

Operating Instructions

Dilatometer with clock gauge

04233.00



1 PURPOSE AND CHARACTERISTIC FEATURES

The dilatometer with clock gauge enables the linear thermal expansion coefficients of solid materials to be determined. The linear expansion of a tube which is flown through by water is measured as a function of the change in temperature of the water.

The apparatus consists of a base plate to which one part of the tube can be firmly fixed, while one end of the tube presses against the clock gauge feeler. The expansion of the tube under examination on change in temperature is so transmitted directly to the clock gauge. Each tube can be fixed in three different positions for measurements to be made with three different tube lengths (200 mm, / 400 mm / 600 mm).

2 FUNCTION ELEMENTS AND OPERATING ELEMENTS

1 Base plate

With measuring device and supports for a measurement tube. Clamps in the underside of the base plate allow two tubes which are not in use to be stored there.

2 Fixing support

For fixing one part of the measurement tube. The support is attached to the base plate at the 600 mm mark with a milled screw. It can be removed from this position and be attached to the base plate at the 400 mm or 200 mm marking.

3 Resting support

Freely supports the end of the measurement tube which presses against the clock gauge feeler.

4 Hose clamps

For holding the inlet and outlet hoses transporting water into and out of the tube.

- 5 Clamping device For fixing the clock gauge.
- 6 Clock gauge For measurement of the linear expansion.
- 7 Measurement tubes

With hose nipples for connection of the water inlet and outlet hoses, and with circular grooves for positioning the tube in the fixing support at the defined 200 mm, 400 mm or 600 mm measurement lengths.

3 HANDLING

The apparatus is supplied with the fixing support *3* attached to the base plate at the 600 mm marking. You must appropriately change its position for a shorter tube length. To insert the measurement tube in the dilatometer, first guide it from the inside through the fixing support and then push the closed end from the inside through the resting support. For the correct hold in the fixing support, ensure that the milled screw exactly catches the circular groove in the tube when it is tightened, then check that it holds the tube so firmly that it cannot be moved.

Slide the clock gauge in the direction of the clamping device 5 until the dial pointer is deflected a little, then fix it in this position by screwing the clamp tight. Turn the outer ring of the clock gauge to move the dial so that the pointer is at the zero point.

Connect rubber tubing (i.d. = 6 mm) to the two hose nipples so that the water flows in at the hose nipple at the closed end and out of the other hose nipple. Fix the tubings in the hose clamps 4 so that no unintentional force is exerted on the measurement tube. Control the temperature of the water with a thermostat.

When the glass measurement tube is used, the linear expansion is so small that the warming up and expansion of the base plate can cause a noticeable measurement error. We therefore recommend in this case that the measurement only be carried out at two temperatures. First carry out the measurement with hot water, then replace the hot water in the thermostat with cold water. With this succession, the time of temperature change is brief and the temperature of the base plate remains approximately constant.

4 **EXPERIMENT**

The thermal expansion is given by:

 $\Delta I = \alpha \cdot I_0 \cdot \Delta \vartheta \qquad ,$

where Δl is the linear expansion resulting from the temperature change $\Delta \vartheta$, l_0 the total length of the tube before heating it and α the linear expansion coefficient.

Values for α given in the literature:

Brass	18 ⋅ 10 ⁻⁶ ⋅ K ⁻¹
Steel	1112 · 10 ⁻⁶ · K ⁻¹
Duran glass	3,2 · 10 ⁻⁶ · K ⁻¹

With measurement tubes made of other materials, available as accessories, the following linear expansion coefficients can be determined:

Aluminium	23 · 10 ⁻⁶ · K ⁻¹
Copper	17 · 10 ⁻⁶ · K ⁻¹
Quartz glass	0,45 · 10 ⁻⁶ · K ⁻¹

5 LITERATURE

Laboratory Experiments Physics Exp. Nr. 3.1.01

6 LIST OF EQUIPMENT

Linear expansion apparatus		04231.01
Copper tube		04231.05
Aluminium tube		04231.06
Quartz tube		04231.07
Rubber tubing, i.d. = 6 mm	(2x)	39282.00
Immersion thermostat		46994.93
Cooling coil		46994.01
Set of accessories for immersion thermostat	i	46994.02
Bath for thermostat, Makrolon		08487.02
Replacement material for 04231.01:		
Brass tube		04231.02
Iron tube		04231.03
Glass tube		04231.04

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7 NOTE ON THE GUARANTEE

We guarantee the instrument supplied by us for a period of 6 months. This guarantee does not cover natural wear nor damage resulting from improper handling.

The manufacturer can only be held responsible for the function and safety characteristics of the instrument, when maintenance, repairs and changes to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.