Chapter 2

Fundamentals of the Mechanical Behavior of Materials

Questions

2.1 Can you calculate the percent elongation of materials based only on the information given in Fig. 2.6? Explain.

Recall that the percent elongation is defined by Eq. (2.6) on p. 33 and depends on the original gage length (l_o) of the specimen. From Fig. 2.6 on p. 37 only the necking strain (true and engineering) and true fracture strain can be determined. Thus, we cannot calculate the percent elongation of the specimen; also, note that the elongation is a function of gage length and increases with gage length.

2.2 Explain if it is possible for the curves in Fig. 2.4 to reach 0% elongation as the gage length is increased further.

The percent elongation of the specimen is a function of the initial and final gage lengths. When the specimen is being pulled, regardless of the original gage length, it will elongate uniformly (and permanently) until necking begins. Therefore, the specimen will always have a certain finite elongation. However, note that as the specimen's gage length is increased, the contribution of localized elongation (that is, necking) will decrease, but the total elongation will not approach zero.

2.3 Explain why the difference between engineering strain and true strain becomes larger as strain increases. Is this phenomenon true for both tensile and compressive strains? Explain.

The difference between the engineering and true strains becomes larger because of the way the strains are defined, respectively, as can be seen by inspecting Eqs. (2.1) on p. 30 and (2.9) on p. 35. This is true for both tensile and compressive strains.

2.4 Using the same scale for stress, we note that the tensile true-stress-true-strain curve is higher than the engineering stress-strain curve. Explain whether this condition also holds for a compression test.

During a compression test, the cross-sectional area of the specimen increases as the specimen height decreases (because of volume constancy) as the load is increased. Since true stress is defined as ratio of the load to the instantaneous cross-sectional area of the specimen, the true stress in compression will be lower than the engineering stress for a given load, assuming that friction between the platens and the specimen is negligible.

2.5 Which of the two tests, tension or compression, requires a higher capacity testing machine than the other? Explain.

The compression test requires a higher capacity machine because the cross-sectional area of the