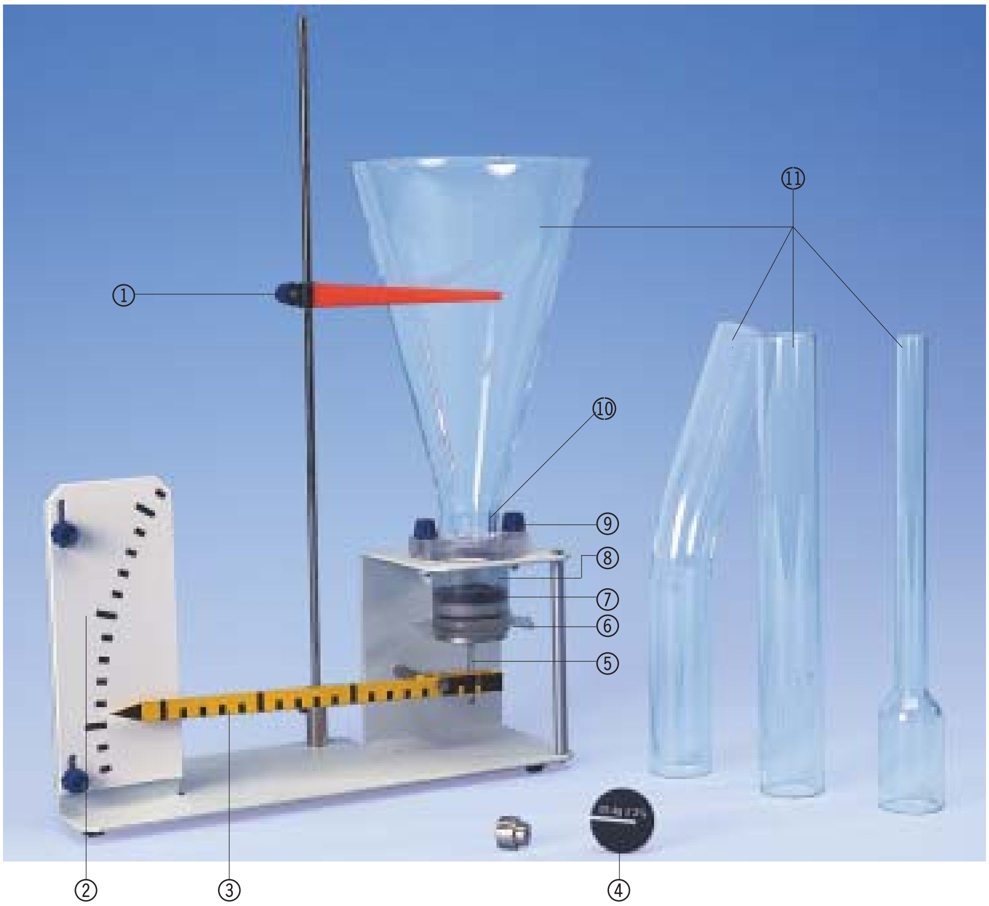
Pascal's vane apparatus U15070

Instruction sheet

08/05 ALF



① Level indicator
② Scale
③ Double-arm lever and scale
④ Slotted weight
⑤ Piston for transmitting forces
⑥ Rubber diaphragm
⑦ Sealing rings
⑧ Acrylic tube
⑨ Locking screws for tube nozzle
⑩ Outlet pipe at rear
⑪ Glass vessels

Pascal's vane apparatus is used for demonstrating the hydrostatic paradox and for quantitative measurements of pressure at the bottom of a fluid column as a function of its height.

1. Safety instructions

- Insert the glass vessels with care.
- Do not expose the glass vessels to any mechanical stress. They could break.
- Only use liquids that will not corrode the rubber diaphragm and sealing rings. Coloured water is recommended.

2. Description, technical data

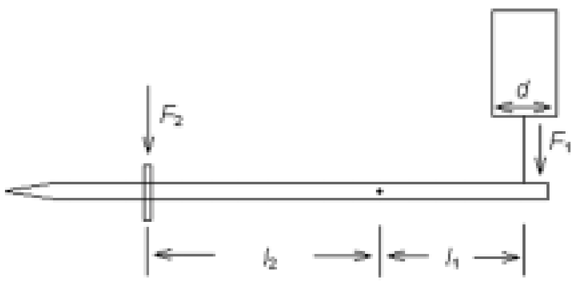
Pascal's vane apparatus consists of a metal base plate, on the right-hand side of which is mounted a bracket for an acrylic plastic tube ⑧ with sealing rings ⑦ and a rubber diaphragm ⑥ for supporting various glass vessels ⑪. The liquid in the glass vessels exerts a force on the rubber diaphragm. The force is transmitted from the diaphragm to the short arm of the lever ③ via a piston ⑤. The lever action means that the displacement due to the force can be seen enlarged at the end of the long arm. This displacement is indicated on a large scale and acts as a measure of the force. The height of the scale can be adjusted. By moving a slotted weight ④ along the long arm of the lever, the apparatus can be balanced to match the force acting on the short arm. Four glass vessels of different shapes ⑪ but with the same base area and height are available for experiments. A level indicator ① can be used to show the filling level of the glass vessels. An outlet pipe ⑩ at the rear of the acrylic tube allows a hose pipe to be connected for draining liquid.

Height of vessels:	220 mm
Diameter of base:	22 mm
Total height:	350 mm
Base plate dimensions:	260 mm x 100 mm
Length of lever arms:	20 mm, 175 mm
Outlet tube:	8 mm Ø
Mass of slotted weight:	20.4 g
Weight:	0.8 kg

3. Operation

- Set up the Pascal's vane apparatus on a high enough surface that liquid can drain away via the drainage hose into a beaker.
- On the movable scale, mark the balanced position of the lever with no force acting (and no slotted weight).
- Place a glass vessel into the Pascal's vane apparatus so that the outlet is sealed off.
- Pour some of the liquid being used for the experiment into the glass vessel and mark the filling level with the help of the level indicator.
- Balance the lever with the aid the slotted weight.
- In order to determine the pressure at the bottom of the tube, first calculate the force F_1 exerted by the liquid column on the diaphragm by multiplying the weight of the balancing mass F_2 by the ratio of the lengths of the lever arm l_1 and l_2.

$$F_1 = \frac{l_2 F_2}{l_1}$$



- The pressure at the bottom of the tube is given by:

$$P = \frac{F_1}{r^2 \pi}$$

  where r is the radius of the effective base surface of the vessel. (Measure the diameter of the tube $d = 2r$ using vernier callipers
- Lift up the glass vessel enough for the liquid to drain through the outlet and into a beaker.
- Thoroughly dry the apparatus to ensure that the tube does not get dirty due to residual liquid.

3.1 Replacing rubber diaphragm and seals

- In order to replace the rubber diaphragm and the seals, undo the screws ⑨ and pull out the acrylic tube ⑧ from above.
- Unscrew the bottom, i.e. the diaphragm holder, then remove the plastic ring and the damaged diaphragm.
- Secure the new diaphragm with the plastic ring. Make sure the membrane is slightly slack. If it is too taut experimental results may be in error.
- Screw the acrylic tube into the apparatus again.

If liquid starts to leak from glass vessels, even though they are correctly inserted, then the seals need to be replaced, as follows:

- Remove the acrylic tube ⑧ and unscrew the bottom, i.e. the diaphragm holder.
- Grip the lips of the seals and pull them out.
- Firmly press new sealing rings into the groove.