GLOBAL MANUFACTURING

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AUG, 2015
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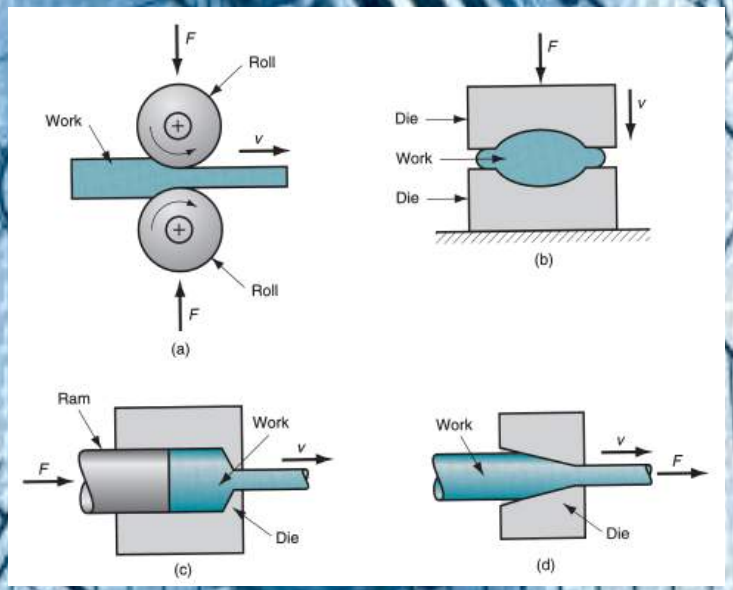
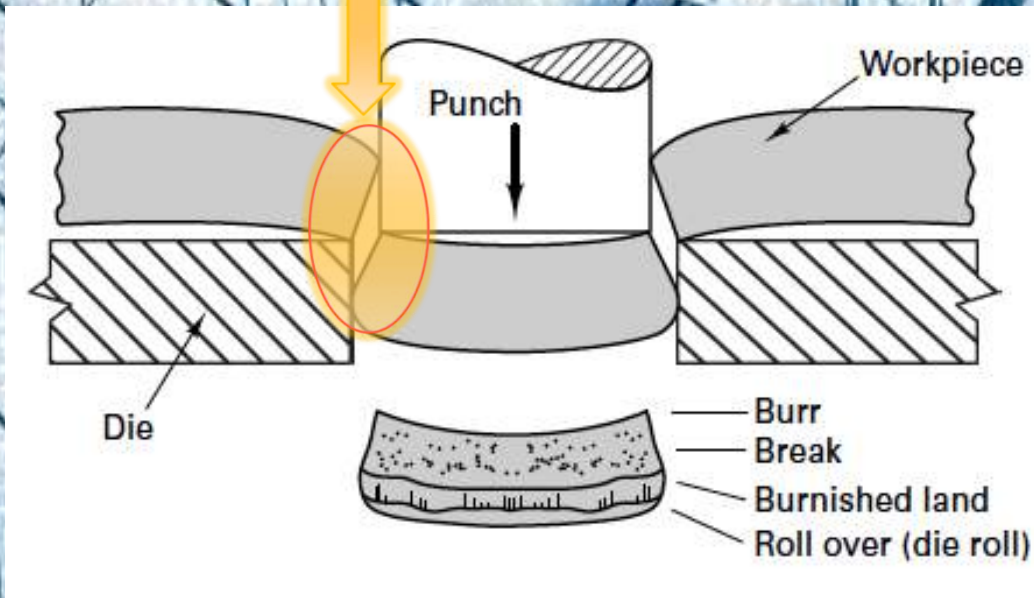
Sheet Forming [#9]

Bulk x Sheet Deformation Processes





SHEET METALWORKING

- Shearing
- Bending
- Drawing and Strethching

TABLE 17-1 Classification of the Nonsqueezing Metal-Forming Operations

Shearing	Bending	Drawing and Stretching
1. Simple shearing	1. Angle bending	1. Spinning
2. Slitting	2. Roll bending	2. Shear forming or flow turning
3. Piercing	3. Draw bending	3. Stretch forming
4. Blanking	4. Compression bending	4. Deep drawing and shallow drawing
5. Fineblanking	5. Press bending	5. Rubber-tool forming
6. Lancing	6. Tube bending	6. Sheet hydroforming
7. Notching	7. Roll forming	7. Tube hydroforming
8. Nibbling	8. Seaming	8. Hot drawing
9. Shaving	9. Flanging	9. High-energy-rate forming
10. Trimming	10. Straightening	10. Ironing
11. Cutoff		11. Embossing
12. Dinking		12. Superplastic sheet forming

Shearing

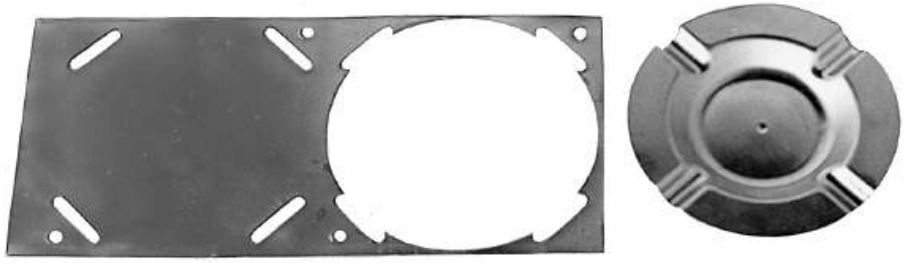
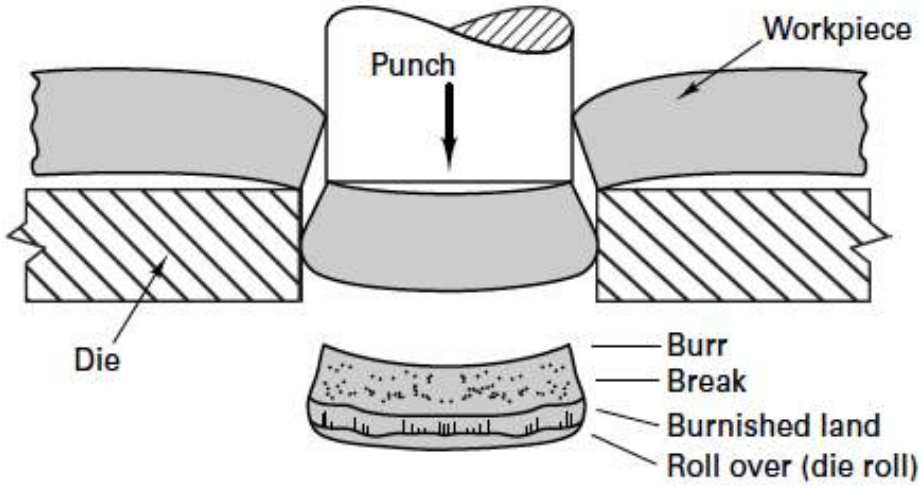
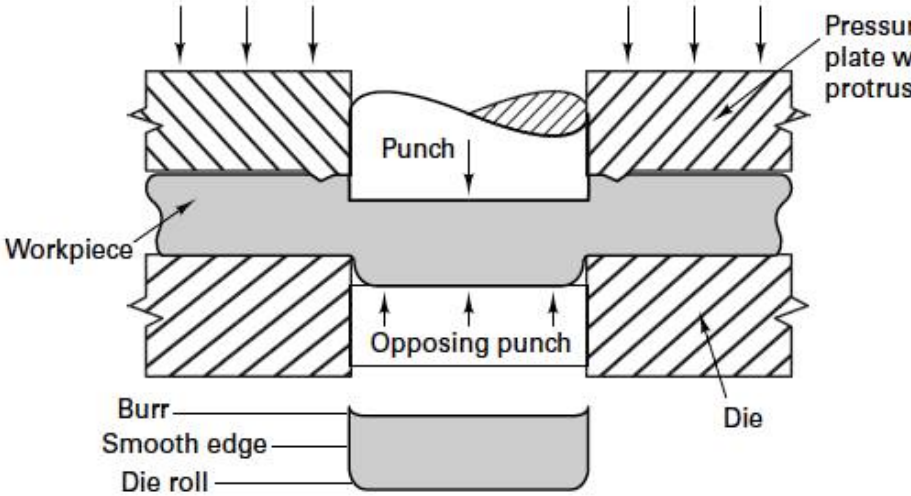


FIGURE 17-8 (Left to right) Piercing, lancing, and blanking precede the forming of the final ashtray. The small round holes assist positioning and alignment. *(E. Paul DeGarmo)*





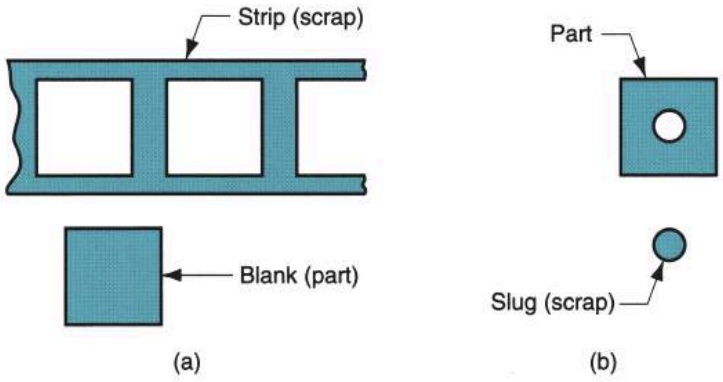


FIGURE 14.4
(a) Blanking and (b) punching. (Credit: *Fundamentals of Modern Manufacturing*, 4th Edition by Mikell P. Groover, 2010. Reprinted with permission of John Wiley & Sons, Inc.)

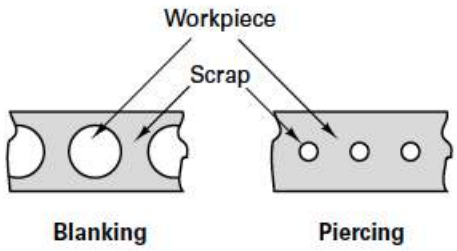


FIGURE 17-7 Schematic showing the difference betwe piercing and blanking.

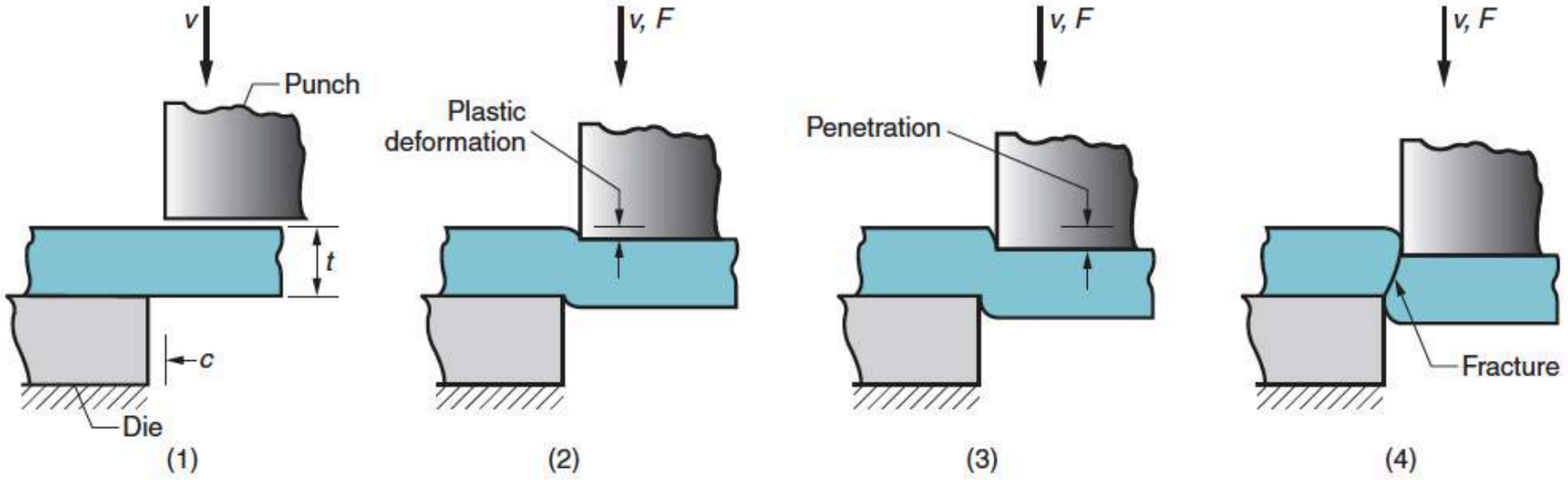
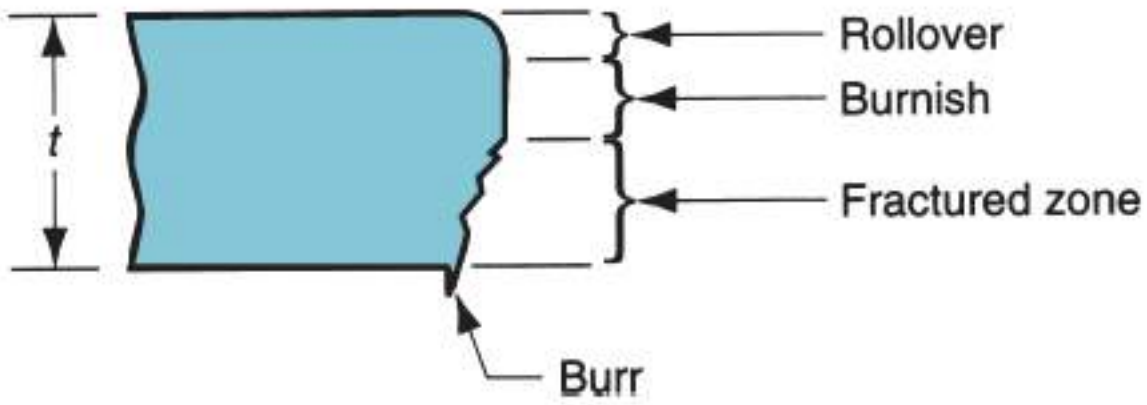
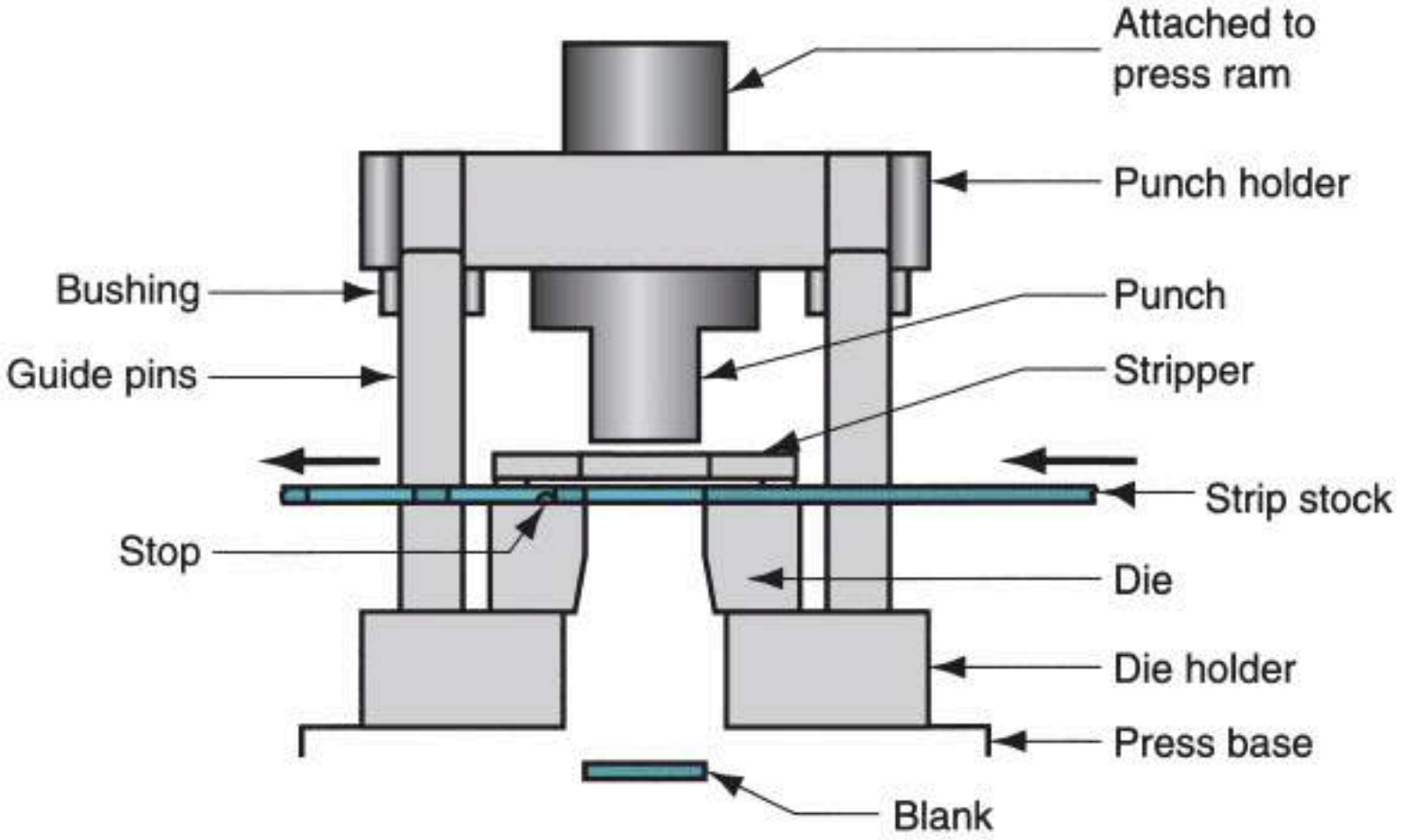
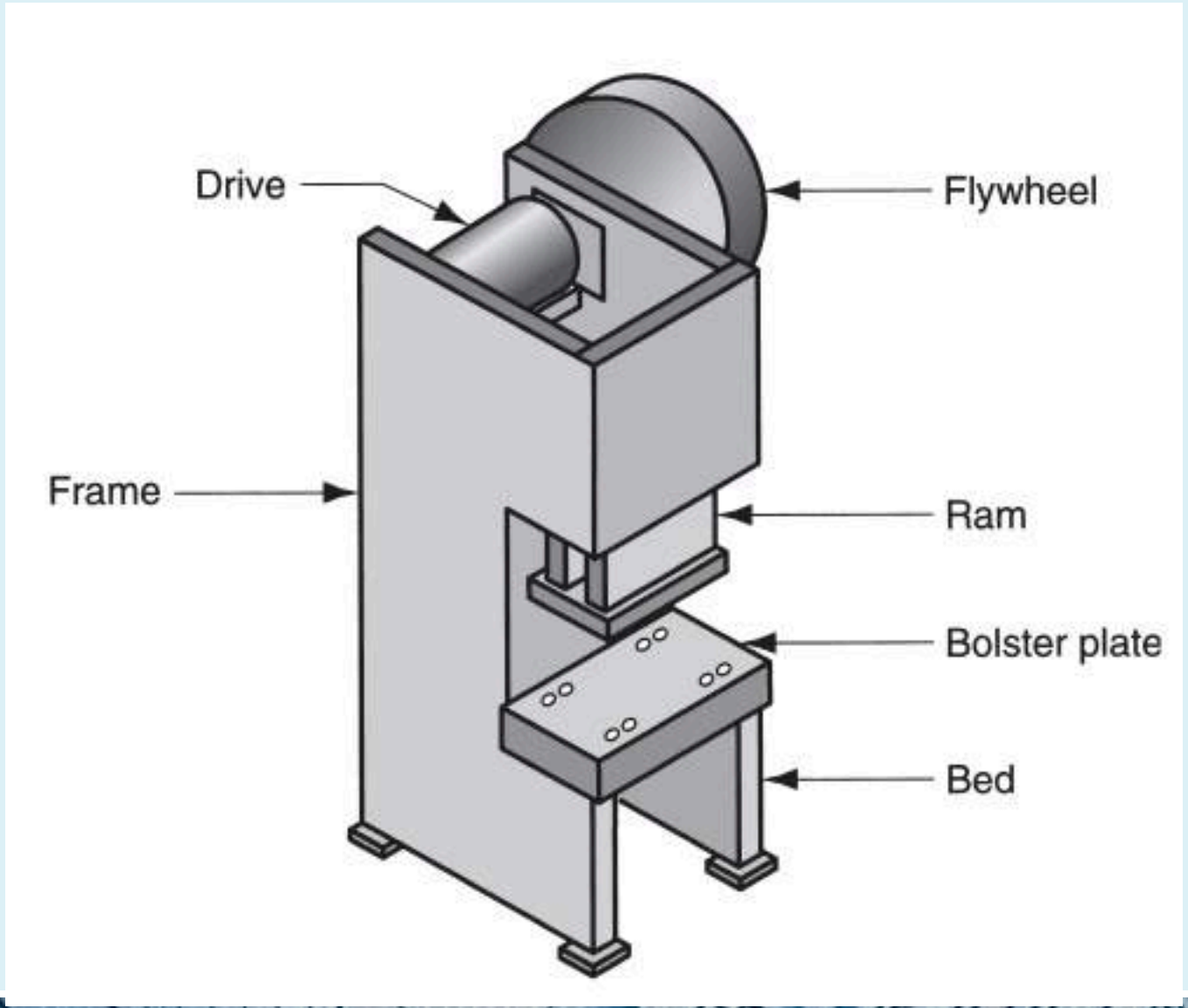


FIGURE 14.1 Shearing of sheet metal between two cutting edges: (1) just before the punch contacts work; (2) punch begins to push into work, causing plastic deformation; (3) punch compresses and penetrates into work causing a smooth cut surface; and (4) fracture is initiated at the opposing cutting edges that separate the sheet. Symbols v and F indicate motion and applied force, respectively, t = stock thickness, c = clearance. (Credit: *Fundamentals of Modern Manufacturing,* 4th Edition by Mikell P. Groover, 2010. Reprinted with permission of John Wiley & Sons, Inc.)




Attached to press ram
Punch holder
Bushing
Punch
Guide pins
Stripper
Strip stock
Stop
Die
Die holder
Press base
Blank


Drive
Flywheel
Frame
Ram
Bolster plate
Bed

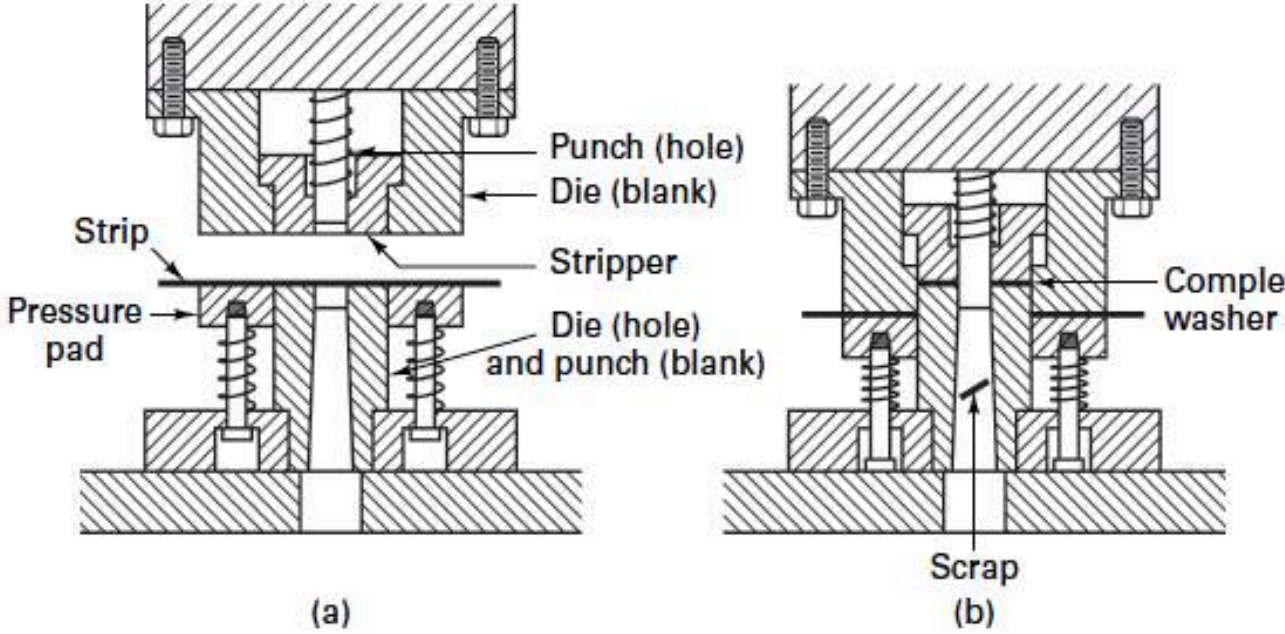
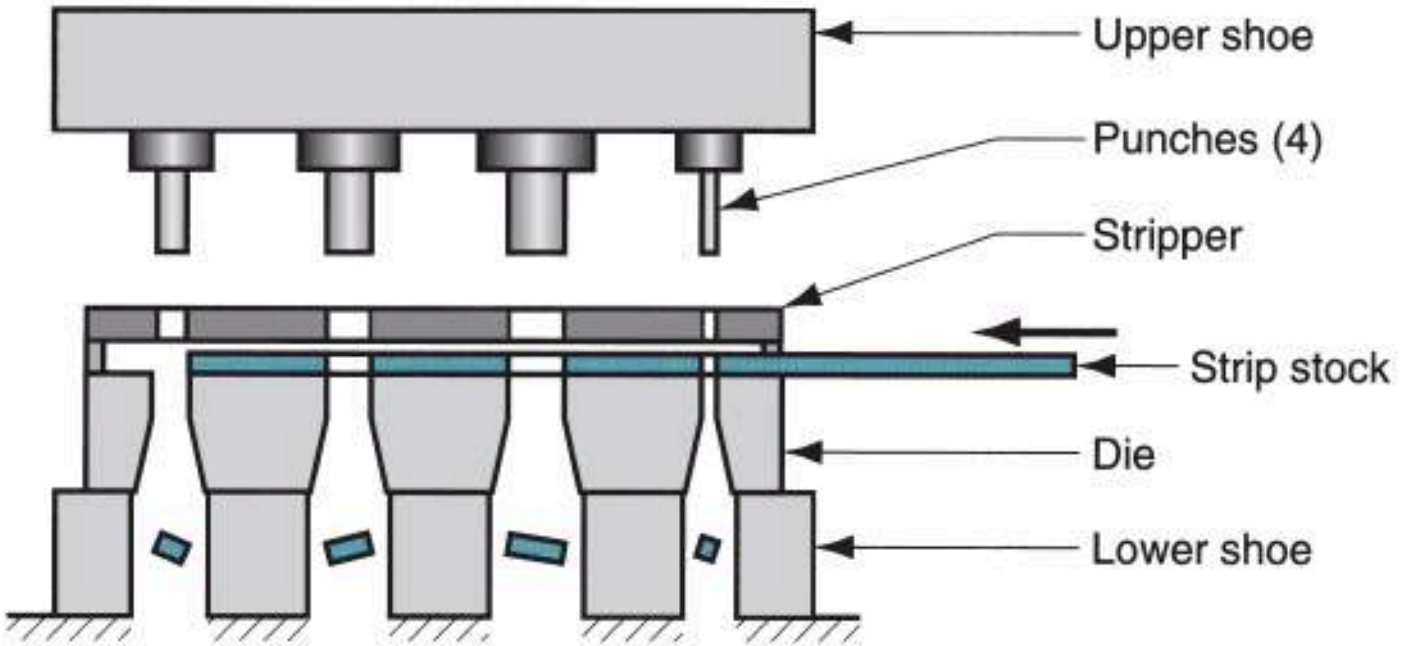


FIGURE 17-16 Method for making a simple washer in a compound piercing and blanking die. Part is blanked (a) and subsequently pierced (b) in the same stroke. The blanking punch contains the die for piercing.

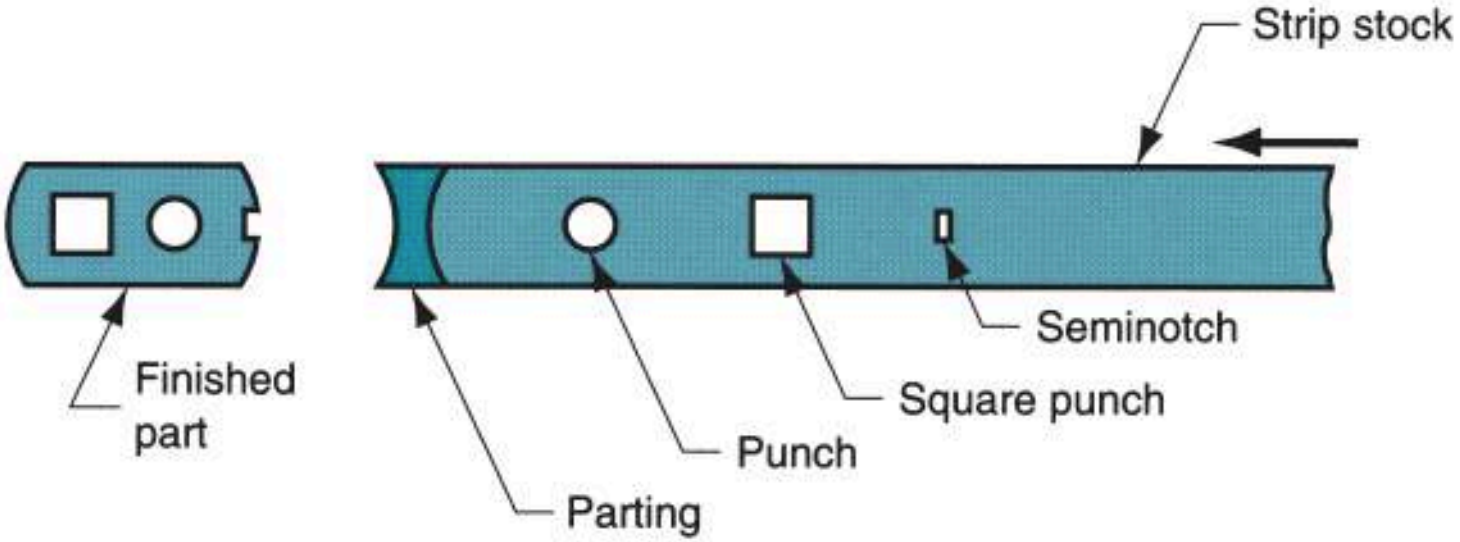
DESIGN FOR PIERCING AND BLANKING

The construction, operation, and maintenance of piercing and blanking dies can be greatly facilitated if designers of the parts to be fabricated keep a few simple rules in mind:

1. Diameters of pierced holes should not be less than the thickness of the metal, with a minimum of 0.3 mm (0.025 in.). Smaller holes can be made, but with difficulty.
2. The minimum distance between holes, or between a hole and the edge of the stock, should be at least equal to the metal thickness.
3. The width of any projection or slot should be at least one times the metal thickness and never less than 2.5 mm ($\frac{3}{32}$ in.).
4. Keep tolerances as large as possible. Tolerances below about 0.075 mm (0.003 in.) will require shaving.
5. Arrange the pattern of parts on the strip to minimize scrap.

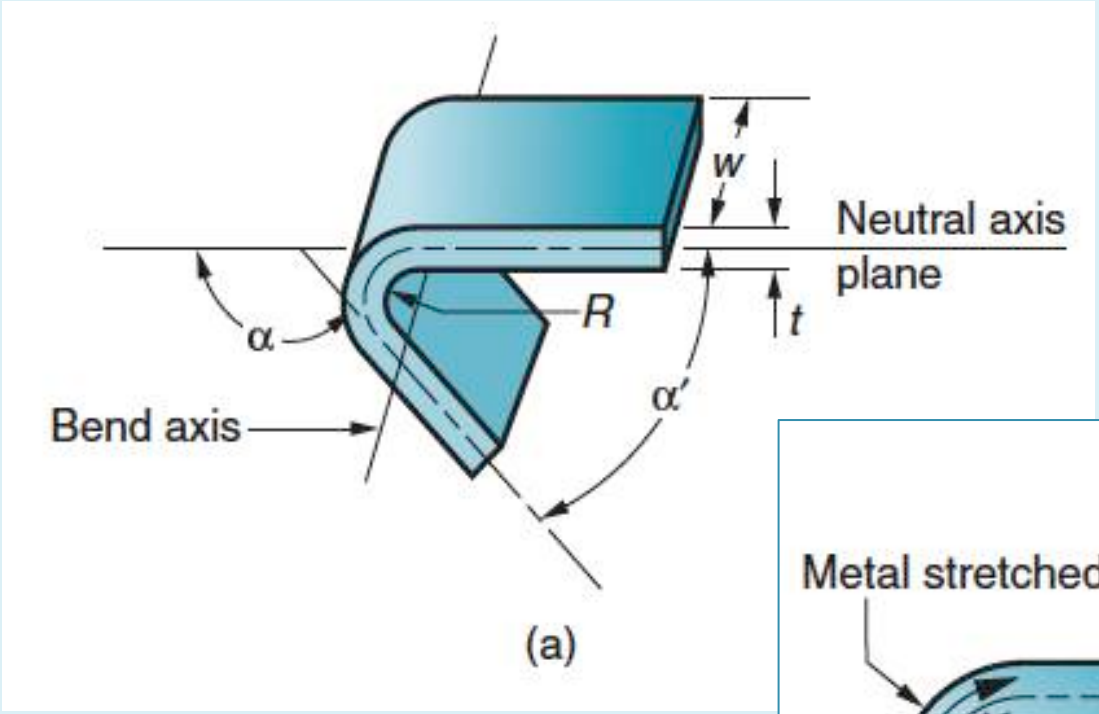

Upper shoe
Punches (4)
Stripper
Strip stock
Die
Lower shoe

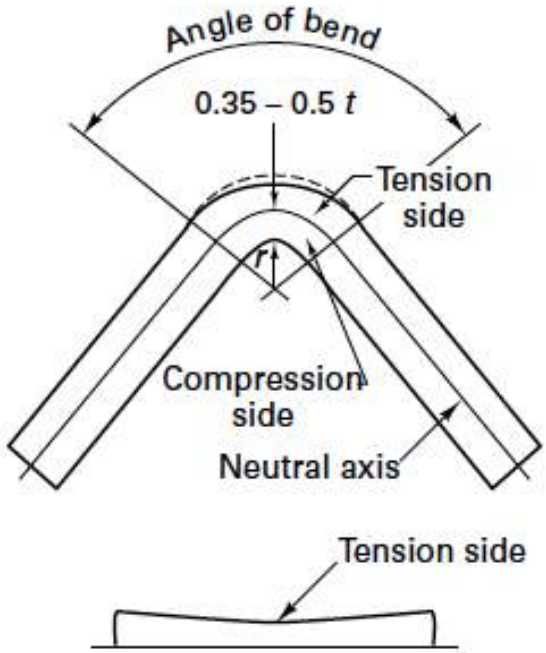
(a)

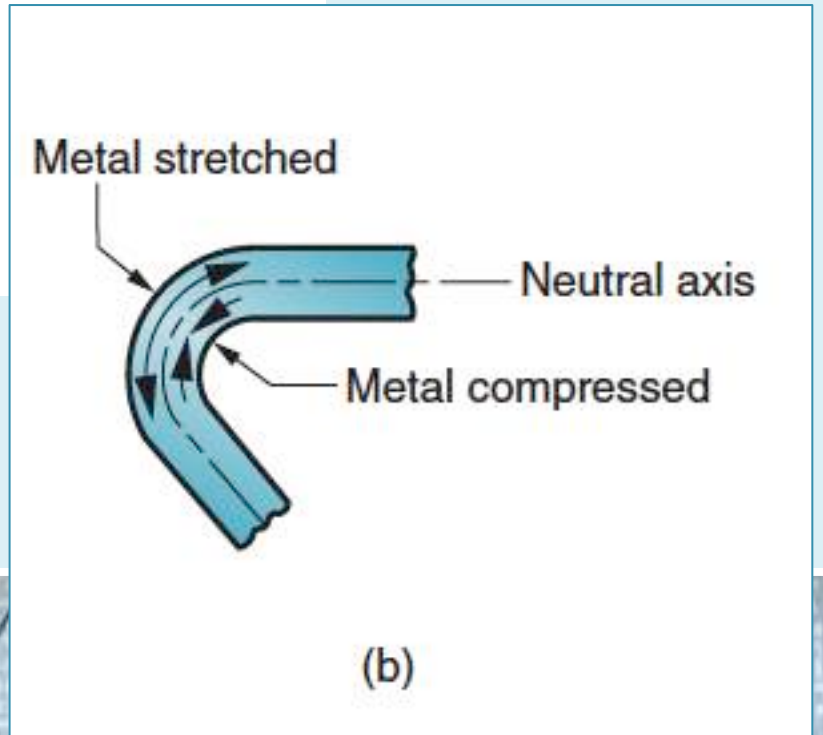

Strip stock
Finished part
Seminotch
Square punch
Punch
Parting

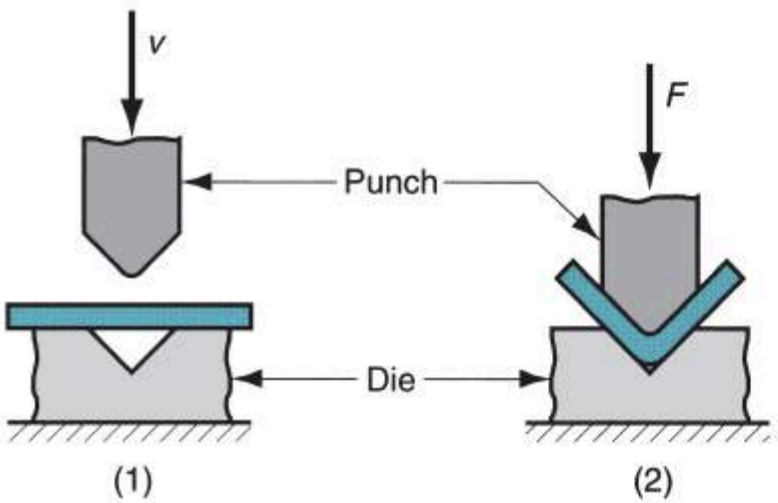
(b)

Bending


w
Neutral axis plane
R
t
α
α′
Bend axis
(a)


Angle of bend
0.35 – 0.5 t
Tension side
r
Compression side
Neutral axis
Tension side


Metal stretched
Neutral axis
Metal compressed
(b)



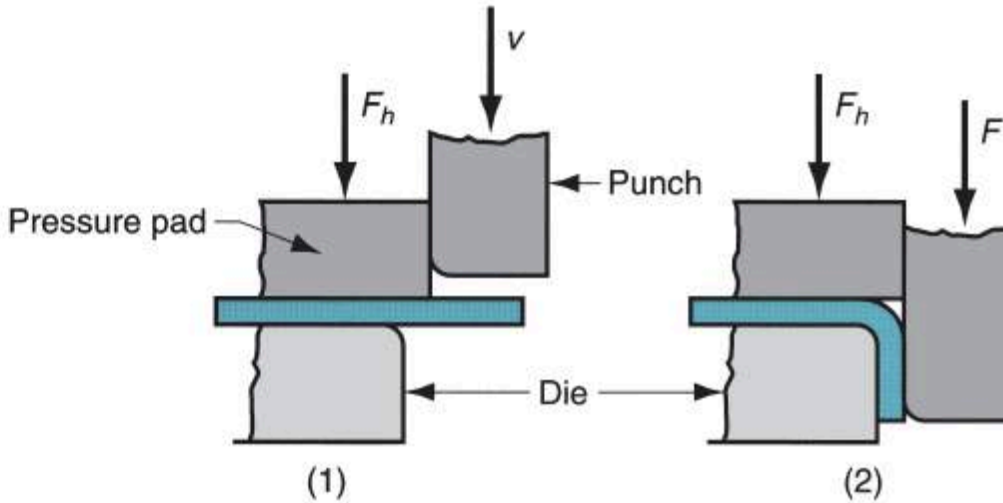
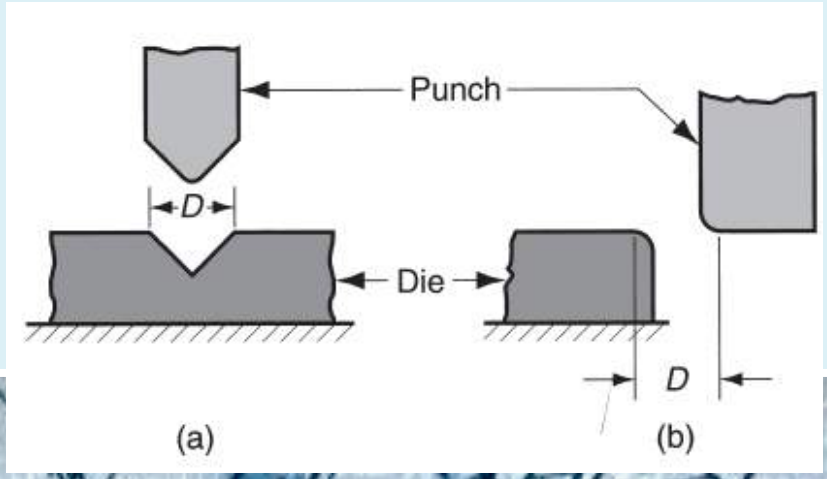


FIGURE 14.10 Two common bending methods: (a) V-bending and (b) edge bending; (1) before and (2) after bending. Symbols: v = motion, F = applied bending force, F_h = blank. (Credit: *Fundamentals of Modern Manufacturing*, 4th Edition by Mikell P. Groover, 2010. Reprinted with permission of John Wiley & Sons, Inc.)

$$F = \frac{K_{bf}(TS)wt^2}{D}$$

TS: Tensile Strength



Spring Back

$$SB = \frac{\alpha' - \alpha'_b}{\alpha'_b}$$

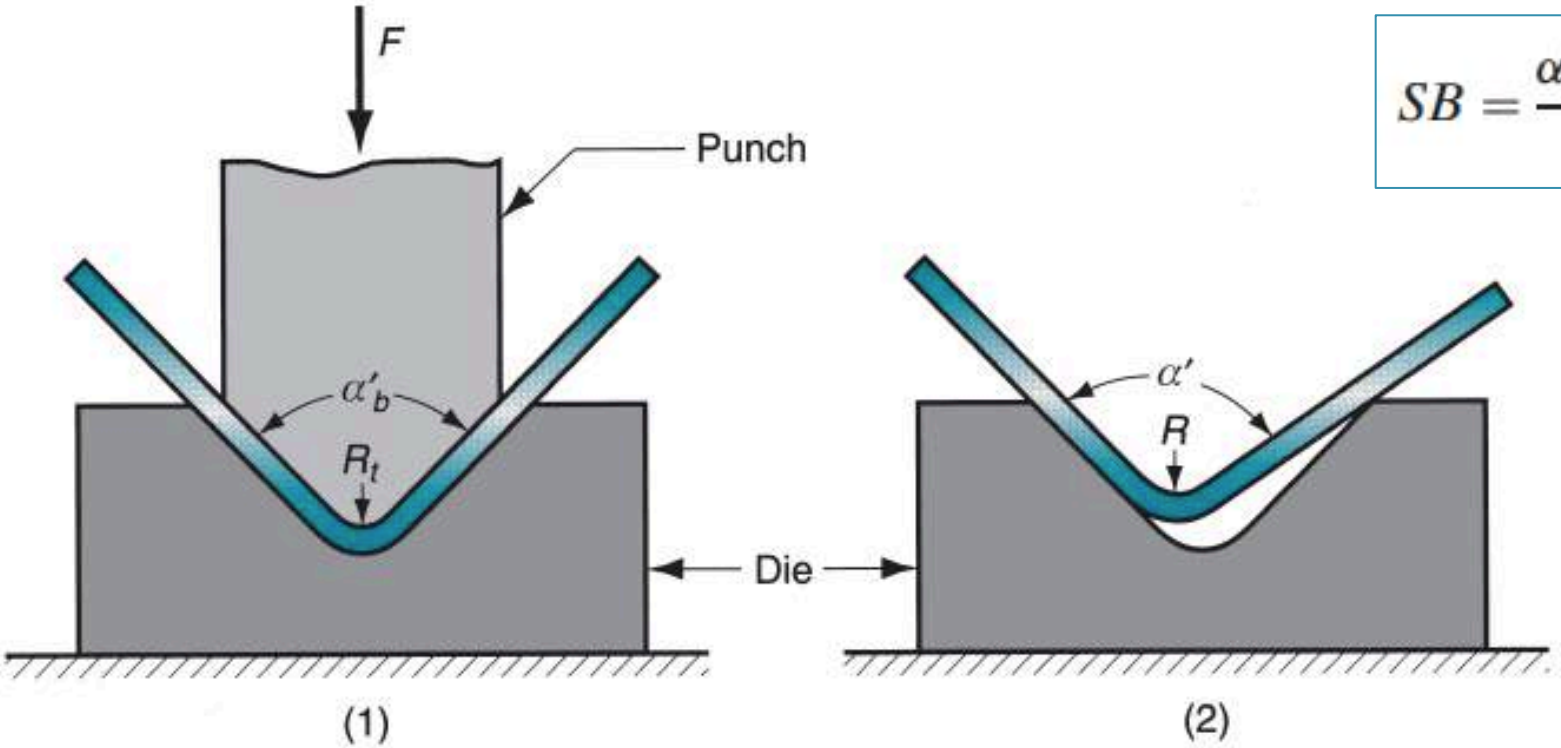
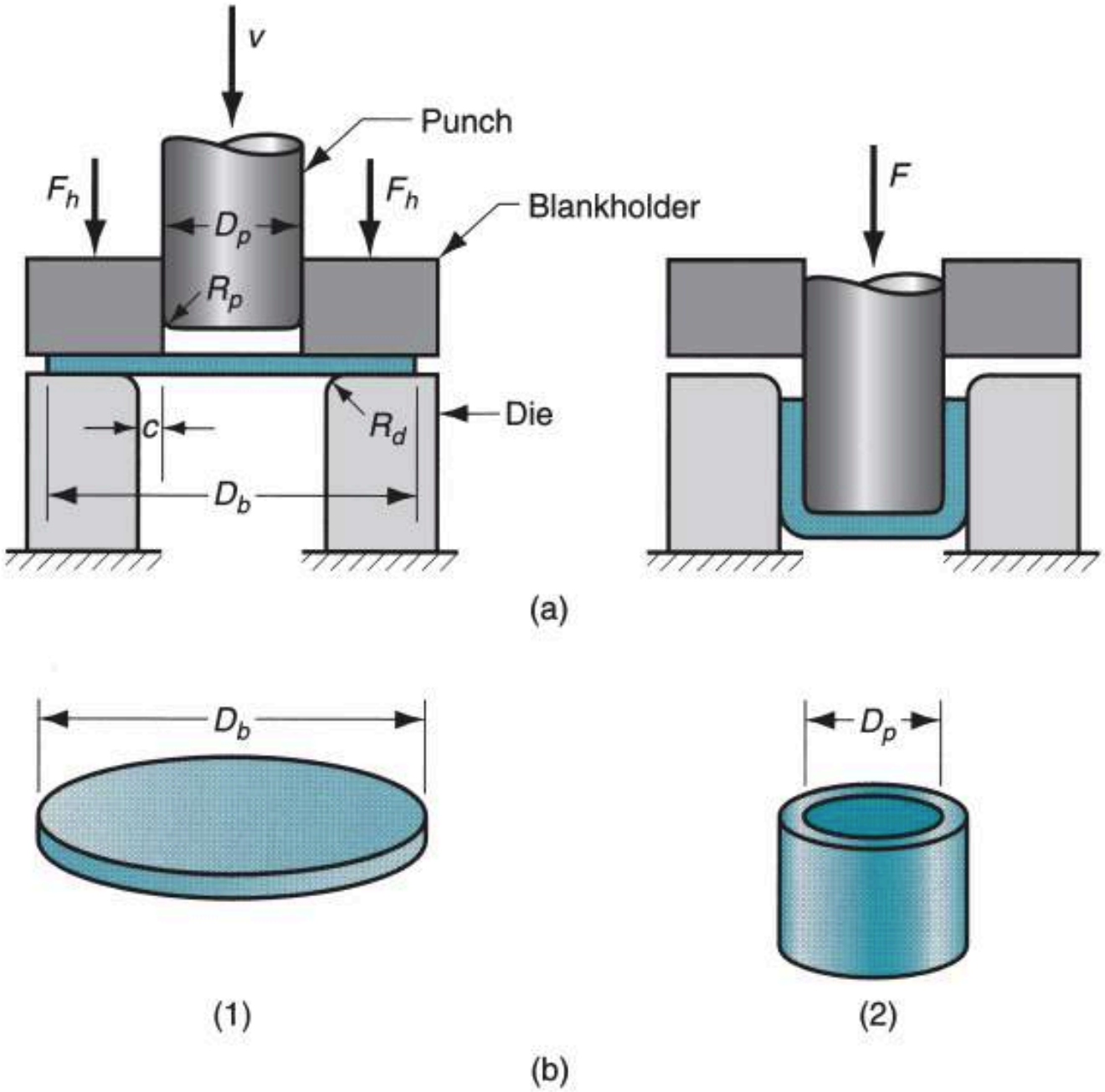
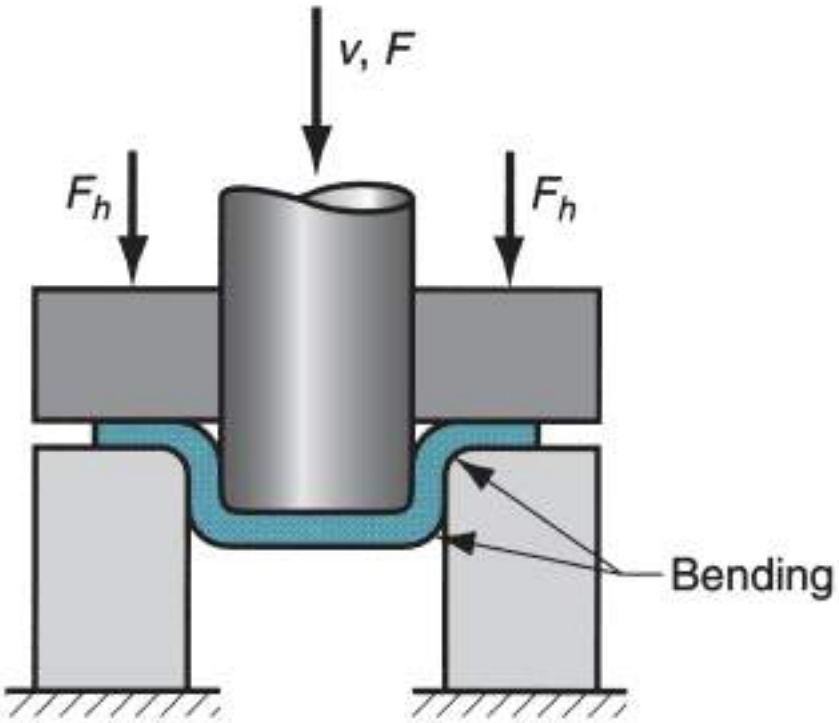


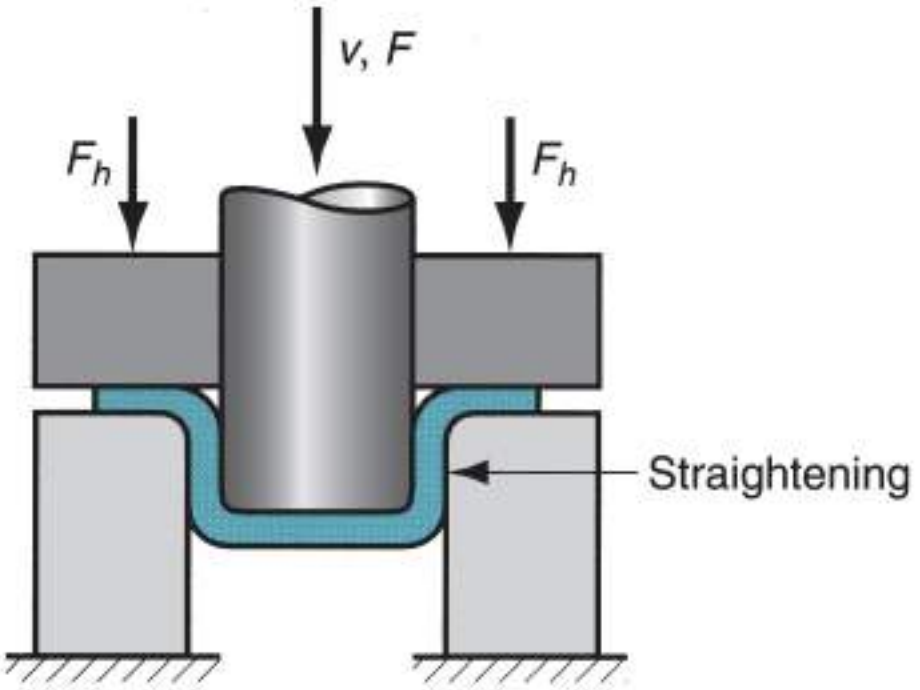
FIGURE 14.11 Springback in bending shows itself as a decrease in bend angle and an increase in bend radius: (1) during the operation, the work is forced to take the radius R_t and included angle $\alpha_b' =$ determined by the bending tool (punch in V-bending); (2) after the punch is removed, the work springs back to radius R and included angle α'. Symbol: $F =$ applied bending force. (Credit: *Fundamentals of Modern Manufacturing*, 4th Edition by Mikell P. Groover, 2010. Reprinted with permission of John Wiley & Sons, Inc.)

DRAWING

$$r = \frac{D_b - D_p}{D_b}$$

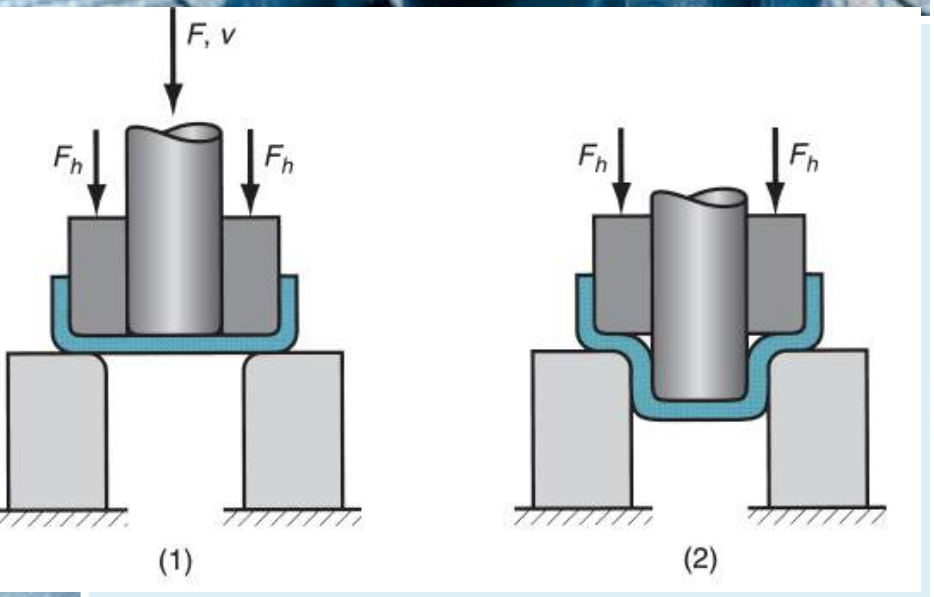


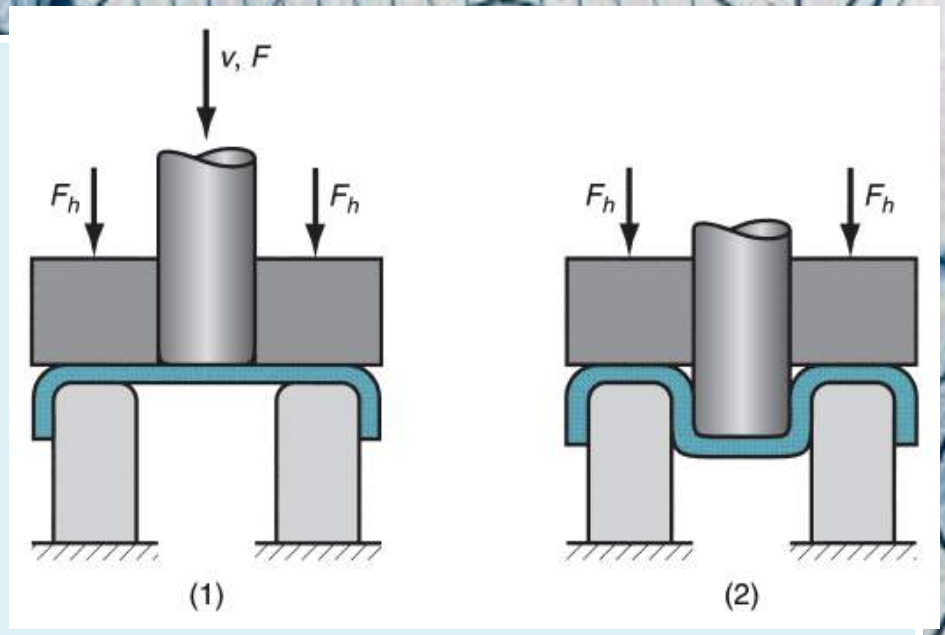




$$F = \pi D_p t(TS)\left(\frac{D_b}{D_p} - 0.7\right)$$

The constant 0.7 is a correction factor to account for friction





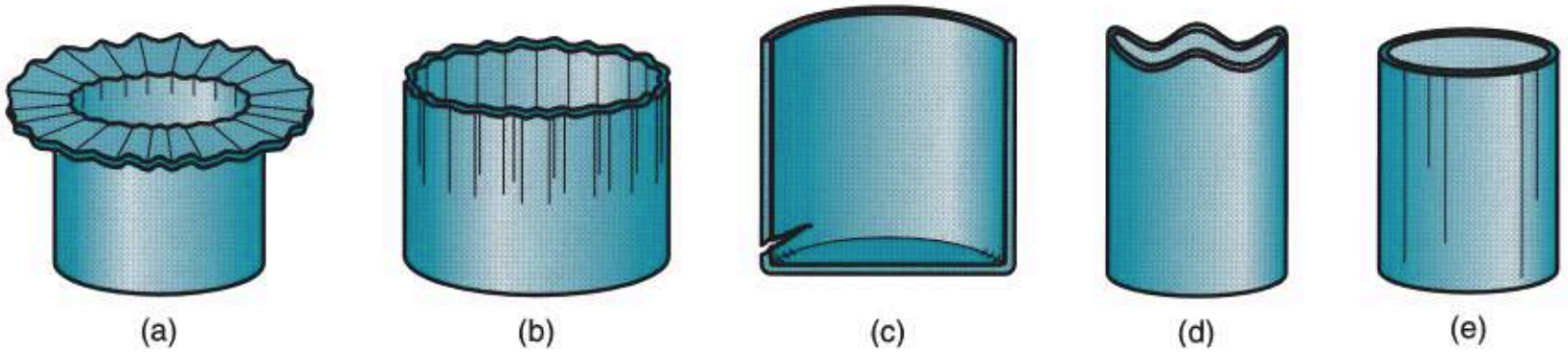


FIGURE 14.20 Common defects in drawn parts: (a) wrinkling can occur either in the flange or (b) in the wall, (c) tearing, (d) earing, and (e) surface scratches. (Credit: *Fundamentals of Modern Manufacturing,* 4th Edition by Mikell P. Groover, 2010. Reprinted with permission of John Wiley & Sons, Inc.)

Videos

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