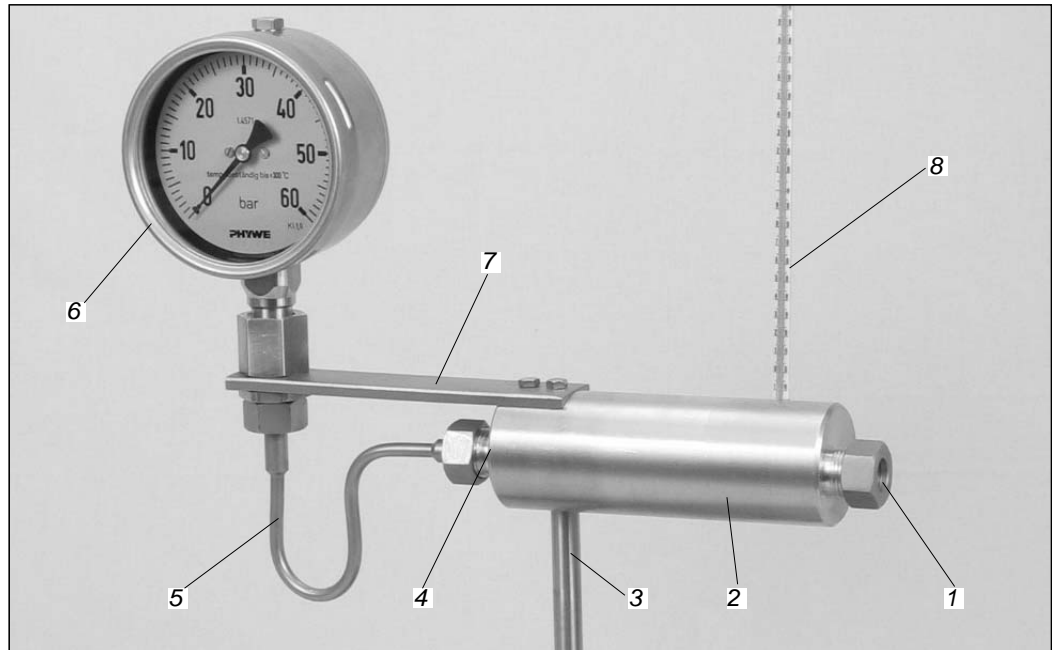


PHYWE Systeme GmbH & Co. KG  
Robert-Bosch-Breite 10  
D-37079 Göttingen

Phone +49 (0) 551 604-0  
Fax +49 (0) 551 604-107



## Operating Instructions

### 1 SAFETY PRECAUTIONS



- Carefully read the operating instructions supplied with the instrument before putting it into operation.
- Only use the instrument for the purpose for which it was designed.



#### Warning!

The apparatus can become very hot when used. There is a danger of burns to hands. Always wear protective, heat-insulated gloves when handling the apparatus!

The apparatus is under pressure during use, only open it after it has completely cooled!

### 2 PURPOSE AND DESCRIPTION

The high-pressure steam unit serves for the measurement of the vapour pressure (excess pressure) of water in the 100 ... 250 °C temperature range, and so for the examination of the equilibrium condition between gaseous and liquid phases that is typical for real gases and vapours.

### 3 APPROPRIATE APPLICATIONS

The specified working range for the measurement of the vapour pressure of water ends at a temperature of 250 °C and a pressure of 50 bar.

Connections are tightened together with union nuts, in which copper washers must be positioned for hermetic sealing. Use a 24 mm wrench for the three union nuts and a 27 mm wrench for the female manometer connector.

Do not subject the high vapour pressure unit to rapid cooling.

Because of the small amount of water used and the robust construction, there is no danger in carrying out experiments provided that the operating instructions are followed.

### 4 FUNCTION AND OPERATING ELEMENTS

- 1 Fill port, closable with a blind flange, for filling in water
- 2 Thick-walled metal cylinder with shaft for a thermometer serves as pressure chamber
- 3 Rod (can be screwed off), for holding the apparatus
- 4 Opening for the connection of a manometer
- 5 U-shaped connecting tube, connects the pressure chamber to the manometer
- 6 Manometer, for measurement of the pressure in the system
- 7 Support, for rigid mounting of the manometer
- 8 Thermometer (not included in the parts standardly for measurement of the the temperature of the system

## 5 HANDLING

### 5.1 Safety precautions

Because of the different thermal expansions of copper and the material of threaded connectors, leakage could occur in the course of the experiment and result in the emergence of hot steam. To avoid this, check the nuts during the experiment and re-tighten them if necessary. Wear heat-insulated protective gloves when doing this.

A protective plexiglas screen can be additionally placed in front of the apparatus as protection against sprays of steam. We recommend that it then be left standing there at the end of the experiment until the pressure chamber has cooled down, to provide protection against inadvertently touching it while hot.

### 5.2 Filling the pressure chamber

Fill the pressure chamber completely up to the fill port with distilled water (to avoid scaling of the sealing surfaces). When doing this, ensure that the U-shaped tube to the manometer is also filled with water. This is important for the pressure to be correctly transmitted to the manometer. If necessary, open the union nut on the manometer to allow remaining air to escape there. Should filling be incomplete, then all of the water in the pressure chamber could distill over into the cold manometer part, with the result that, despite increasing temperature, the pressure in the system does not increase.

Tightly close the carefully filled system by very firmly tightening the union nuts. This tightening must be strong enough to cause the copper washers to be so plastically deformed, that they compensate for any sealing surface irregularities. We recommend that the rod be screwed into the high-pressure steam unit before tightening is carried out, so that a greater leverage is possible without damaging the manometer or the U-shaped tube. Ensure also that the flange surfaces are clean and that the copper washers are suitably seated. The copper washers are subject to wear. Replace them with new ones when several experiments have been carried out.

Occasionally also tighten the union nuts on the manometer, and renew the copper gaskets.

### 5.3 Preparation for measurement

Before each heating up, check that all union nuts are tightly fitted. Put a 24 mm spanner that fits the union nuts and protective gloves in readiness for re-tightening the nuts when the chamber is hot.

Should the pressure chamber be heated with a gas burner, set up the unit with the rod in the tripod (see Fig. 2). Adjust the gas and air flows so that the temperature slowly increases, for the best possible heat exchange. Take care that the gas burner flame does not cause the temperature at the manometer or thermometer to exceed the maximum permissible values.

When heating with the electrical heater, screw the rod off and fix the pressure cylinder directly above the curved heating surface (see Fig. 3). Do not allow the pressure cylinder to lie on the heater, however, as this would make it difficult to draw out the cylinder, e.g. to re-tighten the union nuts when steam leaks out.

Apply heat conductive paste to the thermometer shaft in the wall of the cylinder and insert the thermometer as far as possible into the shaft.

### 5.4 Taking measurements for the vapour pressure curve

Both on heating and on cooling, read the vapour pressure at different temperatures and record the pressures and temperatures. The expected vapour pressure curve is obtained with a good accuracy, whereby, because of the inertia of the temperature measurement, the curve on cooling can lie a little above that on heating.



Fig.: 2

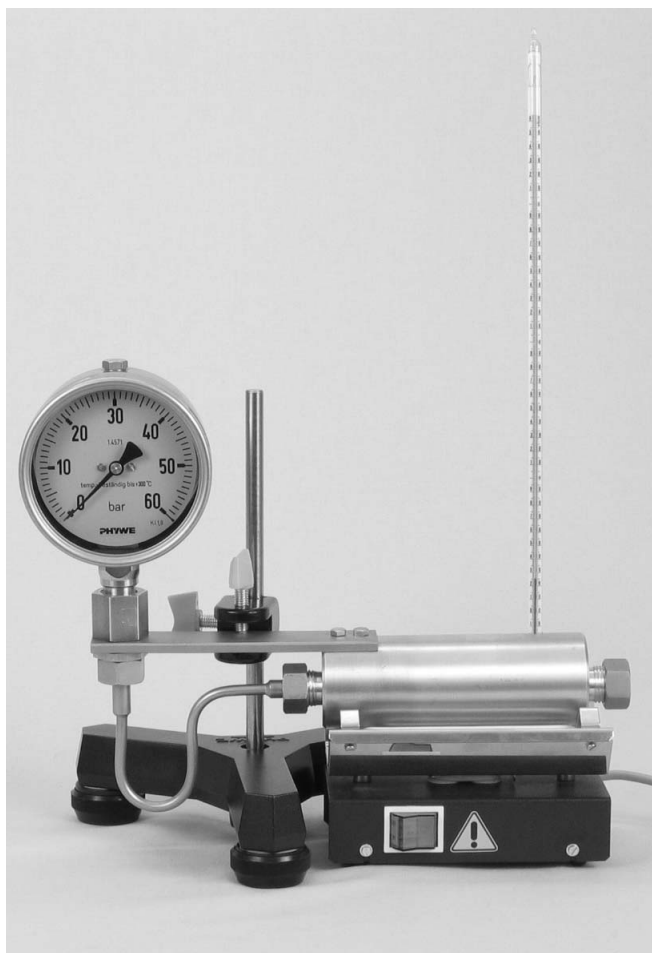


Fig.: 3

## 6 LITERATURE REFERENCES

Phywe Laboratory Experiments Physics,  
Experiment 3.4.01-00 16502.32  
Phywe Series of Literature Physics, Thermodynamics II

## 7 LIST OF EQUIPMENT

High-pressure steam unit with spare copper washers  
(ten with 10 mm bore, five with 6 mm bore) 02622.10  
Laboratory thermometer, - 10 ... + 25 °C 38065.00  
Protective screen 39159.01  
Heat conductive paste, 50 g 03747.00

Optionally, for the experimental set-up  
Bunsen support 37692.00  
Boss head 02043.00  
Heating apparatus 32246.93

or  
Tripod base 02002.55  
Butane burner 32178.00  
Butane cartridge without valve, 190 g 47535.00  
Spanner, 24 mm/27 mm  
Heat-insulated protective gloves

## 8 TECHNICAL SPECIFICATIONS

Working range of the high-pressure steam unit	0 ... 50 bar
Pressure chamber	
Outer dimensions	140 mm long, 50 mm diameter
Capacity	approx. 15 cm <sup>3</sup>
Manometer	
Scale	0 ... 60 bar
Scale division	1 bar
Rod	
	approx. 250 mm long (can be screwed off)
	12 mm diameter
Weight	approx. 2.25 kg

## 9 WASTE DISPOSAL

The packaging consists predominately of environmental compatible materials that can be passed on for disposal by the local recycling service.

Please contact your municipal administration for information on the disposal of instruments.

## 10 GUARANTEE

We guarantee the instrument supplied by us for a period of 12 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.