HW 4

6.3 A specimen of copper having a rectangular cross section 15.2 mm × 19.1 mm (0.60 in. × 0.75 in.) is pulled in tension with 44,500 N (10,000 lbf) force, producing only elastic deformation. Calculate the resulting strain.

6.6 Consider a cylindrical nickel wire 2.0 mm (0.08 in.) in diameter and 3 × 104 mm (1200 in.) long. Calculate its elongation when a load of 300 N (67 lbf) is applied. Assume that the deformation is totally elastic.

6.18 A cylindrical specimen of a hypothetical metal alloy is stressed in compression. If its original and final diameters are 30.00 and 30.04 mm, respectively, and its final length is 105.20 mm, compute its original length if the deformation is totally elastic. The elastic and shear moduli for this alloy are 65.5 and 25.4 GPa, respectively.

6.24 A cylindrical rod 120 mm long and having a diameter of 15.0 mm is to be deformed using a tensile load of 35,000 N. It must not experience either plastic deformation or a diameter reduction of more than 1.2 × 10–2 mm. Of the following materials listed, which are possible candidates? Justify your choice(s).

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| --- | --- | --- | --- |
| **Material** | **Modulus of Elasticity (GPa)** | **Yield Strength (MPa)** | **Poisson’s Ratio** |
| Aluminum alloy | 70  | 250 | .33 |
| Titanium alloy | 105 | 850 | .36 |
| Steel alloy | 205 | 550 | .27 |
| Magnesium alloy | 45 | 170 | .35 |

6.46 For some metal alloy, a true stress of 345 MPa (50,000 psi) produces a plastic true strain of 0.02. How much does a specimen of this material elongate when a true stress of 415 MPa (60,000 psi) is applied if the original length is 500 mm (20 in.)? Assume a value of 0.22 for the strain-hardening exponent, n.

7.5 (a) Define a slip system. (b) Do all metals have the same slip system? Why or why not?

7.20 List four major differences between deformation by twinning and deformation by slip relative to mechanism, conditions of occurrence, and final result.

7.25 The lower yield point for an iron that has an average grain diameter of 1 × 10–2 mm is 230 MPa (33,000 psi). At a grain diameter of 6 × 10–3 mm, the yield point increases to 275 MPa (40,000 psi). At what grain diameter will the lower yield point be 310 MPa (45,000 psi)?

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

7.40 A hypothetical metal alloy has a grain diameter of 1.7 × 10-2 mm. After a heat treatment at 450 ° C for 250 min the grain diameter has increased to 4.5 × 10-2 mm. Compute the time required for a specimen of this same material (i.e., d0 = 1.7 × 10-2 mm) to achieve a grain diameter of 8.7 × 10-2 mm while being heated at 450 ° C. Assume the n grain diameter exponent has a value of 2.1