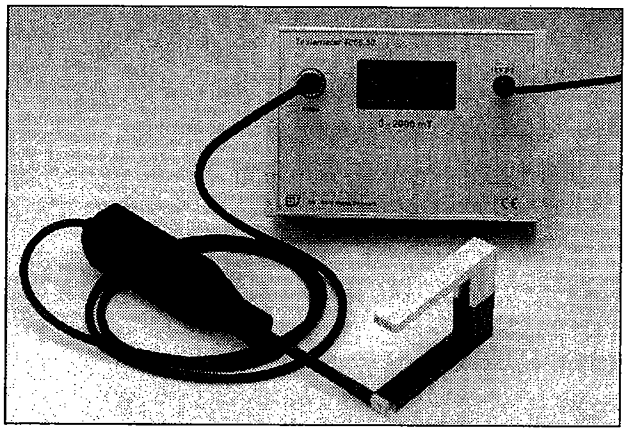
Users manual for 4060.50 Teslameter

21.11.03

Ae 4060.50



Description:

This apparatus comprises a Hall Effect probe sensitive to magnetic fields, a mounting rod, and a meter unit for displaying data. The instrument is connected to the mains by means of the enclosed power adapter. The instrument has an auto-range display, changing between the two ranges: 0.01 – 2 T, and 1 – 200 mT.

The probe is mounted in a sturdy housing, with a threaded nut for mounting with the enclosed rod, and has a DIN connector, ensuring that the probe and the instrument can be interchanged without calibration. This also means that a school owning more than one teslameter can interchange probes and meters.

The instrument is supplied by means of a standard power adapter, 6-12 VDC. (On the meter is printed 12 VDC, but 6-12 VDC is correct)

Operation:

Connect the probe and meter. When the instrument is connected to the mains by means of the power adapter, it automatically turns ON. The Hall detector measures field perpendicular to the probe, and is sensitive to direction. The measured value of the magnetic field is shown directly on the digital display.

Maintenance:

The apparatus is maintenance free.

Technical data:

Measuring range:
0.02 – 2 T, resolution: 1 mT.
1-200 mT, resolution: 0,1 mT.
Accuracy: 5%.
Dimensions:
Magnetic field probe (excl. housing): 10 mm long, 8 mm wide, 2 mm thick.
Instrument: 158 x 108 x 56 mm

Spare parts:

Power adapter, part no: 3550.10.
Magnetic field probe, part no: 4060.55.

Experiments:

Magnetic field from a bar magnet:

Equipment:

Teslameter, 4060.50.
Permanent magnet rod, 3305.10.
Paper.

Place the magnet in one end of the paper. Measure the strength of the magnetic field for each 5 or 10 mm moving in the direction of the magnet. Values can be written directly on the paper.

Follow a magnetic field line:

Equipment:

Teslameter, 4060.50.
Permanent magnet rod, 3305.10.
Paper.

Place a permanent magnet on a piece of paper. The magnetic field lines goes through the points where the strength of the magnetic field has the same value. By placing the magnetic field probe near the magnet, and adjusting the position, one can find the position where the magnetic field is perpendicular to the probe, which is the position where the maximum value is read in the display. Try to find different pla-

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ces around the magnet with the same value for the magnetic field. A curve drawn through these points is a magnetic field line.

Magnetic field from a coil:
Magnetic field vs. current in a coil - with and without iron core.

Direct Current through a coil results in a static magnetic field. The field strength depends on whether the coil has an iron core, or just air, the number of windings on the coil and the current.

Equipment:
Teslameter, 4060.50.
Power supply, 3620.60, or equivalent.
Coil with 200 windings, 4625.10.
Coil with 400 windings, 4625.20.
Iron core, laminated, 4630.10.
Test Leads.

The coil is connected to the power supply, and the teslameter probe is placed at the end of the coil, parallel to the direction of the windings (thus perpendicular to the magnetic field).

Register the strength of the magnetic field at different currents. Make a table as the follows:

I/A									
B/T									

Make a graph with the field strength on the y-axis, and the current on the x-axis.

Repeat with a coil with twice the number of windings. Try to hit the same values of current as above. Make a table as follows:

I/A									
B/T									

From the measurements you may be able to estimate how the number of windings affects the field strength.

Now repeat the experiments, with an iron core in the coils.

Magnetic field in special coils:

Magnetic field from a flat circular coil:
A single winding of a conductor, with radius r, through which a current I is running, will create a magnetic field. Field lines originating from each small piece of the circular conductor are added and pass parallel to each other through the centre of the coil, and parallel to the axis of the coil. It can be shown that the contribution from a single coil in the centre is:

$$B = \mu_o \cdot I/2 \cdot r$$

mo is a constant of nature, called permeability of free space, with the value $1{,}257 \cdot 10^{-6}$ H/m.

If contributions from all windings are added, the following equation for the value of the magnetic field in the centre of a flat coil with N windings:

$$B = \mu_o \cdot N \cdot I/2 \cdot r$$

The magnetic field from a long coil:
It can be shown that for a long coil with radius r and length l, the magnetic field inside the coil is:

$$B = \mu_o \cdot N \cdot I/l$$

Experiment:

Equipment:
Teslameter, 4060.50.
Power supply, 3620.60, or equivalent.
Long coil (solenoid).
Test Leads.

Measure the strength of the magnetic field in a long coil vs. current. Make a table as the following:

I/A									
B/T									

Make a graph showing B as a function of I. Do your measurements fulfil the equation: $B = \mu_o \cdot N \cdot I/l$ for this experiment?

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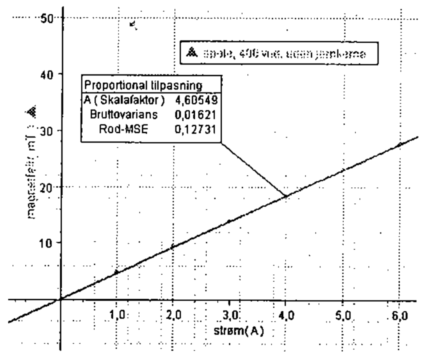
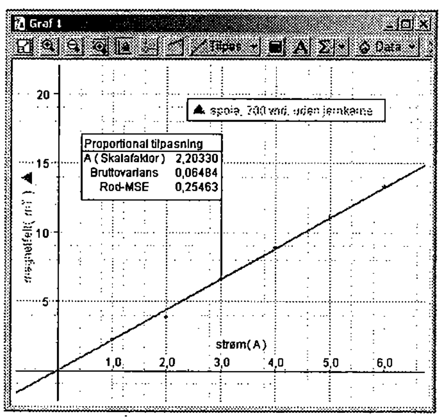
Example of data:

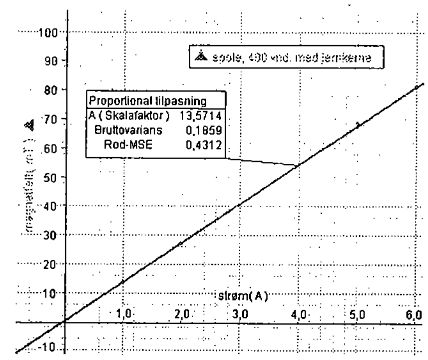
Coil with 400 windings, no Iron core



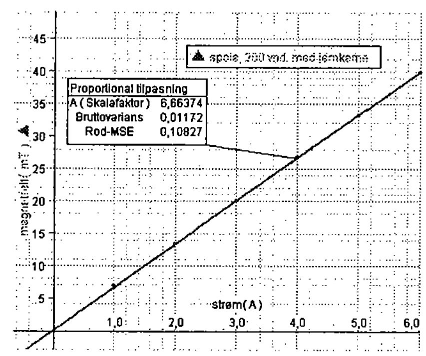
Coil with 200 windings, no Iron core



Coil with 400 windings, with Iron core



Coil with 200 windings, with Iron core



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