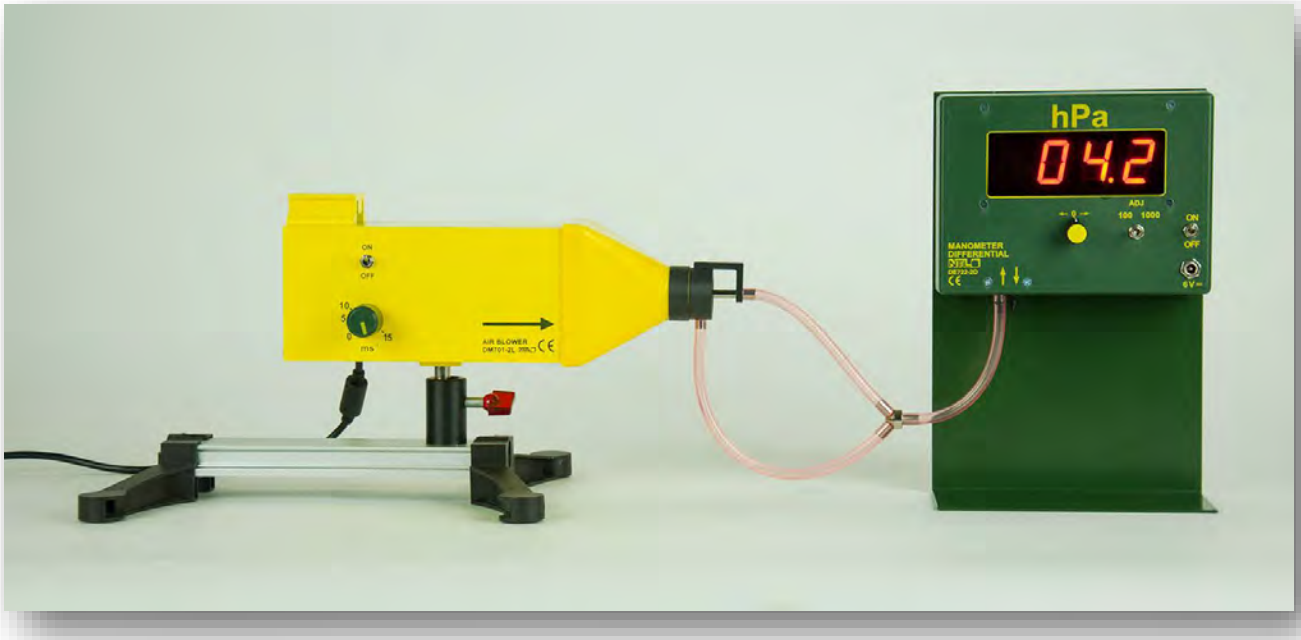
PRANDTL TUBE

MED 19.23



Material:

Item-no.	Qty.	Description
DS090-3K	1	Claw base "Sepp", 260 x 220 mm
DM701-2L	1	Blower 12 V
P3130-2Q	1	Fixed voltage transformer 12V DC/10 A
DM701-2K	1	Tube adapter for blower
DM713-1S	1	Pitot tube, apparatus set
DE722-2D	1	Manometer differential, „inno"
P3120-4A	1	L-shaped assembly platform
DM718-SM	1	Manometer sensitive, Krell type

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Purpose

The difference of the static pressure and the dynamic pressure is called the total pressure.

$$p_{ges} - p_{stat} = \rho v^2 / 2 = p_{dyn}$$

The Prandtl tube measures the dynamic pressure. If the density of the flowing medium is known, the Prandtl tube can be used to measure the flow speed.

$$V = \sqrt{(2 \cdot p_{dyn} / \rho)} \quad \sqrt{((2 p_{ges} - p_{stat}) / \rho)}$$

Preparation

- the blower is fixed to the saddle on the support base and screwed down tightly
- the tube adapter for blower is fixed on the blower
- the Manometer is attached to the S-shaped assembly platform
- a silicone hose (approx. 20 cm) is inserted into the tube on the side of the Pitot tube
- the hose is then connected with the Manometer (inlet - arrow pointing upwards)
- the rotary knob for the flow speed of the blower is turned to the very left
- the blower is powered by a fixed voltage transformer (12 V DC, min. 6 A)

Experiment 1

We select the range 100 hPa at the Manometer and adjust the displayed value to 0 with the help of the regulator.

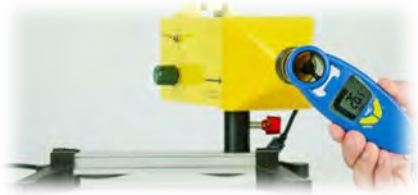
We turn on the blower and slowly increase the flow speed.
We observe the flow speed and the measured pressure.

Dynamic pressure (p_{dyn}) at maximum flow speed: …….. hPa
Calculation of the flow speed $V = \sqrt{(2 \cdot p_{dyn} / 1{,}2)} =$ …… m/s

Experiment 2

We remove the tube adapter for blower and measure the flow speed at this spot with the help of an Anemometer.

Flow speed measured with the Anemometer: …… m/s



Note

The dynamic pressure is also called velocity pressure.
The measuring unit (Prandtl tube) is also used in aviation to determine the air speed.

Attention

The measured pressure may deviate from theoretically calculated values since the air flow in our experiment is not ideally laminar.

We produce the air flow with a fan blade which clearly creates turbulences and whirls, which can of course affect the measured values.

Performing experiments with the Manometer sensitive, Krell type:

The set-up works in the same way as displayed on the previous pages.
Instead of a digital manometer we used a sensitive manometer.
On the first image the blower is not in operation.

Image 1

Observe the level of the Manometer.
(In the technical description of the Manometers it is described how to fill it.)

If the flow speed is increased the dynamics pressure increases as well.

Image 2

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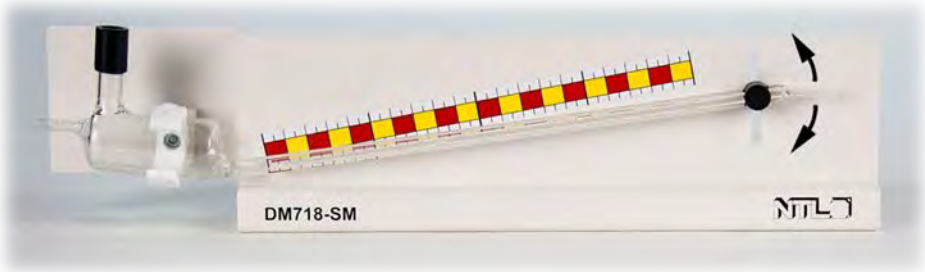
Using the Manometer sensitive, Krell type:

Remove the stopper from the conservator

Fill it with (colored) Water!
(the easiest way to do this is with the help of a small syringe)



The sensitivity of the Manometer can be changed through changing the angle of inclination of the riser pipe.

The thumbscrew on the backside needs to be loosened first before the angle of inclination can be changed; afterwards the thumbscrew is fixed again.

The overflow can be collected with a beaker.