Experiment 7
Lee's Method

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Synopsis

In this experiment the thermal conductivity of a bad conductor is measured.

I. THEORY AND PROCEDURE

A. Apparatus

- Lee's Apparatus
- Bad conductor discs
- Two thermometers
- Boiler and Induction
- Stop watch
- Weighing balance
- Vernier Caliper
- Screw gauge

B. Theory

Fourier's Law of heat conductance gives the rate of transfer of heat between two objects at temperatures T2 and T1 connected by a conductor with conductivity k and cross-sectional areas A (assumed uniform) and length l as

C. Procedure

1. Fill the boiler with water to nearly half and heat it to produce steam. In the mean time, weigh the disc D1 on which the apparatus rests. Further, measure the diameter of specimen disc d with a vernier calliper and its thickness using a screw gauge at several spaces and determine the mean thickness. Clamp the glass specimen between the base disk D2 of the steam jacket and the auxiliary brass disc D1. Insert the thermometers (either mercury thermometer or thermocouples) in the two brass disks D1,D2. Check if they show the same readings at room temperatu

1. Precautions

- PRECAUTIONS

II. OBSERVATIONS

Least count of scale: 0.1 cm
Least count of thermometer: 0.1 °C
Least count of spherometer: 10^{-5} m

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Material	T_i (°C)	Length (cm)	ΔL (10^{-5} m)
Copper	24.0	59.8	75
Copper	25.5-24.5-25.5	59.7	74
Aluminium	24.0-23.0-24.7	59.9	105
Brass	24.1-23.2-24.3	59.7	85
Steel	22.1-24.8-20.5	-	74
Aluminium	24.3-23.7-24.3	59.8	104
Brass	23.7-22.4-24.3	60.0	85
Steel	24.6-25.3	59.9	76
Brass	24.8-25.3	60.1	86
Steel	23.3-23.5	59.7	76

TABLE I. Data taken on 11 Mar 2025, the variables represents the property as described in the theory.

III. UNCERTAINTIES AND ERROR SOURCES

A. Measurement Uncertainties

- **Length Measurements:** Estimated uncertainty of ± 0.1 cm due to not proper method of viewing, expansion uncertainty of $\pm 5 \times 10^{-6}$ m.
- **Temperature Measurements:** Uncertainty of ± 0.05 K due to instrument resolution.

B. Random Errors

- Errors in the final value of α due to different rods having different material composition

C. Systematic Errors

- Errors from the uneven temperature of the rod during the initial temperature measurement
- Improper contact between the thermometer and the metal rod during temperature measurement

IV. CALCULATION AND ERROR ANALYSIS

A. Error Propagation

From the length and temperature uncertanity, the formula given in the thory the uncertanity will travel as: REFRENCE THE BOOOkThe uncertainty in α is given by the basic formula for error propagation.:

$$\sigma_\alpha = \alpha\sqrt{\left(\frac{\sigma_{\Delta L}}{\Delta L}\right)^2 + \left(\frac{\sigma_L}{L}\right)^2 + \left(\frac{\sigma_{\Delta T}}{\Delta T}\right)^2}$$

where $\sigma_{\Delta L}, \sigma_L, \sigma_{\Delta T}$ are the uncertainties in expansion length, initial length, and temperature difference, respectively.

B. Calculation

We calculate the value of α of all data points and their uncertainity from hte above formul, we get:[1]

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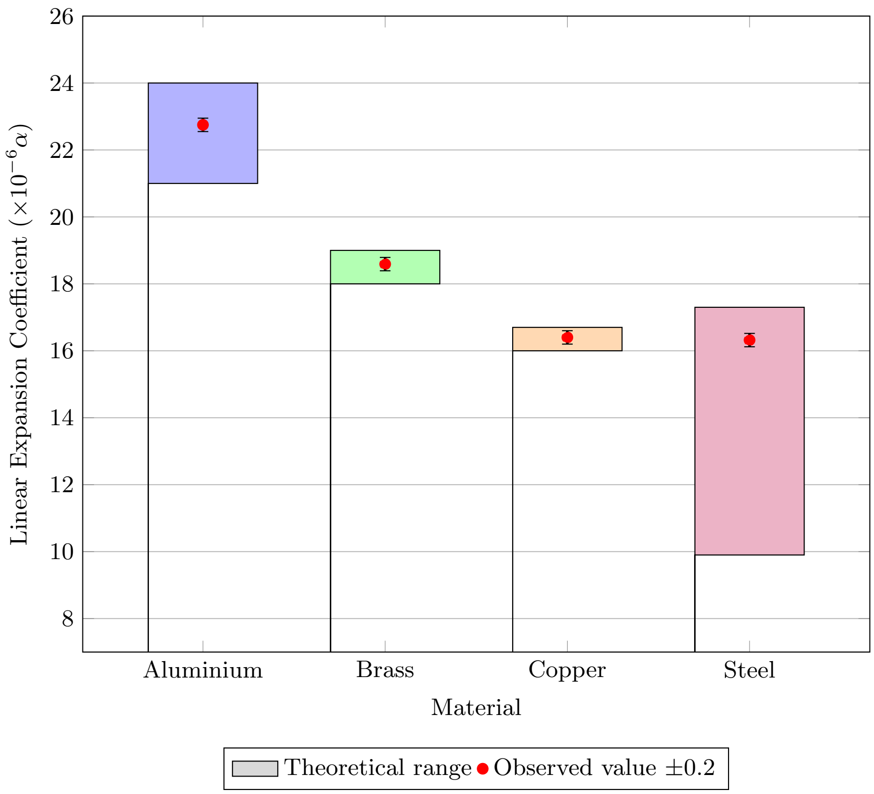
[1] Refer to **?** for calculations

Material	α (1/°C)
Aluminium	$(2.303 \pm 0.005) \times 10^{-5}$
Aluminium	$(2.291 \pm 0.005) \times 10^{-5}$
Brass	$(1.870 \pm 0.004) \times 10^{-5}$
Brass	$(1.851 \pm 0.004) \times 10^{-5}$
Brass	$(1.909 \pm 0.004) \times 10^{-5}$
Copper	$(1.650 \pm 0.003) \times 10^{-5}$
Copper	$(1.656 \pm 0.003) \times 10^{-5}$
Steel	$(1.591 \pm 0.003) \times 10^{-5}$
Steel	$(1.691 \pm 0.003) \times 10^{-5}$
Steel	$(1.662 \pm 0.003) \times 10^{-5}$

TABLE II. Calculated expansion coefficients

V. RESULT

The calculated values of α show high precision but large variations from expected values. The inconsistencies suggest experimental errors, leading to unreliable results.



Lets fucking go

Appendix A: Theoretical Values

The expected values of α in $^{\circ}\mathrm{C}^{-1}$ are:[2]

$$\begin{aligned} \alpha_{\text{Steel}} &\approx (1.08 - 1.25) \times 10^{-5} \\ \alpha_{\text{Brass}} &\approx (1.8 - 1.9) \times 10^{-5} \\ \alpha_{\text{Aluminium}} &\approx (2.1 - 2.4) \times 10^{-5} \\ \alpha_{\text{Copper}} &\approx 1.78 \times 10^{-5} \end{aligned}$$

[2] **?**