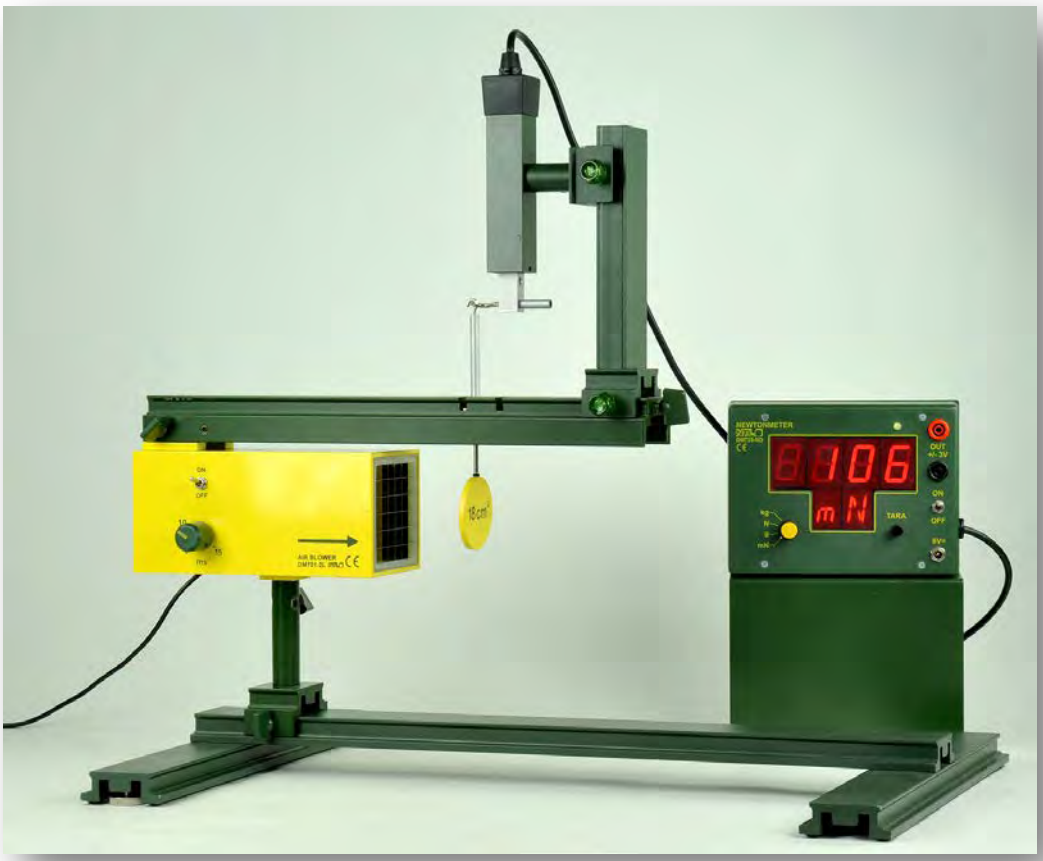
AIR RESISTANCE AND CROSS-SECTIONAL AREA

MED 19.13



Material:

Item Code	Qty	Description
DS101-1G	1	Support base, large, L=500 mm
DS103-7G	1	Sliding saddle, H=70 mm
DS103-3G	1	Sliding saddle, H=34 mm
DS103-1G	1	Rail support "parallel", H=150 mm
DM701-2L	1	Blower 12 V
P3130-2Q	1	Fixed voltage transformer 12V DC/10 A
DM715-2S	1	Adapter rail
DM712-1H	1	Stand for aerodynamic objects
DM710-2S	1	Aerodynamic objects, set
DM725-ND	1	Newtonmeter "inno" 20 N / 2000 g
P3120-5B	1	S-shaped assembly platform

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Purpose
In case of same shape and overall same conditions, the air resistance F is proportional to the cross-sectional area A of the surrounded body.

$$F = c_w \cdot \rho/2 \cdot v^2 \cdot A$$

(F... Air resistance, cw... drag coefficient, ρ ... density of air, v ... speed, A ...cross-sectional area)

Preparation
- the sliding saddle is fixed on the support base
- the blower is inserted into the sliding saddle and screwed down tightly
- the adapter rail is mounted on the blower
- at the right end of the adapter rail the vertical rail support is fixed with the sliding saddle (34 mm)
- the Newtonmeter is attached to the S-shaped assembly platform
- the holder for the aerodynamic objects is placed in the slit of the adapter rail
- the weighing bar is positioned so that both hooks fit exactly into each other (see image)
- 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)

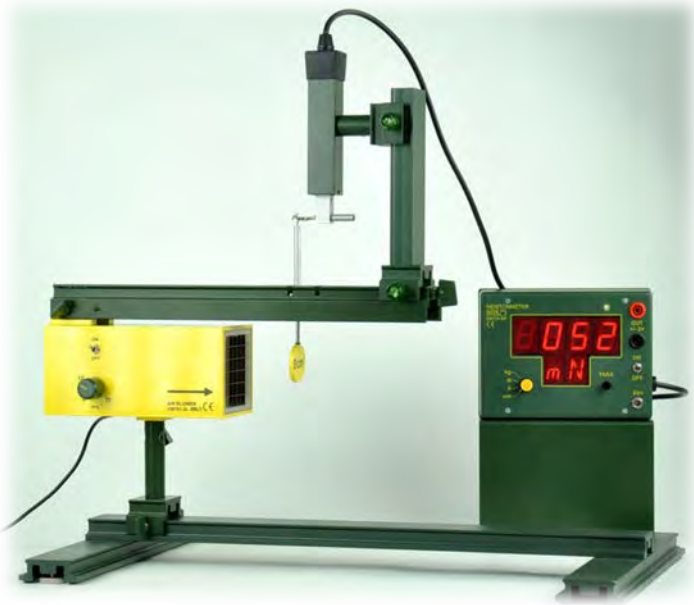
Experiment 1
The „round disk 9 cm²“ is used as an aerodynamic body;
we attach it to the stand for aerodynamic objects from below.

We adjust the weighing bar through the sliding saddle and place the aerodynamic body in a complete vertical position.

Then we turn on the Newtonmeter, select the range „mN“and tare it to 0.

We turn on the blower and slowly increase the flow speed to 10 m/s.

Afterwards we read off the value and note it in our chart.



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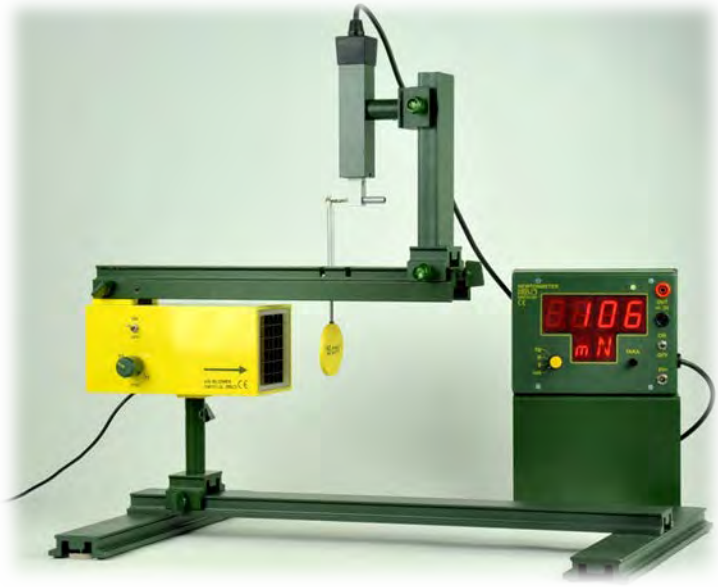
Experiment 2
The „round disk 18 cm²“ is used as an aerodynamic body;
we attach it to the stand for aerodynamic objects from below.

We adjust the weighing bar through the sliding saddle and place the aerodynamic body in a complete vertical position.

Then we turn on the Newtonmeter, select the range „mN“and tare it to 0.

We turn on the blower and slowly increase the flow speed to 10 m/s.

Afterwards we read off the value and note it in our chart.



	Cross-sectional area „A“ in cm²	Air resistance „F“ in mN
Aerodynamic body, disk, small	9	
Aerodynamic body, disk, big	18	

Result
In case of same shape and overall same conditions, the air resistance F is proportional to the cross-sectional area A of the surrounded body.
With double the cross-sectional area and the same flow speed, the measured air resistance is about twice as much.

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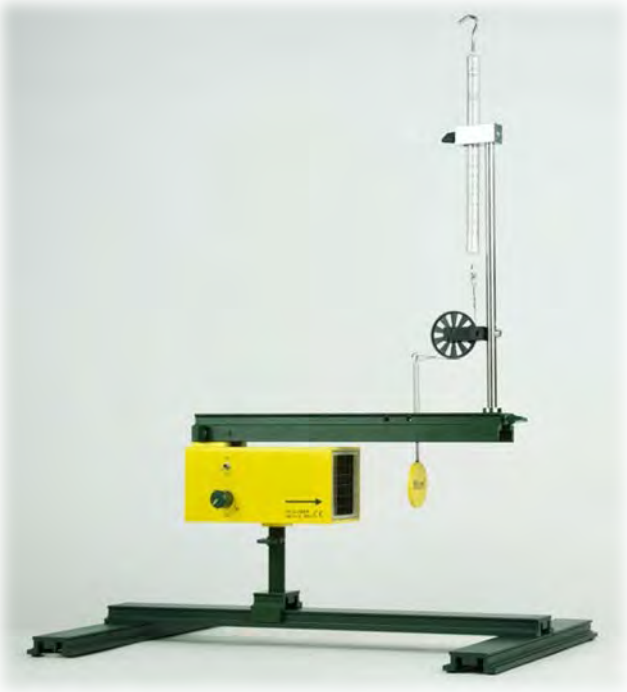
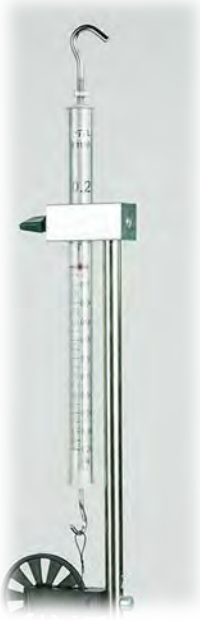
Alternative Setup
In case that this experiment is performed with a dynamometer and a pulley the following setup is recommended:

- on the right end of the adapter rail the dynamometer mount with pulley is fixed
- the dynamometer 0,2 N is inserted from above and screwed down carefully
- we cut of a thread of approx. 12 cm and make a loop at one end
- the thread is put through the hanger of the pulley and inserted as shown on the image





Experiment
The stand for aerodynamic objects has to be in a full vertical position during the entire experiment. If necessary, adjust the height level of the dynamometer and tare it in the same direction as it will be used during the experiment (check the image above).

As soon as the blower is turned on the aerodynamic object is pushed to the right side, therefore the stand for aerodynamic objects is not in vertical position anymore.

We loosen the screw from the dynamometer mount with pulley and pull the dynamometer upwards until the stand for aerodynamic objects is in a full vertical position again.

Now we can perform a correct measurement of the resistance.