

**Problem 2.18** Polyethylene with  $\epsilon_r = 2.25$  is used as the insulating material in a lossless coaxial line with characteristic impedance of  $50\ \Omega$ . The radius of the inner conductor is 1.2 mm.

- (a) What is the radius of the outer conductor?
- (b) What is the phase velocity of the line?

**Solution:** Given a lossless coaxial line,  $Z_0 = 50\ \Omega$ ,  $\epsilon_r = 2.25$ ,  $a = 1.2\text{ mm}$ :

- (a) From Table 2-2,  $Z_0 = (60/\sqrt{\epsilon_r}) \ln(b/a)$  which can be rearranged to give

$$b = ae^{Z_0\sqrt{\epsilon_r}/60} = (1.2\text{ mm})e^{50\sqrt{2.25}/60} = 4.2\text{ mm}.$$

- (b) Also from Table 2-2,

$$u_p = \frac{c}{\sqrt{\epsilon_r}} = \frac{3 \times 10^8\text{ m/s}}{\sqrt{2.25}} = 2.0 \times 10^8\text{ m/s}.$$

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