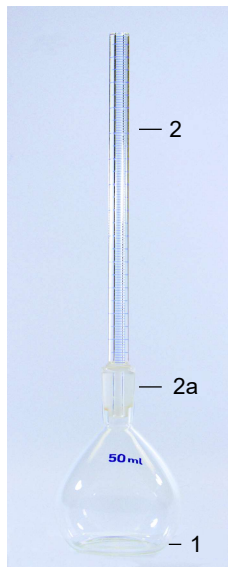


Volume Dilatometer 1024297

Instruction sheet

12/25 HJB/DA



- 1 Glass vessel
- 2 Graduated riser tube with ground joint (2a)

1. Safety instructions

The dilatometer for the investigation of volumetric expansion is made of glass. There is a risk of breakage and therefore of injury!

- Handle the dilatometer carefully
- Avoid an exertion of mechanical loads on this instrument.
- Take care not to scald yourself when using hot water

2. Description

The volume dilatometer is for investigations of changes in volume in a liquid as a function of temperature. By this, the volume expansion coefficient γ of a liquid (here water) can be determined.

When a sample liquid is heated or cooled in a water bath, a change of its volume ΔV with the change of its temperature $\Delta T = (T_2 - T_1)$ can be observed and this by the change of the liquid level Δh in the riser tube.

By taking into account the change in volume of the dilatometer itself by a correction constant γ_D , the volume expansion coefficient $\gamma \left(T = \frac{T_1 + T_2}{2} \right)$ of the liquid at a certain temperature T results in:

$$\gamma(T) = \frac{1}{V_0} \cdot \frac{\Delta V}{\Delta T} + \gamma_D \quad (1)$$

with:

$$\gamma_D = 0.84 \cdot 10^{-4} \text{ K}^{-1}$$

$$\Delta V = \pi \cdot r^2 \cdot \Delta h, \quad \text{where } r = (1.5 \pm 0.05) \text{ mm}$$

V_0 : initial volume of the water in the vessel

3. Technical data

Glass vessel:

Volume: $\sim 68 \text{ cm}^3$

Volume expansion coefficient γ_D : $0.837 \cdot 10^{-4} \text{ K}^{-1}$

Riser tube:

Maximum rise height (without glass ground): $\sim 210 \text{ mm}$

Inside diameter: $(2.5 \pm 0.1) \text{ mm}$

Outside diameter: $(8.0 \pm 0.25) \text{ mm}$

Dilatometer in total:

Height: $\sim 315 \text{ mm}$

Weight: $\sim 66 \text{ g}$

4. Required Equipment

- Volume dilatometer
- Distilled water
- Water bath, e.g. water filled beaker
- Heater
- Thermometer, digital recommended (e.g. 1002803 + 1002804)
- Stand with clamp
- (Electronic) balance, rcmd. accuracy: 0.1 g (e.g. 1022627)

5. Sample Preparation

- Before the first use clean the inside of the vessel and of the riser tube with isopropanol. Dry both with oil-free, compressed air.
- To reduce the oxygen content and therefore to avoid air bubbles during the experiment, bring the distilled water almost to boiling and cool it down to room temperature afterwards.

6. Determination of V_0

- Determine the mass m_1 of the empty, dry volume dilatometer.
- Fill the vessel with distilled water to the half the height of the ground glass.
- Measure the temperature T_0 of the water in the vessel.
- Put the riser tube on the vessel; the water is rising a little bit inside the capillary.
- Remove this excess of water by: pressing a finger on the opening of the riser tube, remove the tube with the closed opening and allow the water to drain. A subsequent drying of the riser tube with oil-free, compressed air is recommended.
- Replace the dried riser tube on the vessel again and check, if the now filled dilatometer is completely dry.
- Measure the mass m_2 of the water-filled dilatometer.

With the determined masses m_1 and m_2 the initial volume of the water V_0 at the initial temperature T_0 is:

$$V_0 = \frac{m_2 - m_1}{\rho_{T_0}},$$

where ρ_{T_0} is the density of the water at temperature T_0 .

For $T_0 \leq 30^\circ\text{C}$: $\rho_{T_0} \cong 1 \frac{\text{g}}{\text{cm}^3}$.

7. Determination of the volume expansion coefficient of water

To monitor the change in rising height Δh at given change in temperature ΔT the observation in the cooling phase of the water is recommended, as it gives enough time to collect these data in small temperature steps of $\Delta T = 1\text{K}$:

For this heat up the water-filled dilatometer in a water bath and stop heating before the water inside the riser tube is draining out at the end of the tube. Otherwise the wrong mass m_2 and the wrong resulting V_0 would be used.

With the collected Δh and $\Delta \vartheta$ and the known V_0 the volume expansion coefficient of water γ at temperature $T = \frac{T_1 + T_2}{2}$ is given by the formula (1).