

PROBLEM 2-1

Statement: Figure P2-1 shows stress-strain curves for three failed tensile-test specimens. All are plotted on the same scale.

- Characterize each material as brittle or ductile.
- Which is the stiffest?
- Which has the highest ultimate strength?
- Which has the largest modulus of resilience?
- Which has the largest modulus of toughness?

Solution:

- The material in Figure P2-1a is mildly ductile, P2-1b is brittle and P2-1c is ductile.
- The material in Figure P2-1c is the stiffest with a 5:1 slope in the elastic region.
- The material in Figure P2-1b has the highest ultimate strength.
- The material in Figure P2-1a has the largest modulus of resilience.
- The material in Figure P2-1c has the largest modulus of toughness.

PROBLEM 2-2

Statement: Determine an approximate ratio between the yield strength and ultimate strength for each material shown in Figure P2-1.

Solution:

The material in Figure P2-1a has a S_y/S_u ratio of about 5/6.

The material in Figure P2-1b has a S_y/S_u ratio of about 9/10.

The material in Figure P2-1c has a S_y/S_u ratio of about 5/8.

PROBLEM 2-3

Statement: Which of the steel alloys shown in Figure 2-19 would you choose to obtain

- Maximum strength
- Maximum modulus of resilience
- Maximum modulus of toughness
- Maximum stiffness

Solution:

- AISI 4142
- AISI 4142
- AISI 1020
- all are the same stiffness ($E = 30 \text{ Mpsi}$)

PROBLEM 2-13

Statement: The Brinell hardness of a steel specimen was measured to be 250 HB. What is the material's approximate tensile strength? What is its hardness on the Vickers scale? The Rockwell scale?

Solution: Also see the TKSolver file P02-13.

Rule Sheet:

$$S_{ut} = HB * 500$$

$$Vickers = HB2HV(HB)$$

$$Rockwell = HB2HRC(HB)$$

Variable Sheet:

St	Input	Name	Output	Unit	Comment
	250.	HB			Brinell hardness
		Sut	125 000.	psi	tensile strength
		Vickers	263.		Vickers hardness
		Rockwell	24.3		Rockwell C hardness

PROBLEM 2-16

Statement: What are the principal alloy elements of an AISI 1095 steel? How much carbon does it have? Is it hardenable? By what techniques?

Solution: Also see the TKSolver file P02-16.

Carbon—0.95%.

Can be through-hardened or case hardened.