questions

Saturday, May 25, 2024 2:30 PM

operation.

18.3 A compound die will be used to blank and punch a large washer out of 6061ST aluminum alloy sheet stock 3.50 mm thick. The outside diameter of the washer is 50.0 mm and the inside diameter is 15.0 mm. Determine (a) the punch and die sizes for the blanking operation, and (b) the punch and die sizes for the punching operation.

$t = 3.5$ mm. $A_c = 0.060$.

$D_b = 50$ mm

$D_h = 15$ mm

a) punch diameter $= D_b - 2c$

die $= D_b$

$C = A_c \times t = 0.060 \times 3.5 = 0.21$.

punch $= 50 - 2 \times 0.21 = 49.58$ mm.

die $= 50$ mm

b) punch $= 15$ mm

die $= 15 + 2 \times 0.21 = 15.42$ mm

18.6 Determine the minimum tonnage press to perform the blanking and punching operation in Problem 18.3. The aluminum sheet metal has a tensile strength = 310 MPa, a strength coefficient of 350 MPa, and a strain-hardening exponent of 0.12. (a) Assume that blanking and punching occur simultaneously. (b) Assume the punches are staggered so that punching occurs first, then blanking.

$TS = 310$ MPa. $K = 350$ MPa

$n = 0.12$.

a) $F = 0.7\,TS\,t\,L$

$L = (50 + 15)\pi = 204.20$ mm

$F = 0.7 \times 310 \times 204.20 \times 3.5 = 155092.57$ N

F in ton $= \dfrac{155\,092.57}{8896.4} = 17.4 \simeq 18$ ton.

b) $L_b = 50\pi$, $L_h = 15\pi$

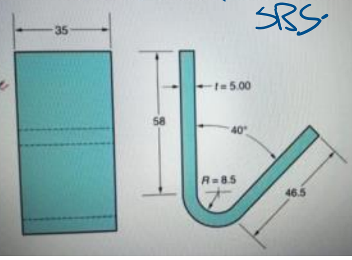
(2) more force so we use this alone (1)

$F = 0.7 \times 50\pi \times 310 \times 3.5 = 119301.981$ N

$F_{ton} = 13.4 \simeq 4$ ton.

Bending

20.9. A bending operation is to be performed on 5.00-mm thick cold-rolled steel. The part drawing is given in Figure P20.9. Determine the blank size required. SBS.



$t = 5$ mm. $R = 8.5$ mm

$\alpha' = 40$.

$\alpha = 140$

$SBS = x + y + A_b$

blank size

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$A_b = 2\pi \frac{\alpha}{360} (R + K_{ba} t)$

$R < 2t$

$8.5 < 5 \times 2$

$K_{ba} = 0.33$

$A_b = 2\pi \times \frac{140}{360} \times (8.5 + 0.33 \times 5) =$

$A_b = 24.8$

$SBS = 58 + 46.5 + 24.8 = 129.3$ mm.

20.10. Solve Problem 20.9 except that the bend radius R = 11.35 mm.

$SBS = x + y + A_b$

$A_b = 2\pi \times \frac{140}{360} (11.35 + 0.5 \times 5) =$

$R > 2t$

$11.35 > 2 \times 5$

$K_{ba} = 0.5$

$A_b = 33.84$ mm.

$= 58 + 46.5 + 33.84 = 138.3$ mm.

$SBS = 58 + 46.5 + 33.84 = 138.3\ mm.$

18.19 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?

$h = 75\ mm$ $D_p = 100\ mm$

$t = 2\ mm$ $D_b = 225\ mm$

a) $DR = \frac{D_b}{D_p} = \frac{225}{100} = 2.25$ ✗ should be ≤ 2

b) $r = \frac{D_b - D_p}{D_b} = \frac{225-100}{225} = 0.55$ ✗ should be > 0.5

c) $\frac{t}{D_p} = \frac{2}{225} = 8.88 \times 10^{-3}$ ✗ $< 1\%$

d) Nope, not at all.

So maybe we can:

① for $DR \leq 2$, $D_b \downarrow$ or $D_p \uparrow$

so maybe $DR = 1.95$ is good $= \frac{D_b}{100}$ $D_b = 195\ mm.$ ✓

② $r = \frac{D_b - D_p}{D_b} = \frac{195-100}{195} = 0.48$ ✓

③ $\frac{t}{D_b} = \frac{2}{195} = 0.0103$ ✓

18.24 A deep drawing operation is to be performed on a sheet-metal blank that is 0.3125 cm thick. The height (inside dimension) of the cup = 9.5 cm and the diameter (inside dimension) = 12.5 cm. Assuming the punch radius = 0, compute the starting diameter of the blank to complete the operation with no material left in the flange. Is the operation feasible (ignoring the fact that the punch radius is too small)?

$t = 0.3125\ cm$ $h_{in} = 9.5\ cm$

$D_p = 12.5\ cm$ $R_p = 0$ D_b?

$V_i \ldots = V_f \ldots$

$V_{initial} = V_{final}$

$A \times t = V_{base} + V_{walls}$

$$\frac{\pi}{4} D_b^2 \times 0.3125 = \frac{\pi}{4} \times (12.5 + 2 \times (0.3125))^2 (0.3125)$$
$$+ \frac{\pi}{4} \times ((12.5 + 2 \times 0.3125)^2 - 12.5^2) \times 9.5$$

$D_b =$

Other Operations

18.31 A 50 cm-long sheet-metal workpiece is stretched in a stretch forming operation to the dimensions shown in Figure P18.31. The thickness of the beginning stock is 0.469 cm and the width is 21.25 cm. The metal has a flow curve defined by a strength coefficient of 515 MPa and a strain hardening exponent of 0.20. The yield strength of the material is 205 MPa. (a) Find the stretching force *F* required near the beginning of the operation when yielding first occurs. Determine (b) true strain experienced by the metal, (c) stretching force *F*, and (d) die force at the very end when the part is formed as indicated in Figure P18.31(b).

not $L = 50$ cm $\quad t_o = 0.469$ cm $\quad L = 21.25$

$K = 515$ MPa $\quad n = 0.20 \quad \sigma_Y = 205$ MPa.

a) $F_{\text{at yield}} = L t Y_f$

$Y_f = K\varepsilon^n$ at yield $\varepsilon = 0.002$.

$515 \times 0.002^{0.20} = 148.5$ MPa.

*what is t at yield?

$$\varepsilon = \ln \frac{t_o}{t_f} = 0.002 = \ln \frac{0.469}{t_f}$$

$$1.002 = \frac{0.469}{t_f} \qquad t_f = 0.468 \text{ cm}$$

$F = 212.5 \text{ mm} \times 4.68 \text{ mm} \times 148.5 = 147683 \text{ N}$