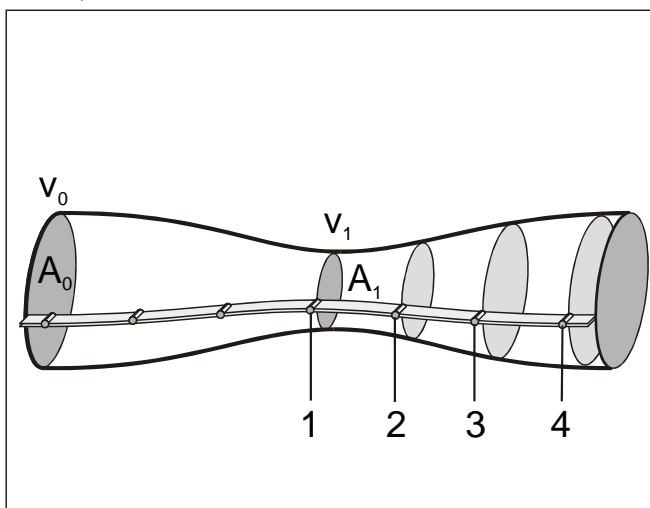


Static pressure in a reduced cross section – measuring the pressure with a pressure sensor and CASSY

Objects of the experiment

- To measure the static pressure in a Venturi tube
- To know the static pressure in a Venturi tube as a function of the cross-section

Fig. 1: Venturi-tube schematically: cross sectional areas A_0 and A_1 , flow velocity v_0 and v_1 . The numbers denote the measuring points.



Principles

The Bernoulli equation

$$p_0 + \frac{\rho}{2} v_0^2 = p_1 + \frac{\rho}{2} v_1^2 \quad (\text{I})$$

ρ : density of the flow medium

and the continuous equation

$$v_0 A_0 = v_1 A_1 \quad (\text{II})$$

v : flow velocity

describes the flow of air through a tube with changing cross section A .

The total pressure is p_0 determined by the static pressure p and the dynamic pressure p_s :

$$p_0 = p + p_s$$

In this experiment the static pressure in a Venturi tube is measured for different cross sections A_1 to A_4 (see Fig. 1). The experiment is closely related to P1.8.5.5 where the volume flow through a Venturi tube is determined.

Apparatus

1 Suction and pressure fan.....	373 04
1 Venturi tube with gauge points.....	373 09
1 Sensor CASSY	524 010USB
or	
1 Pocket CASSY.....	524 006
with	
1 CASSY Lab.....	524 200
or	
1 Mobile-CASSY	524 009
1 Pressure sensor S, ± 70 hPa.....	524 066
1 Stand base, V-shaped, 20 cm.....	300 02
1 Stand rod, 25 cm	300 41
1 Leybold multiclamp	301 01

additionally required: 1 PC with Windows 98 or higher

Setup

Equip the air blower with the small nozzle (100 mm) and the Venturi tube. Set up these devices horizontally on the base like shown in Fig. 2. Additionally, support the Venturi tube using the stand base, stand rod 25 cm and Leybold multiclamp. Do not overtighten screw of the Leybold multiclamp.

- Plug the pressure sensor S, ± 70 hPa to the Input A of the Sensor CASSY (Fig. 2) or to the Mobile CASSY (Fig. 3).
- Connect the vacuum nipple (right side) of the pressure sensor to the central measuring outlet at the smallest diameter of the Venturi tube by means of a hose and a brass nipple.

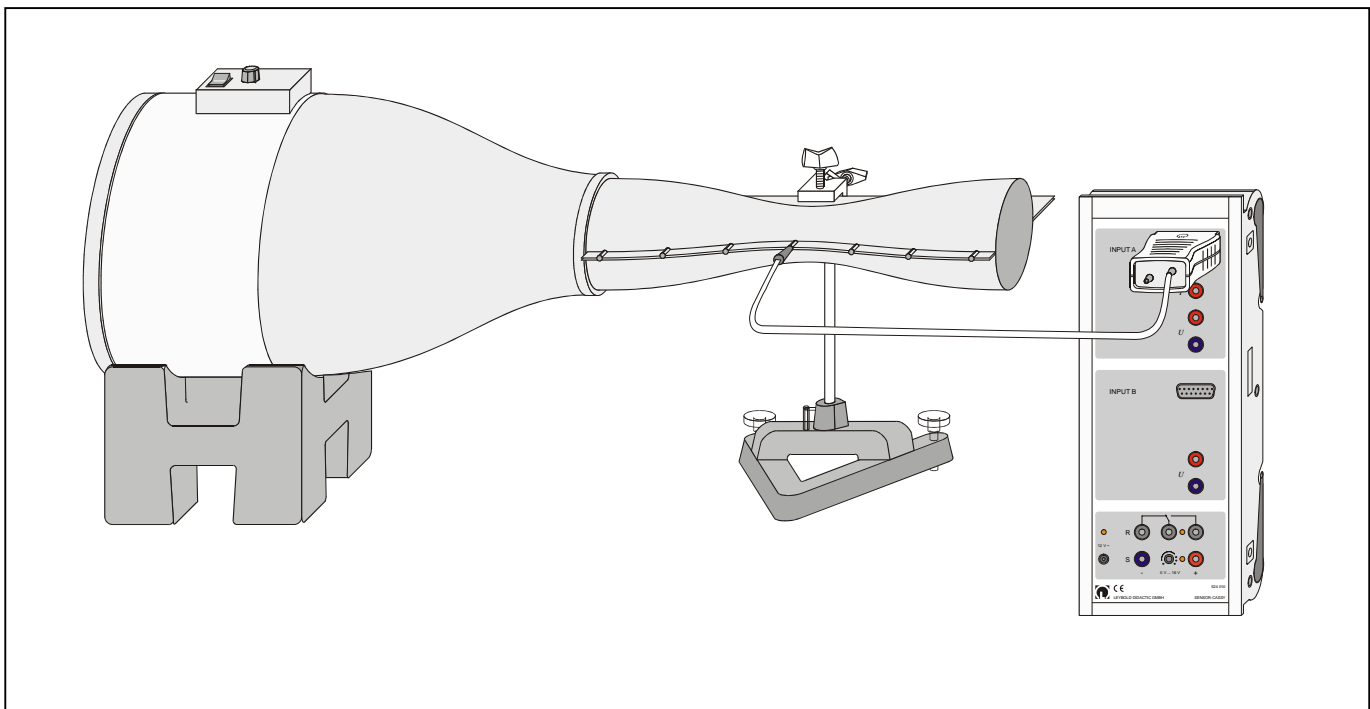
Safety notes

Mind the safety notes in the instruction sheet of the suction and pressure fan.

Before removing the protective grid or the nozzle:


- pull out the mains plug
- wait for at least 30 seconds until the rotor comes to a complete stop.

Fig. 2: Experimental setup with Sensor CASSY schematically.



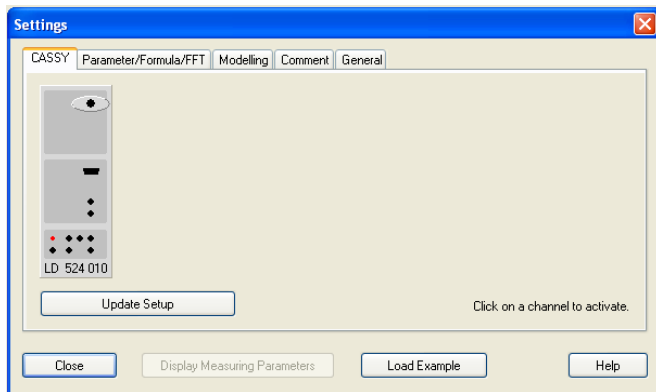
Carrying out the experiment

a) Measuring with Sensor CASSY

- If not yet installed install the software CASSY Lab and open the software.
- Open the window "Settings" using the tool box button  or function key F5 from the top button bar:

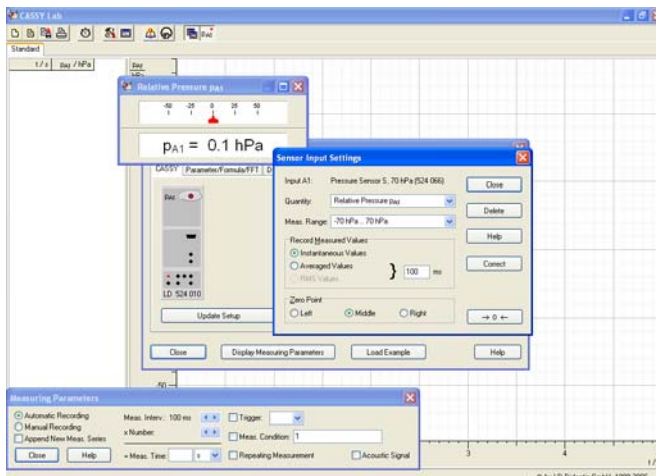


- Sensor CASSY with the connected pressure sensor S at "Input A" should be displayed at the tab "CASSY" if Sensor CASSY is connected via the USB port to the computer.

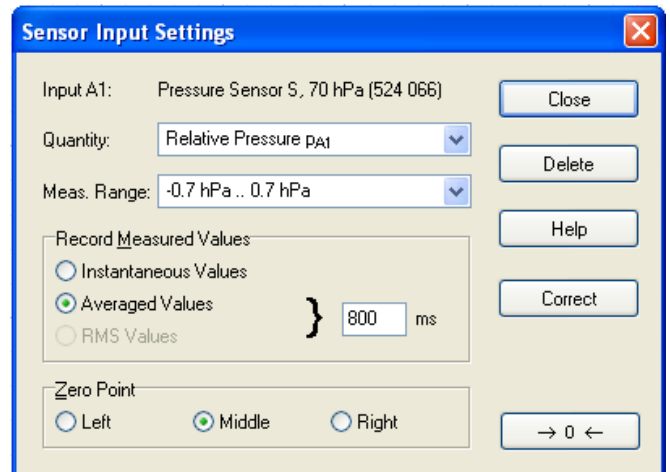


- Activate the connected sensor at Input A by clicking at the pressure sensor S.

Note: Further details about connecting sensors to Sensor CASSY can be found in the manual "CASSY Lab Quick Start".




- In the window "Sensor Input Settings" select "Averaged Values" and enter the value e.g. "800 ms".
- Disconnect the pressure sensor S from the Venturi tube.
- Set the pressure sensor by clicking in the window "Sensor Input Settings" at the button "-> 0 <-".




- Connect the pressure sensor S to the Venturi tube.
- Set the blower to its minimum speed (i.e. left limit position of blower control) and only then switch it on.
- Slowly increase speed of the air blower until the air pressure reaches approx. 50 hPa.
- Read off the static pressure.

Note:

To apply the reset button "-> 0 <-" the window "Sensor Input Settings" have to be invoked if not open. This can be achieved e.g. by clicking the right mouse button on the pressure button in the top menu bar.

- To record the pressure values p at different cross sections A with CASSY double click on the button  and select "Manual Measurement".












- Select the measuring points in turn and record for each cross section the static pressure by clicking on the button  or using the function key F9 .

Note:

Repeat this measurement procedure several times. It is recommended to apply the reset button "-> 0 <-" before each measurement.

b) Measuring with Mobile CASSY

- Switch on the Mobile CASSY with the  key.
- Call the main menu using the  key.
- Select the submenu "Quantities" by using the arrow keys  or  and enter the submenu using the right  key.
- Go to the submenu "p" using the right  key.
- Chose "Compensate Offset" and set the pressure to zero by pushing the right  key.
- Press  key and then the left  key to display the measured pressure value.
- Read off the static pressure.
- Select the measuring points in turn and read off for each cross section the static pressure.

Note: For further hints using Mobile CASSY refer to the instruction sheet 524 009.

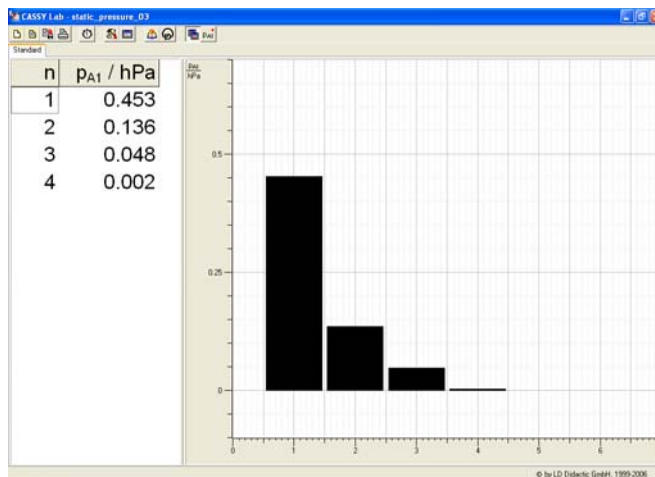


Fig. 4: Static pressure as a function of the cross section A₁ to A₄ of a Venturi tube (compare Fig. 1).

Measuring example

Table 1: Static pressure p as function of the cross section A of a Venturi tube.

	$\frac{p}{\text{hPa}}$	$\frac{A}{\text{cm}^2}$
1	0.453	19.6
2	0.136	33.2
3	0.048	66.5
4	0.002	78.5

Evaluation and results

The static pressure (low pressure) decreases in the reduced cross section of the Venturi tube.

Fig. 3: Experimental setup with Mobile CASSY schematically.

