

## Mechanics of liquids and gases

## Buoyancy

Dependence of the buoyancy force on the kind of liquid -  
Measurement via Sensor-CASSY and CASSY-Display

## Object of the experiment

- Investigating the dependence of the buoyancy force on the kind of liquid

## Setup



Preparation of the aluminium body:

- Thread a 30 cm long piece of fishing line through the bore of the aluminium body and knot the ends together.

Stand setup:

- Slide the 40 cm long stand tube over the other one by about 10 cm, and connect the tubes using the universal bosshead.
- Clamp the stand tube with the smaller diameter in the stand base.
- Fasten the Leybold-multiclamp to the other stand tube.
- The height of the stand setup can now be adjusted continuously by carefully loosening the lower screw of the universal bosshead.

Preparing the force measurement:

- Put the CASSY-Display into operation with the Sensor-CASSY being connected.
- Connect the force sensor to Input A..
- Switch the display of Input B off with the key NEXT (CASSY) at the display.
- Make the zero adjustment for the unloaded force sensor by pressing the key OFFSET (CALIBRATION) until the red LED blinks.
- After the zero has been adjusted, confirm by pressing the key OFFSET (CALIBRATION) once more.

## Apparatus

1 Aluminium block .....	362 32
1 Plastic beaker .....	590 06
1 Sodium chloride, 1 kg .....	673 5720
1 Methylated spirits, 1 l .....	670 9990
1 Force sensor S, $\pm 50$ N .....	524 042
1 Sensor-CASSY 2 .....	524 013
1 CASSY-Display USB .....	524 020USB
1 Stand base, V-shape, small .....	300 02
1 Stand tube, 450 mm, 10 mm diam., set of 2 .....	666 609ET2
1 Stand tube, 400 mm, 13 mm diam. ....	666 607
1 Stand rod, 25 cm, 12 mm diam. ....	300 41
1 Leybold-multiclamp .....	301 01
1 Universal bosshead .....	666 615
1 Fishing line, set of 2 .....	309 48ET2
1 Glass stirring rod, 300 mm x 8 mm diam. ....	665 213

## Carrying out the experiment

- Fill 1000 ml of water into the plastic beaker.
- Suspend the aluminium body from the force sensor and determine the gravitational force  $G$ .
- Then use the height-adjustable stand to lower the body until it is completely immersed.
- Read the force  $F'$  from the CASSY-Display and calculate the buoyancy force  $F_b$ .
- Lift the aluminium body to its initial position.
- Add 300 g of NaCl to the water in the plastic beaker and stir thoroughly using the glass stirring rod.
- Immerse the aluminium body completely in the salt solution, read the force  $F'$ , and calculate the buoyancy force again.
- Empty the plastic beaker and rinse it together with the aluminium body.
- Fill methylated spirit into the beaker, and repeat the experiment.
- Compare the forces of buoyancy to the densities of the liquids.

## Measuring example

Liquid	Water	Salt water	Spirit
Gravitational force $G$ in N	1.0	1.0	1.0
Force $F$ in N	0.66	0.60	0.72
Buoyancy force $F_b$ in N	0.34	0.40	0.28
Density $\rho$ in $\text{g/cm}^3$	0.99	1.13	0.83

## Evaluation

The magnitude of the buoyancy force depends on the kind of liquid.

The greater the density of a liquid, the greater the buoyancy force acting on a body.