Vapor pressure and air pressure (with support equipment) **(Item No.: P1429302)**

Task and equipment

Introduction

Water is heated in a container until it boils, it is tightly sealed following this. The pressure in the container decreases as it cools. It is pressed together by the external air pressure.

The experiment can be setup with support equipment, as described here or on the board (P1429301).

Task

Equipment

Position No.	Material	Order No.	Quantity
1	Tripod base PHYWE	02002-55	1
2	Support rod PHYWE, square, l = 400 mm	02027-55	1
3	Right angle clamp PHYWE	02040-55	1
4	Support ring made of steel, d = 130 mm	37721-03	1
5	Tin can	02678-02	1
6	Beaker, 100 ml, short	36011-01	1
7	Wire gauze, ceramic cen, 160 x 160 mm	33287-01	1
8	Butane burner, Labogaz 206 type	32178-00	1
9	Butane cartridge C206	47535-01	1
10	Matches		
11	Gloves or cloth		

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Set-up and procedure

Set-up

- Attach the support ring to the support rod using the right-angle clamp, place the wire gauze, set the height in such a way that the distance to the burner amounts to approx. 1 cm.
- Fill approx. 50 ml of water into the tin can and place this on the wire gauze.
- Place the screw top on the opening nozzle of the can but do not seal it yet.

Fig.1

Procedure

Attention! Do not touch the hot tin can. Danger of getting burned!

- Heat the tin can on a low flame.
- Allow the water to boil for a few minutes (the air should completely escape from the can if possible).
- Remove the burner and switch it off.
- Screw the screw top of the tin can tight (cloth, gloves).
- Let the tin can cool down.

Fig.2

Results and evaluation

Results

When heating the water begins to boil then the steam escapes beneath the lid that has not been screwed tight. When it cools down the tin can is suddenly pressed together after a few minutes. This generally occurs in two or three steps.

Evaluation

If a liquid vaporizes or evaporates steam is present above its surface. This spreads out in the entire space that is available.
The water boils for a few minutes so that there is no more air in the can (if possible) and instead just water and steam. The liquid vapor has a vapor pressure that is only dependent on the temperature. It is the same volume as the ambient air pressure when the liquid boils.
The water and steam cools down again if the burner is removed. As a result the pressure (vapor pressure) in the interior of the canister decreases and the difference to the external air pressure is so great that the canister suddenly dents at one or several points.

Remarks:
To be able to estimate the pressure or forces that arise the vapor pressure of water at various temperatures must be known (table 1).

At an atmospheric pressure of 1013 hPa (normal pressure) water boils at 100°C, the vapor pressure at this temperature is thus the normal pressure. Once the steam cools to 20°C for instance the pressure in the canister is a mere 23 hPa. The atmospheric pressure is thus approx. 40 times greater than the vapor pressure in the vessel's interior.

The tin can has thin walls and additionally has edges on its lower and upper sides. It can therefore be dented in the event of this great pressure difference.

Table 1: Temperature ϑ and vapor pressure p of water

$\frac{\vartheta}{^\circ C}$	$\frac{p}{hPa}$
20	23
100	1013

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