Blanking - Punching

1. A blanking die is to be designed to blank the part outline shown in the figure below. The material is 4 mm thick stainless steel (the allowance for the stainless steel is $a = 0.075$). Determine the dimensions of the blanking punch and the die opening.

**Solution:**

Since $a = 0.075$, the clearance is given by,

$$c = 0.075 \times 4 = 0.3 \text{ mm}.$$ 

**Blanking die dimensions:** the same as for the part in the figure:

$L = 85 \text{ mm} \quad w = 50 \text{ mm} \quad t = 25 \text{ mm} \quad s = 25 \text{ mm}$

**Blanking punch dimensions:**

Length $L = 85 - 2(0.3) = 84.4 \text{ mm}$

Width $w = 50 - 2(0.3) = 49.4 \text{ mm}$

Top and bottom $t$ widths $= 25 - 2(0.3) = 24.4 \text{ mm}$

The $s = 25 \text{ mm}$ inset dimension remains the same.
2. A **compound die** will be used to blank and punch a **large washer** out of 6061ST aluminum alloy (the allowance is $a = 0.06$), sheet stock **3.50 mm thick**. The **outside diameter** of the washer is **50 mm** and the **inside diameter** is **15 mm**. Determine (a) the punch and die sizes for the blanking operation, and (b) the punch and die sizes for the punching operation.

![Diagram of a washer with dimensions](image)

**Solution:**

Since $a = 0.06$, the clearance is given by,

$$c = 0.06 \times (3.5) = 0.21 \text{ mm}$$

(a) **Blanking punch diameter** = $D_b - 2c = 50 - 2(0.21) = 49.58 \text{ mm}$

Blanking die diameter = $D_b = 50 \text{ mm}$

(b) **Punching punch diameter** = $D_h = 15 \text{ mm}$

Punching die diameter = $D_h + 2c = 30 + 2(0.21) = 15.42 \text{ mm}$
3. A blanking operation is to be performed on **2 mm thick** cold rolled steel. The part is circular with **diameter = 75 mm**. Determine: 

a) the appropriate punch and die sizes for this operation if the allowance for the cold rolled steel is **\( a = 0.075 \)**. 

b) the blanking force required if the steel has a **shear strength = 325 MPa** and the **tensile strength is 450 MPa**

**Solution:**

(a) Since \( a = 0.075 \), the clearance is given by, 

\[
c = 0.075 \times 2 = 0.15 \text{ mm}.
\]

Thus the Punch diameter \( D_p \) is calculated as 

\[
D_p = D_b - 2c = 75.0 - 2(0.15) = 74.70 \text{ mm}.
\]

and the Die diameter is \( D_b = 75 \text{ mm} \).

(b) the blanking force is given by 

\[
F = S t L
\]

The thick of the metal stock \( t \) is given by the problem as \( t = 2 \text{ mm} \)

The length of cut edge is calculated as: 

\[
L = \pi D = 75\pi = 235.65 \text{ mm}
\]

Thus the blanking force is 

\[
F = 325 \times 2 \times (235.65) = 153,200 \text{ N}
\]
Deep drawing

A cup is to be drawn in a deep drawing operation. The height of the cup is 75 mm and its inside diameter = 100 mm. The sheet metal thickness = 2 mm. If the blank diameter = 225 mm, determine (a) drawing ratio, (b) reduction, and (c) thickness-to-diameter ratio. (d) Does the operation seem feasible?

Solution:

(a) Drawing ratio \[ DR = \frac{D_b}{D_p} = \frac{225}{100} = 2.25 \]

(b) Reduction \[ r = \frac{(D_b - D_p)}{D_b} = \frac{(225 - 100)}{225} = 0.555 = 55.5\% \]

(c) Thickness-to-diameter ratio \[ t/D_b = 2/225 = 0.0089 = 0.89\% \]

(d) Feasibility? No!

\[ DR \] is too large (greater than 2),
\[ r \] is too large (greater than 50%),
and \[ t/D \] is too small (less than 1%).