

task_rj0r6j4apumukrj6_with_calculation

Student Group

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resistivity, power, exam ee1 WS2022

Exercise E1 Resistance of a Wire by Resistivity (written test, approx. 6 % of a 60-minute written test, WS2022)

A heating element made of nichrome wire with a temperature coefficient of $1.80 \times 10^{-5} \text{ } ^\circ\text{C}^{-1}$ is electrically connected to a 230 V AC power supply. A power dissipation (= heat flow) of $P=40 \text{ W}$ is necessary. Determine the current I and the operating voltage U for heating elements. The Nichrome wire has a resistivity of $1.10 \cdot 10^{-6} \text{ } \Omega \cdot \text{m}$. The heating element is 3 m long and has a diameter of 3.57 mm .
 .. Calculate the resistance R of the heating element.

Solution

$$P = U \cdot I = R \cdot I^2 \quad \rightarrow \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{40 \text{ W}}{0.33 \text{ } \Omega}} \quad \text{end{align*}}$$

$$R = \rho \cdot \frac{l}{A} \quad | \quad \text{with } A = r^2 \cdot \pi = \frac{1}{4} d^2 \cdot \pi \quad \parallel \quad R = \rho \cdot \frac{4 \cdot l}{d^2 \cdot \pi} \quad \parallel \quad R = 1.10 \cdot 10^{-6} \text{ } \Omega \cdot \text{m} \cdot \frac{4 \cdot 3 \text{ m}}{(3.57 \cdot 10^{-3} \text{ m})^2 \cdot \pi} \quad \parallel \quad \text{end{align*}}$$

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