

PHYWE Systeme GmbH & Co. KG
Robert-Bosch-Breite 10
37079 Göttingen
Germany

Tel. +49 (0) 551 604-0
Fax +49 (0) 551 604-107
E-mail info@phywe.de
Internet www.phywe.com

Operating instructions



Fig. 1: Calorimeter, 500 ml 04401-00

TABLE OF CONTENTS

- 1 SAFETY INSTRUCTIONS
- 2 PURPOSE AND CHARACTERISTICS
- 3 HANDLING
- 4 EXPERIMENTS
- 5 ACCESORIES
- 6 TECHNICAL DATA
- 7 WARRANTY
- 8 DISPOSAL

1 SAFETY INSTRUCTIONS



Caution!

- Read the operating instructions thoroughly and completely prior to using this instrument. This is important for your own protection and for avoiding damage to the unit.
- Do not start up this instrument should there be visible signs of damage to it.
- Only use the instrument for the purpose for which it is intended.

2 PURPOSE AND CHARACTERISTICS

Calorimeter 04401-00 is a water calorimeter with which the specific heat of solids or liquids can be determined. Conversion energies, such as the melting energy of ice, can also be determined. The unit is fitted with an electric heating system to heat up the contents. Power is supplied to the heating resistor over two 4 mm sockets in the lid. The lid has an orifice ($d = 10$ mm) to introduce a thermometer or a temperature probe. An agitator with a yoke handle, which can be lifted, passes through two smaller orifices in the lid. The calorimeter is designed to stand temperatures up to 100 °C.

3 HANDLING

The handling is explained taking the determination of specific thermal capacities as an example. In the case of solids, the mixing method is used, for liquids, energy is added by means of the electric heating element. In order to accelerate thermal equilibrium in the calorimeter, the agitator should be continuously moved during the experiment. It may, however, not be lifted to the point where water is splashed onto the styrofoam lining of the lid.

3.1 Mixing method

To determine the specific heat of solids according to the mixing method, a sample body of known temperature and mass is brought into thermal contact with a quantity of water of known temperature and thermal capacity inside the calorimeter. The specific heat of the sample is calculated from the temperature of the mixture after thermal equilibrium is reached.

Carrying out of experiment:

- An adequate quantity of liquid (200 ml or more) is weighed and filled into the calorimeter.
- The sample body is hanged from a support by means of a fishing thread and heated in a sufficiently stationary water bath, e. g. in boiling water to 100 °C. A gauze bag may be used to carry several small samples.
- The temperature of the heated sample (temperature of the bath) and the temperature of the water in the calorimeter are read as precisely as possible from the corresponding thermometers immediately before immersing the sample in the calorimeter.
- When one is certain the sample body has reached the temperature of the bath, it is immersed as fast as possible in the calorimeter. The calorimeter lid is closed at once and agitation starts.
- When temperature in the calorimeter begins to drop due to thermal release to the environment, maximum temperature is read as temperature of the mixture.

3.2 Electric heating method

To determine the specific heat of liquids, a quantity of liquid of known mass and temperature is filled into the calorimeter and heated by the electric heating element. The specific heat of the liquid is calculated from energy input and temperature increase.

Next to water, only such liquids may be filled into the calorimeter, which do not attack aluminium, nickel or styrofoam, e. g. all types of alcohol. Only alternating current should be used, to avoid corrosion of the heating element. It is furthermore recommended to use highly purified (distilled) water.

The heating element can only be operated when it is completely immersed in the liquid. A filling quantity of 200 ml is sufficient for this. The amount of added electric energy is determined measuring current intensity, voltage and heating time. Adequate current intensities: 3 ... 5 A. Adjustment of the supply voltage should be determined in a preliminary experiment, so that the required heating energy will be immediately available during the main experiment.

Carrying out the experiment:

- An adequate amount of liquid (200 ml or more) are weighed and filled into the calorimeter.
- Initial temperature is read; voltage supply and chronometer are switched on; continuous agitation is assured.
- After temperature has increased by 5 - 10 °C for example, voltage supply and chronometer are switched off simultaneously and the maximum value displayed by the thermometer, before temperature stops increasing, is read.

To obtain a more precise measurement, thermal energy released by the calorimeter to the environment must be taken into account. This is achieved by means of a correction of the read final temperature:

- a second experiment is carried out with the same calorimeter contents, during which the drop of temperature ε is measured at the average heating up temperature during a period of time which corresponds to the total heating time during the main experiment. Calculation is now repeated with the final temperature increased by ε .

4 EXPERIMENTS

Heat capacity of metals P2330101

5 ACCESORIES

Aluminium column	03903-00
Steel Column nickel-plated	03913-00
Metal bodies, set of 3	04406-00
Steel pellets, 120 g	03990-00
Glass beads, 250g	36756-25
Gauze bag	04408-10
Fish line, l = 100 m	02090-00

6 TECHNICAL DATA

Type Water calorimeter
Exterior dimensions d = 134 mm; h = 160 mm
Thermal insulation Styrofoam
Calorimetric capacity approx. 70 J/°C

Calorimeter vessel
Material aluminium
Capacity 500 ml
Dimensions d = 88 mm, h = 92 mm

Heating element
Material Canthal
Resistance 2.4 $\Omega \pm 0.2 \Omega$
Max. power
in water 60 W (12 V/5 A)
in air 10 W (5 V/2 A)
Operating power alternating voltage

7 WARRANTY

We give a warranty of 24 months for units that are supplied by us inside the EU, and a warranty of 12 months outside the EU. The following is excluded from the warranty: damage that is due to non-compliance with the operating instructions, improper use, or natural wear.

The manufacturer can only be held liable for the function and safety-relevant properties of the unit, if the maintenance, service, and modifications of the unit are performed by the manufacturer or by an institution that is expressly authorised by the manufacturer.

8 DISPOSAL

The packaging mainly consists of environmentally-friendly materials that should be returned to the local recycling stations.



Do not dispose of this product with normal household waste.
If this unit needs to be disposed of, please return it to the address that is stated below for proper disposal.

PHYWE Systeme GmbH & Co. KG
Customer Service
Robert-Bosch-Breite 10
37079 Göttingen
Germany

Phone +49 (0) 551 604-274
Fax +49 (0) 551 604-246