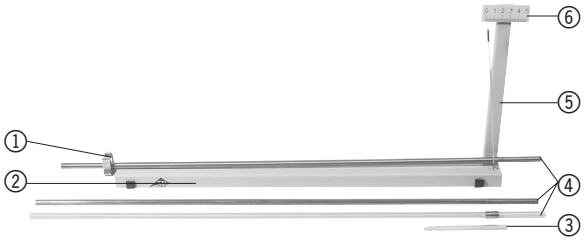
U15405 Linear thermal expansion apparatus

Instruction sheet

3/03 ALF



① *Spring clip*
② *Base track*
③ *Glass rod*
④ *Test rods*
⑤ *Pointer*
⑥ *Scale*

The apparatus demonstrates the linear expansion of solid materials and allows the determination of expansion coefficients for copper, iron and glass.

1. Safety instructions

- Caution. The experimental procedure results in hot steam.
- Do not touch heated rods with your fingers. Use cloths when replacing rods.
- Do not subject the glass rod to mechanical stresses.

2. Description, technical data

The equipment consists of a base track with a spring clip at the left-hand end for attaching a testing rod. At a distance of 50 cm from the end there is a notch in the base strip for the pointer. The copper and iron test rods have a ring nut 65 cm from the end for placing on the pointer. The glass rod has a metal ring with a ring nut in the same place. Behind the pointer is a 0-5 cm scale. To feed in hot steam, a 10 cm long glass rod attached to a hose is provided.

Dimensions:	530 mm x 60 mm x 240 mm
Weight:	0.6 kg
Length of rods:	630 mm approx.
Diameter of rod:	8 mm approx.
Length of pointer:	200 mm
Scale markings:	mm
Scale factor:	1 : 50

3. Principle

To determine the linear expansion coefficient α for various materials, it is necessary to measure the expansion for a certain temperature rise ΔT. Thus the rods are heated to 100° C by means of steam and the temperature difference ΔT from room temperature is calculated. The expansion is determined from the movement of the pointer d, where a pointer movement of 50 mm indicates an expansion of 1mm. The expansion coefficient is determined from the extension w (scale factor 1:50) and the length of rod l between the two fixed points by means of the formula:

$$\alpha = \frac{d}{l \cdot w \cdot \Delta T}$$

4. Instructions for use

Also required for heating the rods is a vapor generator or a bunsen burner heating an Erlenmeyer flask

- Attach the end of the rod without the nut to a rubber hose and secure in the spring clip.
- Place the pointer in the notch under the scale and attach the upper end of the pointer to the rod with the ring nut.
- Adjust the pointer to zero by sliding the rod.
- Attach to a steam generator or an Erlenmeyer flask half-filled with water by means of the short glass rod and a hose.
- Boil water. Steam flows through the test rod and heats it to approximately 100° C.

(***Note***: at high altitudes, water boils at slightly less than 100° C.)

- When steam has been passing through the rod for about 1 minute and no more condensing steam is emerging from the end of the rod, read off the largest movement of the pointer.

5. Example calculation

Room temperature T_1 = 22°C
Temperature of steam = 100° C
Temperature rise ΔT= 78° C
Pointer movement for copper rod d = 32.5 mm
Extension w = 50
Length of rod l = 500 mm

$$\alpha = \frac{32.5}{500 \cdot 50 \cdot 78} = 16{,}7 \cdot 10^{-6} \text{ /° C}$$

Table of values:

Copper:	$16.8 \cdot 10^{-6}$ /° C
Iron:	$12 \cdot 10^{-6}$ /° C
Glass:	$9 \cdot 10^{-6}$ /° C