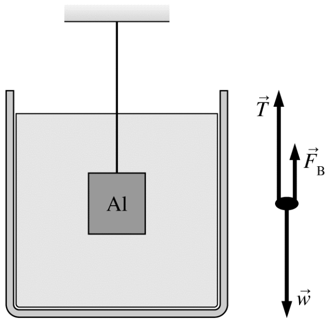
15.19. Model: The buoyant force on the aluminum block is given by Archimedes' principle. The density of aluminum and ethyl alcohol are $\rho_{\text{Al}} = 2700\ \text{kg/m}^3$ and $\rho_{\text{ethyl alcohol}} = 790\ \text{kg/m}^3$.

Visualize:



The buoyant force F_B and the tension due to the string act vertically up, and the weight of the aluminum block acts vertically down. The block is submerged, so the volume of displaced fluid equals V_{Al}, the volume of the block.

Solve: The aluminum block is in static equilibrium, so

$$\sum F_y = F_B + T - w = 0\ \text{N} \Rightarrow \rho_f V_{\text{Al}} g + T - \rho_{\text{Al}} V_{\text{Al}} g = 0\ \text{N} \Rightarrow T = V_{\text{Al}} g(\rho_{\text{Al}} - \rho_f)$$

$$T = (100 \times 10^{-6}\ \text{m}^3)(9.80\ \text{m/s}^2)(2700\ \text{kg/m}^3 - 790\ \text{kg/m}^3) = 1.87\ \text{N}$$

where we have used the conversion $100\ \text{cm}^3 = 100 \times (10^{-2}\ \text{m})^3 = 10^{-4}\ \text{m}^3$.

Assess: The weight of the aluminum block is $\rho_{\text{Al}} V_{\text{Al}} g = 2.65\ \text{N}$. A similar order of magnitude for T is reasonable.