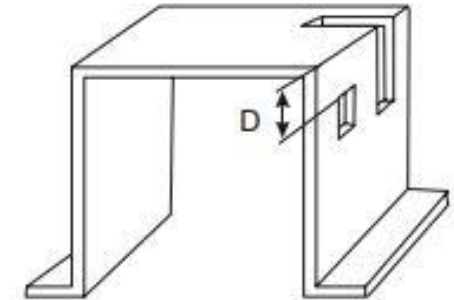
Hole Diameters  
 $H = 1 \frac{1}{2} T + R$



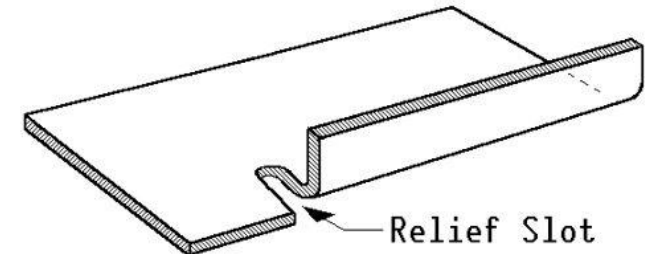
Openings parallel to bend

If "L" is up to 1"  
If "L" is 1" to 2"  
If "L" is 2" or more

$H = 2T + R$   
 $H = 2 \frac{1}{2} T + R$   
 $H = 3 \text{ to } 3 \frac{1}{2} T + R$



$D = 3 \times \text{Thickness} + \text{Bend radius}$



Relief Slot



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# Common Materials, Finishes, & Joining Methods

## Common Raw Materials

- Cold Rolled Steel
- Aluminum
- Stainless Steel
- Galvanized/Galvanealed
- Copper
- Brass
- Considerations
  - Strength Requirements
  - Weight
  - Corrosion Resistance
  - Assembly Process
  - Cost



## Common Finishes

- Powder Coat Paint
- Zinc Plating
- Anodizing
- Chromate Conversion
- Tin Plating
- Nickel Plating
- Considerations
  - Sheet Metal material type
  - Corrosion resistance requirement
  - Product aesthetics requirements
  - Conductivity requirements



## Common Joining Methods

- Pem Inserts w/Machine Screws
  - Nuts, Standoffs, & Studs
- Welding
  - Arc Welding
  - GAS Welding
  - Inert Gas Welding (MIG and TIG)
  - Electron Beam
  - Laser Welding
  - Spot / Seam Welding
- Riveting
- Extruded Hole w/Self Tapping Screws or Tapping



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# Fabrication

## Laser, Turret, & Press Brake

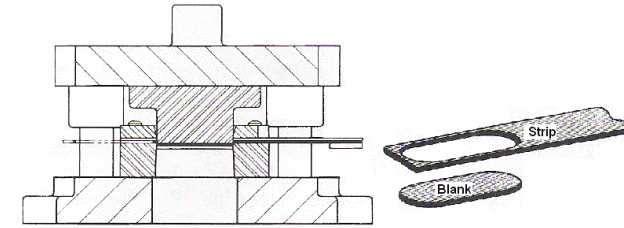
- Minimal to NO tooling Cost
- Typical Volumes >2000 EAU
- Prototypes
- Low Volume – High Mix
- Flexibility through Design Process
- Start Up to Ramp Up
- Pilot Run/Pre-Production
- Larger Parts
- Raw Material comes in Sheet
  - 4x8 ft or 5x10 ft
- Typical Leadtime:
  - Proto – a few days to 2 weeks
  - Production – 3 to 6 weeks
- Higher Part Price



# Stamping

## Dedicated Stage Tooling

- Low Tooling Cost
- Typical Volumes of 2000+ EAU
- One Time Tooling Charge
- One Tool per Operation
- Pierce – Blank – Form
- Raw material in Strip
- Leadtime – 3 to 6 weeks FOT
- Moderate Piece Part Cost



## Progressive Die Tooling

- Higher Tooling Cost
- Typical Volumes of 50,000+ EAU
- One tool for all Operations
- Coil Material
- Lead-time – 5+ weeks FOT
- Lowest Piece Part Cost



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# Choosing a Stamping & Fabrication Supplier

- Personality/ Team
- Believe in & understand your product/ goals
- One supplier to do both:
  - Prototype and Production (Learning Curve)
- Dedicated Engineering & Quality
- Knowledge
- Speed
- Flexibility
- Relationship
- Technology & Capabilities
- Current Customers
- Pretty doesn't always mean good
  - Housekeeping is critical
- Must work in CAD
  - Work in 3D
  - Work without 2D for Proto
- Systems
  - ERP - Estimating – Routing
  - Quality – ISO - APQP
- Supply Chain Management
- Inventory Management



# Cost Drivers in Metal Stamping & Fabrication

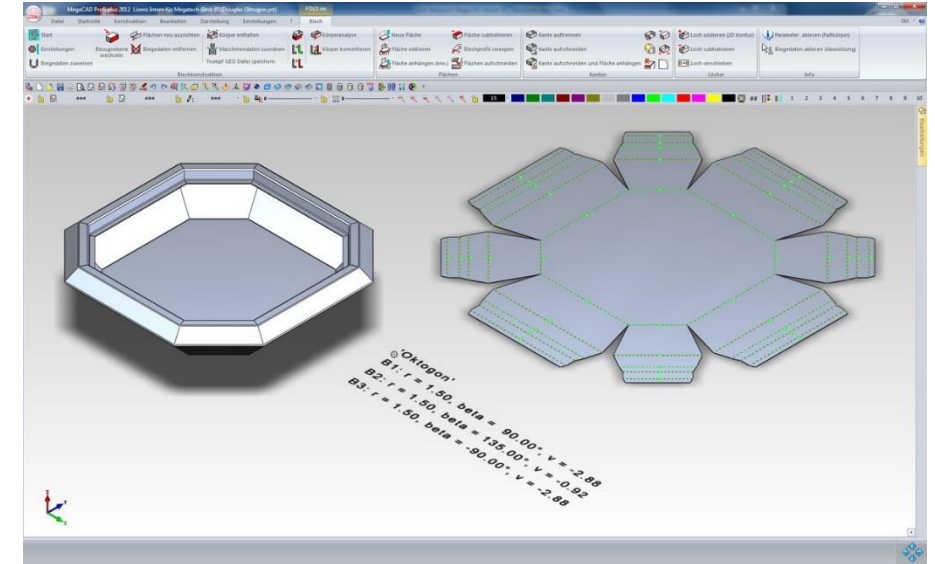
- Raw material
  - Uncommon Thickness/gage
  - Commercially unavailable/ non stocked
- Tolerance & Quality Requirements
  - Too many critical to function dimensions
  - Over/Under Dimensioned
  - Improper use of geometric tolerancing
  - Unrealistic flatness, parallelism, perpendicularity, etc.
  - Excessively tight tolerancing
- Supplier Capabilities
  - Pushing Documented Manufacturing Limits.
- Finishes
  - Not Typical/ Exotic
  - Not Defined/ Unrealistic Cosmetic Requirements
- Part Design
  - Unable to Unfold/ Designed as a Solid
  - Model Crashes
  - Lack of Early Supplier Involvement
    - DFM – DFA
- Supplier Choice
  - Bait & Switch
  - Solutions Provider, not just a parts maker





# Utilize the CAD Tools

- Modeled parts should:
  - Fold/unfold
  - Not have overlaps in flat
  - Clearance for cuts and flanges (no edge on edge designs)
  - Not violate CAD construction warnings
  - Utilize hole wizards whenever possible
  - Call out CTQ dimensions & tolerances in the 3D model
  - Model required weld locations and type
  - Utilize slot & tab designs to control locations and tolerance stacks



# In Summary

Bottom Line: With a better understanding of the processes and the right partner, you can better design parts to minimize scrap, create cost savings, and increase production speed without ever sacrificing quality.



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# Thank you

Questions?



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