TMT 4185 – Øving 5

7.20
Briefly explain why small-angle grain boundaries are not as effective in interfering with the slip process as are high-angle grain boundaries.

7.21
Briefly explain why HCP metals are typically more brittle than FCC and BCC metals.

7.22
Describe in your own words the three strengthening mechanisms discussed in this chapter (i.e., grain size reduction, solid-solution strengthening, and strain hardening). Be sure to explain how dislocations are involved in each of the strengthening techniques.

7.35
Explain the differences in grain structure for a metal that has been cold worked and one that has been cold worked and then recrystallized.

7.36
(a) What is the driving force for recrystallization?
(b) For grain growth?

7.41
An uncold-worked brass specimen of average grain size 0.01 mm has a yield strength of 150 MPa. Estimate the yield strength of this alloy after it has been heated to 500C for 1000 s, if it is known that the value of σ_0 is 25 MPa.

7.D4
It is necessary to select a metal alloy for an application that requires a yield strength of at least 310 MPa while maintaining a minimum ductility (%EL) of 27%. If the metal may be cold worked, decide which of the following are candidates: copper, brass, and a 1040 steel. Why?

8.7
Suppose that a wing component on an aircraft is fabricated from an aluminum alloy that has a plane strain fracture toughness of 26 MPa $\sqrt{m}$. It has been determined that fracture results at a stress of 112 MPa when the maximum internal crack length is 8.6 mm. For this same component and alloy, compute the stress level at which fracture will occur for a critical internal crack length of 6.0 mm.

8.8

A large plate is fabricated from a steel alloy that has a plane strain fracture toughness of 82,4 MPa $\sqrt{m}$. If, during service use, the plate is exposed to a tensile stress of 345 MPa, determine the minimum length of a surface crack that will lead to fracture. Assume a value of 1.0 for Y.

8.14

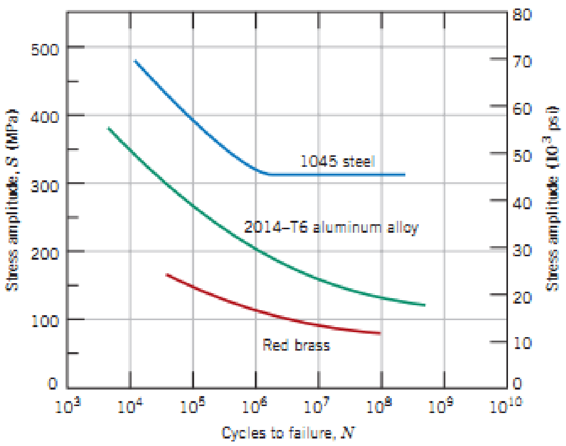
A fatigue test was conducted in which the mean stress was 70 MPa, and the stress amplitude was 210 MPa.

(a) Compute the maximum and minimum stress levels.
(b) Compute the stress ratio.
(c) Compute the magnitude of the stress range.

8.15

A cylindrical 1045 steel bar (Figure 8.34) is subjected to repeated compression-tension stress cycling along its axis. If the load amplitude is 66 700 N, compute the minimum allowable bar diameter to ensure that fatigue failure will not occur. Assume a safety factor of 2.0.

Figure 8.34 Stress magnitude S versus the logarithm of the number N of cycles to fatigue failure for red brass, an aluminum alloy, and a plain carbon steel. (Adapted from H. W. Hayden, W. G. Moffatt, and J. Wulff, *The Structure and Properties of Materials*, Vol. III, *Mechanical Behavior*, p. 15. Copyright © 1965 by John Wiley & Sons, New York. Reprinted by permission of John Wiley & Sons, Inc. Also adapted from *ASM Handbook*, Vol. 2, *Properties and Selection: Nonferrous Alloys and Special-Purpose Materials*, 1990. Reprinted by permission of ASM International.)



8.16

A 6.4 mm diameter cylindrical rod fabricated from a 2014-T6 aluminum alloy (Figure 8.34) is subjected to reversed tension-compression load cycling along its axis. If the maximum tensile and compressive loads are +5340 N and -5340 N, respectively, determine its fatigue life. Assume that the stress plotted in Figure 8.34 is stress amplitude.

8.24

Briefly explain the difference between fatigue striations and beachmarks both in terms of

(a) size and (b) origin.