

task_rj0r6j4apumukrj6_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

resistivity, power, exam WS2022

Place the page description here

Excercise 1 : Temperature-dependent resistance of a wire

(written test, approx. 6% of a 60-minute written test, WS2022)

A heating element made of a Nichrome wire with a round cross-section is used in an electric oven. Nichrome is a common Nickel Chromium alloy for heating elements.

The Nichrome wire has a resistivity of $1.10 \cdot 10^{-6} \text{ } \Omega \text{ m}$.

The heating element is 3 m long and has a diameter of 3.57 mm .

1. Calculate the resistance R of the heating element.

Solution

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

Final result

$$\begin{aligned} R &= 0.33 \text{ } \Omega \quad \end{aligned}$$

2. The heating element is used to heat the oven to a temperature of 180°C . For this, a power dissipation (= heat flow) of $P=40 \text{ W}$ is necessary.

Calculate the current I needed to operate it.

Solution

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

Final result

$$\begin{aligned} I &= 11 \text{ A} \quad \end{aligned}$$

From: <https://mexle.te.hs-heilbronn.de/> - MEXLE Wiki

Permanent link: https://mexle.te.hs-heilbronn.de/electrical_engineering_1/task_rj0r6j4apumukrj6_with_calculation?rev=1676152063

Last update: 2023/02/11 22:47

