d_0 = 100 mm

These d_i data are tabulated in the second column of Table 16.D2. No entry is included for glass. The elastic modulus for glass fibers is so low that it is not possible to use them for a tube that meets the stipulated criteria; mathematically, the term within brackets in the above equation for d_i is negative, and no real root exists. Thus, only the three carbon types are candidate fiber materials.

Table 16.D2 Inside Tube Diameter, Total Volume, and Fiber, Matrix, and Total Costs for Three Carbon-Fiber Epoxy-Matrix Composites

Fiber Type	Inside Diameter (mm)	Total Volume (cm^3)	Fiber Cost ($)	Matrix Cost ($)	Total Cost ($)
Glass	–	–	–	–	–
Carbon--standard modulus	70.4	3324	83.76	20.46	104.22
Carbon--intermediate modulus	78.9	2407	121.31	14.82	136.13
Carbon--high modulus	86.6	1584	199.58	9.75	209.33

(b) Also included in Table 16.D2 is the total volume of material required for the tubular shaft for each carbon fiber type; Equation 16.24 was utilized for these computations. Since V_f = 0.40, 40% this volume is fiber and the other 60% is epoxy matrix. In the manner of Design Example 16.1, the masses and costs of fiber and matrix materials were determined, as well as the total composite cost. These data are also included in Table 16.D2. Here it may be noted that the carbon standard-modulus fiber yields the least expensive composite, followed by the intermediate- and high-modulus materials.