Mechanics of liquids and gases
Buoyancy

Detecting the effect of a buoyancy force in liquids - Measurement via Sensor-CASSY and CASSY-Display

Objects of the experiments

1. Detecting the effect of a buoyancy force when a body is immersed in a liquid step by step
2. Demonstrating the independence of the buoyancy force of a completely immersed body on the depth of immersion

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.
- In order to have well-defined depths of immersion, make marks on one side of the aluminium body with a spacing of 1.5 cm.

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 Force sensor S, ±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 Universal bosshead	666 615
1 Leybold multiclamp	301 01
1 Fishing line, set of 2	309 48ET2
1 Black felt-tip pens, medium size, set of 5	667 019ET5

Carrying out the experiment

1. Detecting the effect of a buoyancy force:
   - Determine the gravitational force of the aluminium body by means of the force sensor.
   - Then immerse the body in the beaker, which is filled with water. Proceed step by step according to the marks on the body.
   - Each time read the acting force from the CASSY-Display.
2. Buoyancy force acting on a completely immersed body:
   - Slowly lower the completely immersed body in the water.
   - Observe the force displayed on the CASSY-Display.

Measuring example

1. Gravitational force of the aluminium body: G = 1.0 N

Depth of immersion s in cm	Force F' in N
1.5	0.93
3.0	0.83
4.5	0.73
6.0	0.63

2. At any depth of immersion, a force F' of 0.6 N is read from the display.

Evaluation

1. When a body is immersed in a liquid, a force acts on it in the opposite direction of the gravitational force. This force is called buoyancy force F_b. The magnitude of the buoyancy force is obtained from the difference of G and F': $F_b = G - F'$.
2. The buoyancy force acting on a body which is completely immersed in a liquid is independent of the depth of immersion.

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