Answer on Question #40594 – Physics – Acoustics

For a metal rod, the value of Young's modulus is 1.5X10^11 Nm^-2 and density is 7500 kgm^-3 Calculate the speed of sound in the metal rod.

Solution:

$\mathrm{E} = 1.5 \times 10^{11} \frac{\mathrm{N}}{\mathrm{m}^2} -$ Young's modulus of the metal rod;

$\rho = 7500 \frac{\mathrm{kg}}{\mathrm{m}^3} -$ density of the metal rod;

The propagation speeds of traveling waves are characteristic of the media in which they travel and are generally not dependent upon the other wave characteristics such as frequency, period, and amplitude. The speed of sound in air and other gases, liquids, and solids is predictable from their density and elastic properties of the media (Young's modulus). In a volume medium the wave speed takes the general form:

$$\mathrm{c} = \sqrt{\frac{\mathrm{E}}{\rho}} = \sqrt{\frac{1.5 \times 10^{11} \frac{\mathrm{N}}{\mathrm{m}^2}}{7500 \frac{\mathrm{kg}}{\mathrm{m}^3}}} = 4472 \frac{\mathrm{m}}{\mathrm{s}}$$

Answer: speed of sound in the metal rod is equal to $4472 \frac{\mathrm{m}}{\mathrm{s}}$.