# AIR RESISTANCE OF MODEL CARS

**MED 19.16**


***Material:***

| Item-no. | 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, vertical, H=152 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 |
| DM714-1L | 1 | Truck, model |
| DM714-1P | 1 | Delivery van, model |
| DM714-1S | 1 | Car, model |
| DM725-ND | 1 | Newtonmeter „inno“, 20 N/2000 g |
| P3120-5B | 1 | S-shaped assembly platform |
| DG100-1L | 1 | Vernier caliper, metal |

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**Purpose**

Given a constant flow speed, the air resistance F is proportional to the cross-sectional area A of the body around which flow is taking place.
In addition, the shape of the body has an important role to play.

$$F = c_w \,.\, \rho/2 \,.v^2 \,.\, A$$

(F Air resistance, cw... drag coefficient, $\rho$ ... 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 „Truck model” 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 15 m/s.

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

With the help of vernier callipers we can measure the height and width of the truck and therefore determine the cross-sectional area of the model

| Model car | Cross-sectional area in cm² | Air resistance „F“ in mN |
|---|---|---|
| Truck | | |
| Delivery van | | |
| Car | | |

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**Experiment 2**
The „Delivery van model” 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 15 m/s.

Afterwards we read off the value of the air resistance and the cross-sectional area and note it in our chart.

**Experiment 3**
The „Car model” 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 15 m/s.

Afterwards we read off the value of the air resistance and the cross-sectional area and note it in our chart.

**Result**
If we compare the cross-sectional area with the measured air resistance we realize that they are not directly proportional to each other. Therefor we understand that the air resistance is also depending on the shape of the body.

**Note:**
Cars have a cw-value of 0.25 to 0.55.
The measurement values given in the technical literature are determined by measurements in a laboratory wind tunnel. Deviations from the measurement readings determined in this experiment are due to the simplified measurement arrangement used here.
This experiment arrangement, of course, is only an experiment with a model character.