3. (a) The current in each strand is $i = 0.750$ A/63 $= 1.19 \times 10^{-2}$ A = 11.9 mA.

(b) The potential difference is $V = iR = (1.19 \times 10^{-2}\ \text{A})\ (2.65 \times 10^{-6}\ \Omega) = 3.15 \times 10^{-8}$ V.

(c) The resistance is $R_{\text{total}} = (2.65 \times 10^{-6}\ \Omega)/63 = 4.21 \times 10^{-8}\ \Omega$.

15. (a) From $P = V^2/R = AV^2 / \rho L$, we solve for the cross-sectional area:

$$A = \frac{\rho LP}{V^2} = \frac{(5.00\times10^{-7}\ \Omega\cdot\text{m})(5.85\text{ m})(4000\text{ W})}{(112\text{ V})^2} = 9.33\times10^{-7}\text{ m}^2.$$

(b) Since $L \propto V^2$ the new length should be

$$L' = L\left(\frac{V'}{V}\right)^2 = (5.85\text{ m})\left(\frac{100\text{ V}}{112\text{ V}}\right)^2 = 4.66\text{ m}.$$

36. Since the potential difference V and current i are related by $V = iR$, where R is the resistance of the electrician, the fatal voltage is $V = (50 \times 10^{-3}\ \text{A})(2100\ \Omega) = 105\ \text{V}$.

45. (a) The current resulting from this non-uniform current density is

$$i=\int_{\text{cylinder}} J_a\, dA=\frac{J_0}{R}\int_0^R r\cdot 2\pi r dr=\frac{2}{3}\pi R^2 J_0=\frac{2}{3}\pi(2.67\times10^{-3}\,\text{m})^2(5.50\times10^4\,\text{A/m}^2)\,.$$
$$=0.821\ \text{A}.$$

(b) In this case, we have

$$i=\int_{\text{cylinder}} J_b\, dA=\int_0^R J_0\left(1-\frac{r}{R}\right)2\pi r dr=\frac{1}{3}\pi R^2 J_0=\frac{1}{3}\pi(2.67\times10^{-3}\,\text{m})^2(5.50\times10^4\,\text{A/m}^2)$$
$$=0.411\ \text{A}.$$

(c) The result is different from that in part (a) because J_b is higher near the center of the cylinder (where the area is smaller for the same radial interval) and lower outward, resulting in a lower average current density over the cross section and consequently a lower current than that in part (a). So, J_a has its maximum value near the surface of the wire.

48. (a) Since the material is the same, the resistivity ρ is the same, which implies (by Eq. 26-11) that the electric fields (in the various rods) are directly proportional to their current-densities. Thus, J_1: J_2: J_3 are in the ratio 2.5/4/1.5 (see Fig. 26-27). Now the currents in the rods must be the same (they are "in series") so

$$J_1 A_1 = J_3 A_3 , \ J_2 A_2 = J_3 A_3 .$$

Since $A = \pi r^2$, this leads (in view of the aforementioned ratios) to

$$4r_2^2 = 1.5r_3^2 , \ 2.5r_1^2 = 1.5r_3^2 .$$

Thus, with r_3 = 1.70 mm, the latter relation leads to $r_1 = (1.5/2.5)^{1/2}(1.70 \text{ mm}) = 1.32 \text{ mm}$.

(b) The $4r_2^2 = 1.5r_3^2$ relation leads to $r_2 = (1.5/4.0)^{1/2}(1.70 \text{ mm}) = 104 \text{ mm}$.