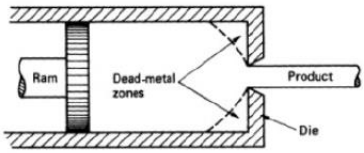
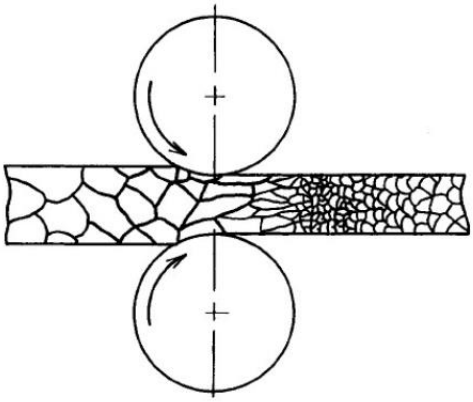
EDPT 601

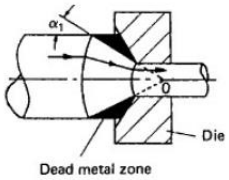
Materials Manufacturing Technology

4 Metal Forming Problems

Rolling ,Extrusion and wire Drawing







Source: **Manufacturing Engineer's Reference Book,** Butterworth-Heinemann

Students Names:	Date ____/____/____ dd / mm / yy
Semester _____ Student ID _____ Group _____	
(For instructor use only) **Evaluation**	
Grade	
Comments	

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1- Rolling

Compare the roll force and the power required for AISI 1020 steel and 1100-O aluminum with the following dimensions.
Width: 300 mm
Initial Thickness: 30 mm
Final thickness: 25 mm
Rolls speed: 100 rpm
Rolls radius: 320 mm

2- Extrusion

a. A round billet made of steel is extruded at a temperature of 1200 °C. The billet diameter is 150 mm and the final bar diameter is 80 mm. Calculate the extrusion force on the ram.

b. Calculate the extrusion force required for the extrusion of an aluminum I-section, at 400 °C, from a billet of 25 mm diameter, where the I-section has a height of 12.5 mm, the flange width is 6 mm, and the thickness is 1.5 mm.

3- Wire Drawing

A wire of 1.5 mm diameter is to be drawn from a 6 mm diameter work piece. The material can endure 60% reduction before annealing. It can be reduced by 30% per stage. How many drawing stages are needed and when is annealing needed to be performed?
Calculate the drawing force associated with the first stage.

Useful Data

1. Rolling

$$a = L/2.$$

$$F = LwY_{\text{avg}}$$

$$\text{Power} = \frac{\pi FLN}{60{,}000} \quad (kW)$$

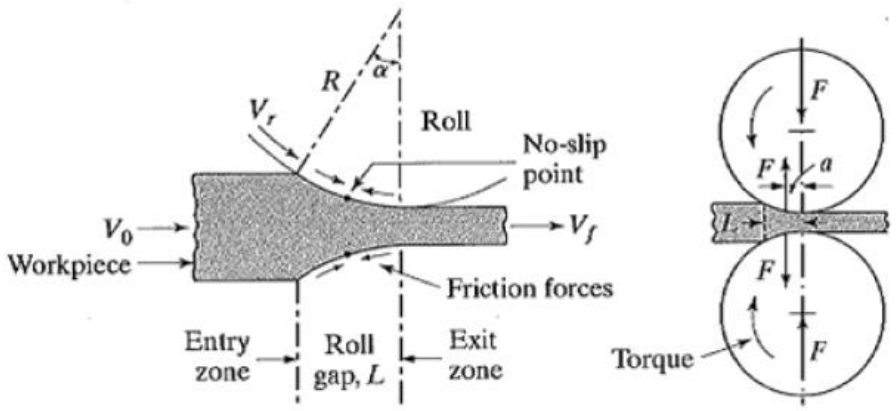

Fig. 1

2. Extrusion

$$F = A_o k \ln\left(\frac{A_o}{A_f}\right)$$

3. Wire drawing

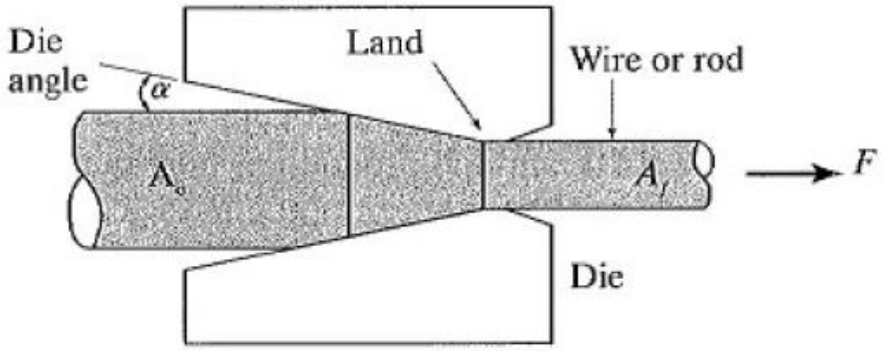

Fig. 2

$$F = Y_{\text{avg}} A_f \ln\left(\frac{A_o}{A_f}\right).$$

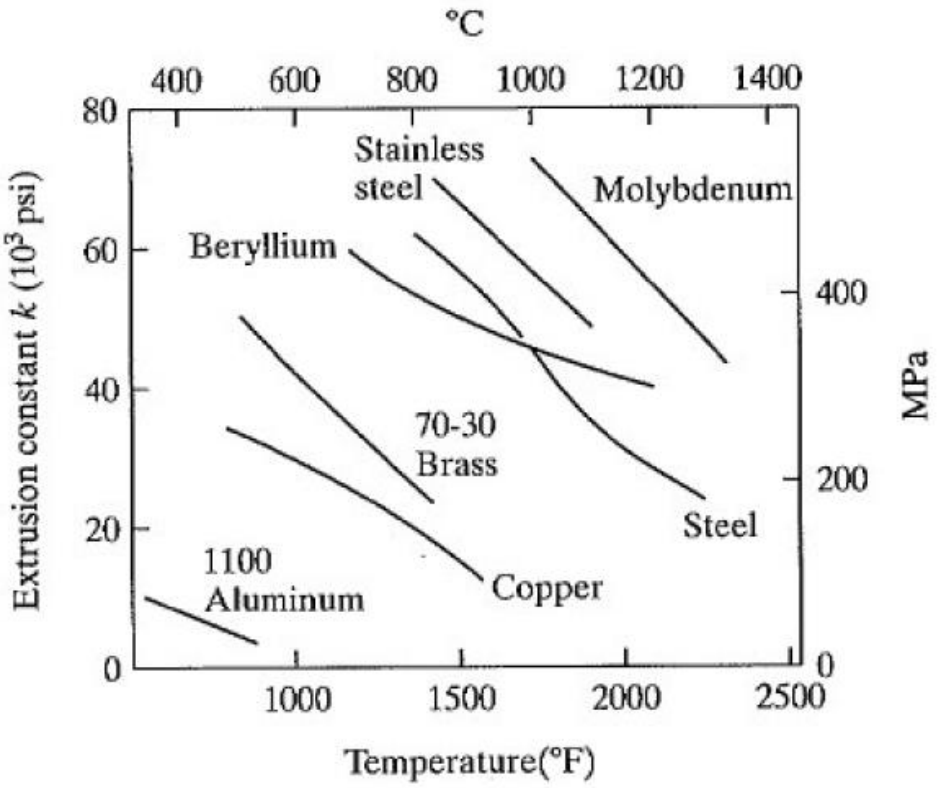
°C
400
600
800
1000
1200
1400
80
60
40
20
0
Extrusion constant k (10^3 psi)
Stainless steel
Molybdenum
Beryllium
70-30 Brass
Steel
1100 Aluminum
Copper
400
200
0
MPa
1000
1500
2000
2500
Temperature(°F)

Fig. 3

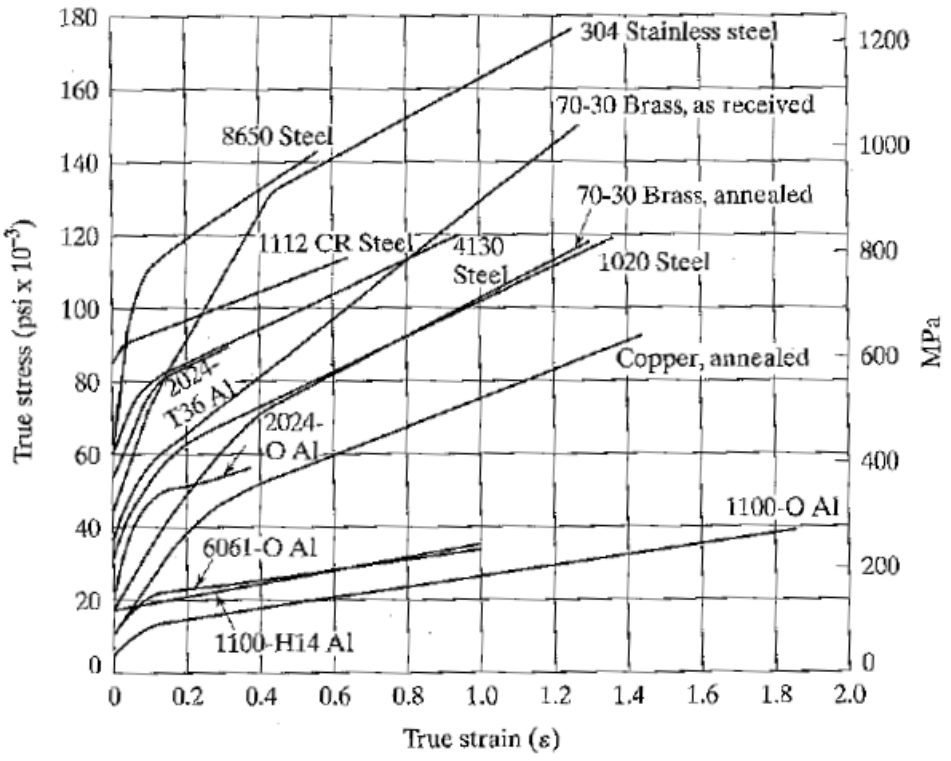
180
160
140
120
100
80
60
40
20
0
True stress (psi x 10^{-3})
304 Stainless steel
70-30 Brass, as received
8650 Steel
70-30 Brass, annealed
1112 CR Steel
4130 Steel
1020 Steel
Copper, annealed
2024-T36 Al
2024-O Al
1100-O Al
6061-O Al
1100-H14 Al
1200
1000
800
600
400
200
0
MPa
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
True strain (ε)

Fig. 4