Stamping Overview

The operations associated with stamping are blanking, piercing, forming, and drawing.

These operations are done with dedicated tooling also known as *hard tooling*. This type of tooling is used to make high volume parts of one configuration of part design. (By contrast, *soft tooling* is used in processes such as CNC turret presses, laser profilers and press brakes). All these operations can be done either at a single die station or multiple die stations — performing a progression of operations, known as a *progressive die*.

Equipment Types

The equipments of stamping can be categorized to two types: mechanical presses and hydraulic presses.

Mechanical Presses: Mechanical presses have a mechanical flywheel to store the energy, transfer it to the punch and to the work piece. They range in size from 20 tons up to 6000 tons. Strokes range from 5 to 500 mm (0.2 to 20 in) and speeds from 20 to 1500 strokes per minute. Mechanical presses are well suited for high-speed blanking, shallow drawing and for making precision parts.

Hydraulic Presses: Hydraulic Presses use hydraulics to deliver a controlled force. Tonnage can vary from 20 tons to 10,000 tons. Strokes can vary from 10 mm to 800 mm (0.4 to 32 in). Hydraulic presses can deliver the full power at any point in the stroke; variable tonnage with overload protection; and adjustable stroke and speed. Hydraulic presses are suitable for deep-drawing, compound die action as in blanking with forming or coining, low speed high tonnage blanking, and force type of forming rather than displacement type of forming.

Tooling Considerations

Optimum clearance (total = per side × 2) should be from 20 to 25% of the stock thickness. This can be increased to 30% to increase die life.

Punch life can be extended by sharpening whenever the punch edge becomes 0.125 mm (0.005 in) radius. Frequent sharpening extends the life of the tool, cuts down on the punch force required. Sharpening is done by removing only 0.025 to 0.05 mm (0.001 to 0.002 in) of the material in one pass with a surface grinder. This is repeated until the tool is sharp. If it is done frequently enough, only 0.125 to 0.25 mm (0.005 to 0.010 in) of the punch material is removed.

Grinding is to be done with the proper wheel for the tool steel in question. Consult with the abrasive manufacturer for proper choice of abrasive material, feeds and speeds, and coolant.

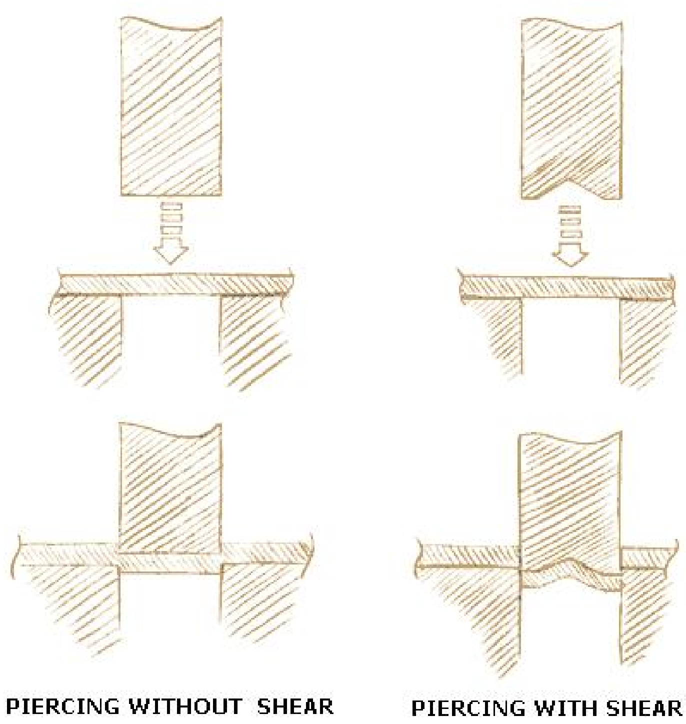
After sharpening the edge is to be lightly stoned to remove grinding burrs and end up with a 0.025 to 0.05 mm (0.001 to 0.002 in) radius. This will reduce the chance of chipping.

Punching Force: Punching can be done without shear or with shear.

- **Punching without shear.** This is the case where the entire punch surface strikes the material square, and the complete shear is done along the entire cutting edge of the punch at the same time. Punching Force = Punch Perimeter × Stock thickness × Material Shear Strength.

  e.g.,
  Punch Diameter = 25 mm (1 in),
  Circumference = 78.54 mm (3.092 in)
  Thickness = 1.5 mm, (0.060 in)
  Material Shear Strength (Steel) = 0.345 kN/mm^2 (25 tons/in^2)
  Punching Force = 78.54 × 1.5 × 0.345 (3.09 × 0.060 × 25)
  = 40.65 kN (4.64 tons)
  = 4.14 Metric Tons (4.64 US Tons)

  Punching with shear. This is the case where the punch surface penetrates the material in the middle, or at the corners, first, and as the punch descends the rest of the cutting edges contact the material and shear the material. The distance between the first contact of the punch with the material, to when the whole punch starts cutting, is the Shear Depth. Since the material is cut gradually (not all at the same time initially), the tonnage requirement is reduced considerably.



The Punching Force calculated above is multiplied by a shear factor, which ranges in value form 0.5 to 0.9 depending on the material, thickness, and shear depth. For shear depths of 1.5 mm (0.060 in) the shear factor ranges from 0.5 (for 1.2 mm / 0.047 in stock) to 0.9 (for

6.25 mm / 0.25 in stock). For shear depth of 3 mm (0.120 in) the shear factor is 0.5.
Punching Force = Punch Perimeter × Stock thickness × Material Shear Strength × Shear Factor.
Since shear factor is about 0.5, the Punching Force is reduced by about 50%.

For the same example above,
Punching Force = 78.54 × 1.5 × 0.345 (3.09 × 0.060 × 25) × 0.5 (Shear Factor)
= 40.65 kN (4.64 tons) × 0.5
= 2.07 Metric Tons (2.32 US Tons)

2005 Source: efunda.com