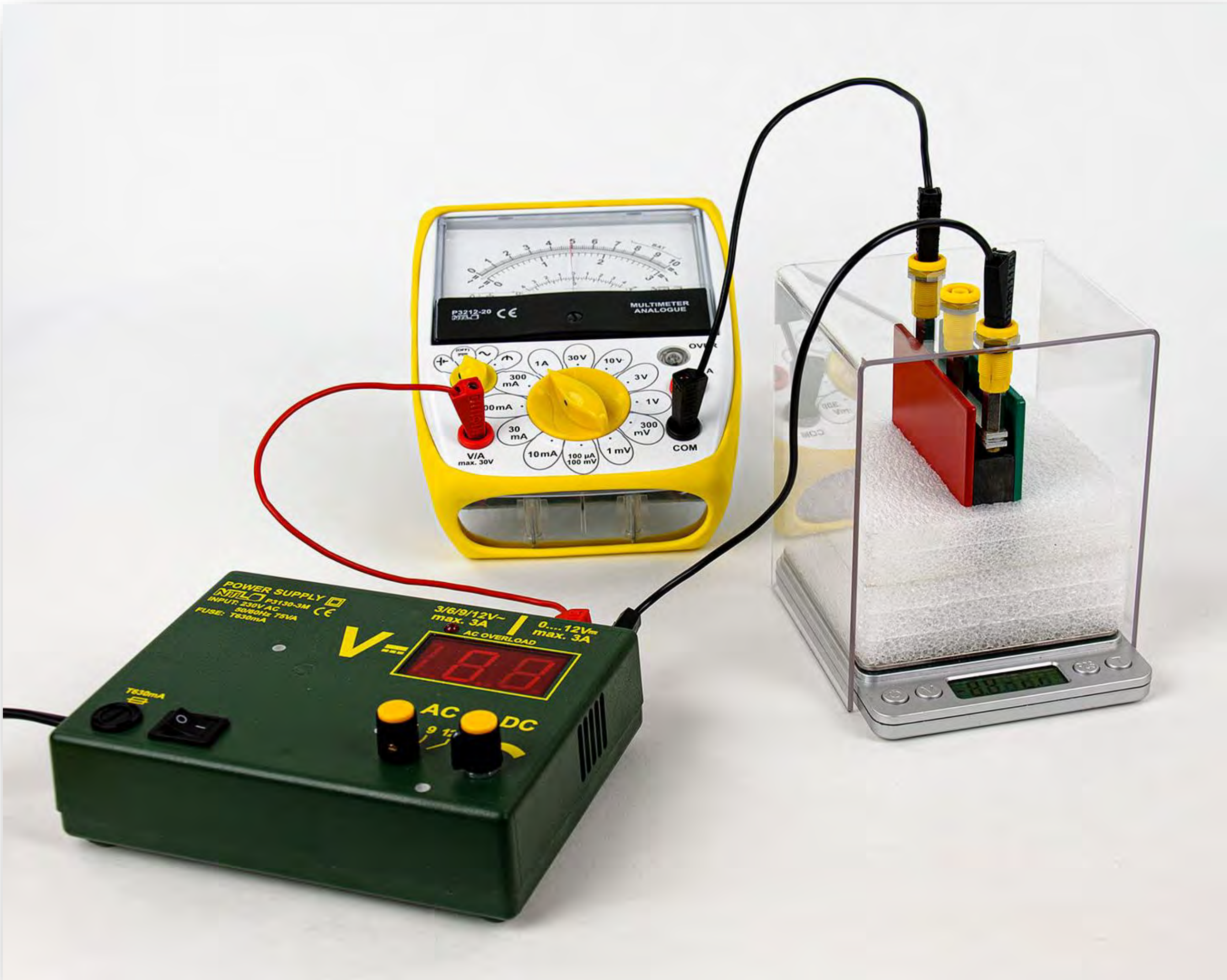
CURRENT BALANCE COMPACT

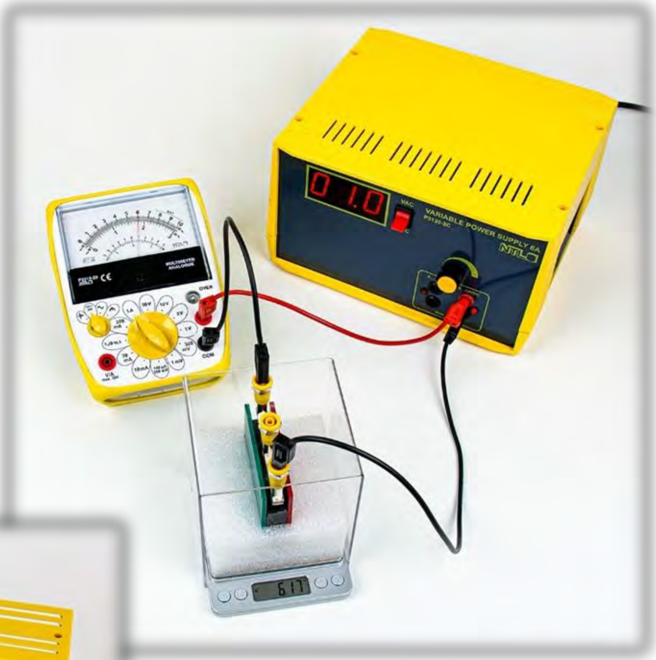
EMS 3.6



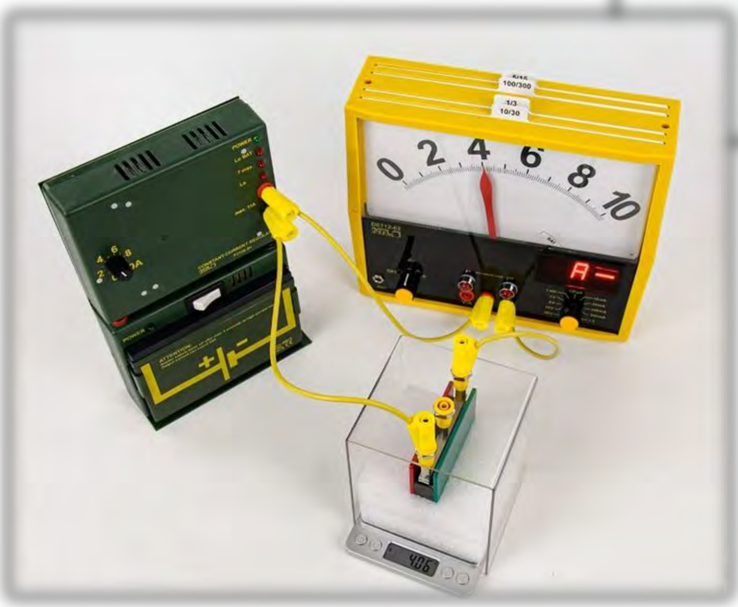
Material:

Item code	Qty.	Description
DE445-1S	1	Current balance
DM125-4A	1	Digital scales 06, 500/0,01 g
P3310-2E	2	Connecting lead SE, 25 cm, black
P3310-2R	1	Connecting lead SE, 25 cm, red
P3130-3D	1	Low-voltage power supply with digital display
P3212-20	1	Multimeter analog „Daisy“

Various setup variants of the current balance



Setup variant with a power supply unit with an output power of up to 10 amps



Setup variant with the demo measuring device and the constant current regulator

These experiments can be carried out with higher currents using more powerful power supplies.

If you use your own power supply, make sure that it can supply sufficient current and is relatively insensitive to short circuits.

If you use your own scales, they should have a weighing range of at least 500 g and a resolution of 0.01 g.

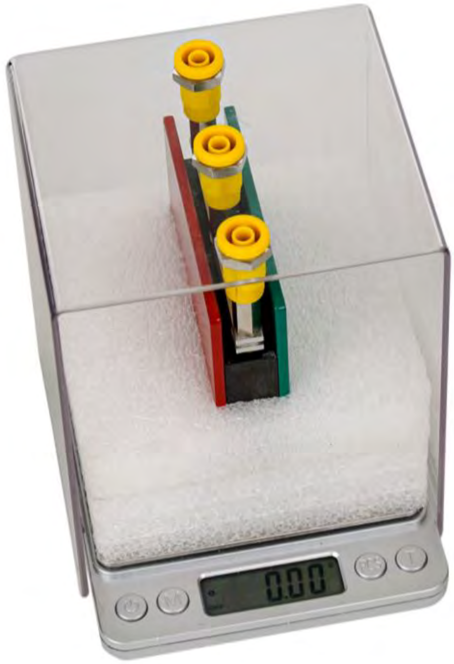
Objective:
If electric charges move in a homogeneous magnetic field, a force (Lorentz force) acts on them that is normal to the direction of movement of the charges (current flow) and normal to the magnetic field (magnetic flux density).

Setup:

The digital scale is placed on a stable base (table surface).

The two pole plates (thickness = 3 mm) are attached to the block magnets and inserted into the recess provided in the bearing block.

The bearing block and magnet are placed in the centre of the weighing plate.



The U-bracket is placed over this unit. The bracket is now moved and adjusted so that the power cables are centred between the two legs.

The experiment setup is assembled and wired up as shown in the diagram.

The measuring range 1 A DC is set on the measuring device.

Experiment series 1:

In the first series of experiments, the single conductor (L=35 mm) is supplied with power.
The supply cables are plugged in as shown in the illustration.

Attention

The table on which the scales are placed must not be exposed to any vibrations from now on, otherwise the scales will not measure at all or not correctly.

A small ring above the 'Zero' display indicates that the scales are stable and ready for weighing.

The scales are switched on and tared to zero if necessary.

The power supply is switched on.
The voltage is now increased very slowly until we measure a current flow of 0.2 A.

Wait a few more seconds until the display on the scale is stable.
Now read the value on the scale and enter it in the table 'Single conductor, L=35 mm (mass).

Note:
If the value on the scales goes into the minus range, simply rotate the bearing block and magnet by 180°.

	Experiment series 1: conductor simple L=35 mm		Experiment series 2: conductor double L=35 mm		Experiment series 3: conductor L=70 mm		Experiment series 4: conductor-L=70 mm Pole sheets thin	
Amperage [A]	Mass [g]	Force [mN]	Mass [g]	Force [mN]	Mass [g]	Force [mN]	Mass [g]	Force [mN]
0,2								
0,4								
0,6								
0,8								
1,0								

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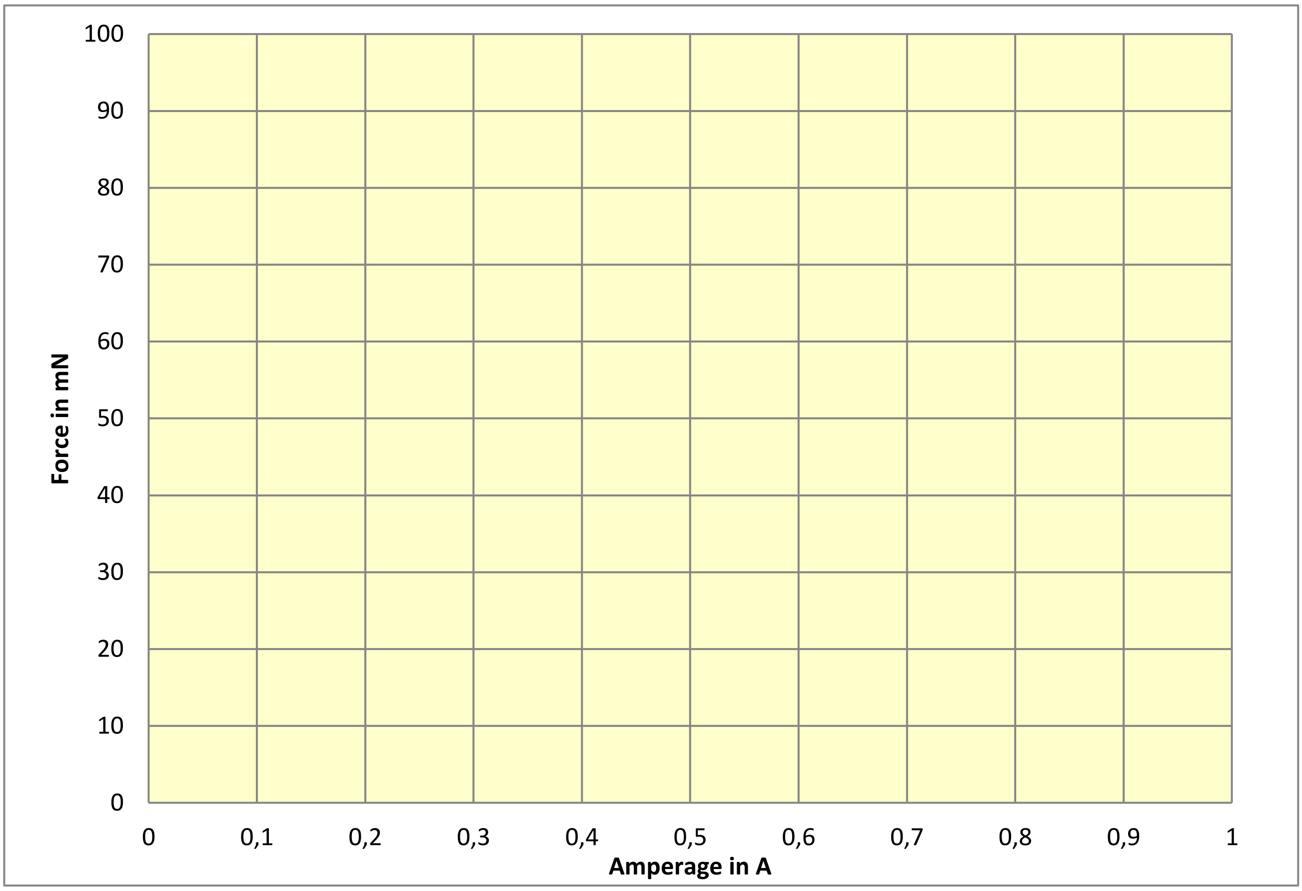
We carefully increase the voltage until we measure the currents specified in the table.
Wait until the value stabilises before each reading on the scale.
The other values on the scale are entered in the table.

Once all the values have been entered, the value on the scales is multiplied by 9.81 m/s² to obtain the force.

The values of the current and the calculated force are entered in the following table.



Is there a connection between current and force?

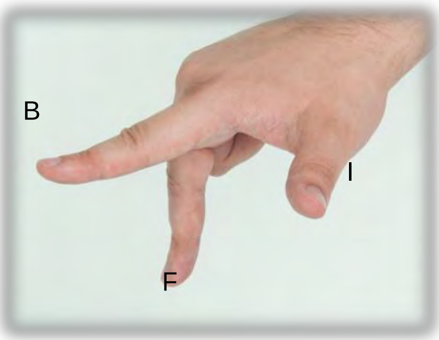
Note:
The direction of the force can also be determined using the three-finger rule.

Thumb (technical current direction I),

index finger (magnetic field B) and

Middle finger (force F)

of the right hand should be aligned normally
be directed towards each other.



Experiment series 2:

In the second series of experiments, the double conductor (L=35 mm) is supplied with current.

You can see that we are now using twice the cross-section of the conductor.

The supply cables are plugged in as shown in the illustration.

The further sequence is the same as that of experiment series 1.

The values read off the scale are entered in the table “Double conductor, L=35 mm (mass)”.

Compare the deflection force of the two series of experiments.

Conclusion:
The force of the deflection has remained roughly the same.
It is therefore not dependent on the cross-section of a conductor.

Experiment series 3:

In the third experiment series, the conductor (L=70 mm) is supplied with current.

We now use twice the length of the conductor.

The supply cables are plugged in as shown in the illustration.

The rest of the sequence is the same as for experiment series 1 and 2.

The values read off the scale are entered in the table ‘Single conductor “L=70 mm (mass)”.

Compare the deflection force of this series of experiments with the results of series 1 and 2.

Conclusion:
The force of the deflection is now about twice as great.
This is therefore dependent on the conductor length.

Experiment series 4:

As in experiment series 3, the conductor (L=70 mm) is supplied with power.
The supply cables are plugged in as shown in the illustration.

The bearing block and magnet are removed from the scale.

We use a teslameter to measure the strength of the magnetic field.

For this purpose, the probe is held in the centre between the two plates.

.... mT

The magnet is pulled out of the bearing block.
The 3 mm thick pole plates are removed from the magnet and the 1.5 mm thick plates are attached instead.

The magnet and pole plates are put back into the block.

Again, we measure the strength of the magnetic field: .... mT

The bearing block and magnet are placed in the centre of the weighing plate.

The U-bracket is placed over this unit. The bracket is now moved and adjusted so that the power cables are centred between the two legs (plates).

The further sequence is the same as that of experiment series 3.

The values read off the scale are entered in the table “Conductor L=70 mm thin pole plates (mass)”.

Now compare the values with the magnetic fields of different strengths (experiment series 4 and 3).

Conclusion:
A weaker magnetic field results in a lower deflection force.

Note:

A review of the basic law of electrodynamics could be considered:

If current I flows through a conductor l, a force F acts on it as soon as it is immersed normally in a magnetic field of strength B.

$$F = B * I * l$$

However, due to the fact that the magnetic field is not sufficiently homogeneous over the entire length of the conductor, there will be large deviations from the measured results when analysing the results.