Application Note PE002

The Difference between Transverse Probes and Axial Probes

For their Teslameters, Projekt-Elektronik GmbH offers two types of probes: transversal probes and axial probes. With some instruments, different types of probes can be selected. The transversal probe is the most common type. At this, the magnetic flux density B is measured, which strikes the probe surface perpendicularly.

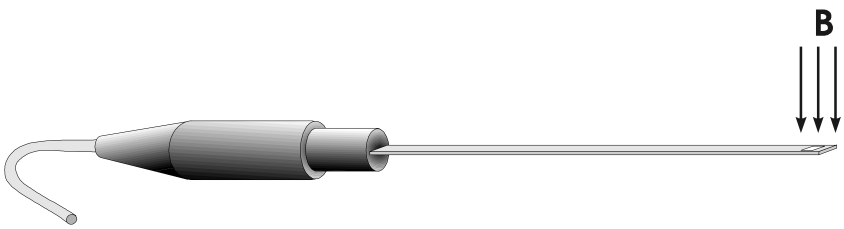

Fig. 1: Transverse Probe

Transverse probes are suitable for nearly all applications, e. g. measurement of the external flux density of bar magnets, measurements in air gaps of magnets or electric motors.

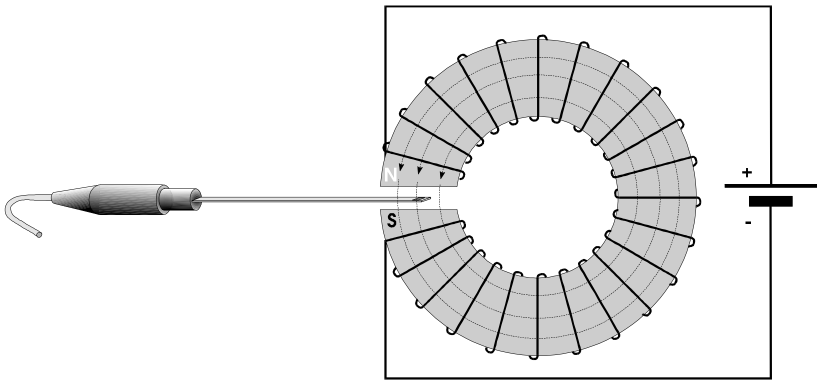

Fig. 2: Measurement inside of the Air Gap of an Electromagnet

The magnetic sensors (Hall Effect sensors) are made of ceramic carriers, on which a thin, magnetic field-dependent layer is applied. Due to their structure these elements are very sensitive to mechanical stress such as bending or pressure.

For this reason, for the FM 205, there are transversal probes in two variants. The first variant is the transversal probe in plastic version, only 0.8 mm thinly. This is particularly suitably in narrow air gaps, e. g. at loudspeaker magnets or electric motors. For other applications, the transversal probe, protected by a brass tube, is recommended. Thickness is 1.3 mm. By the brass protective tube, it is substantially more durable than the transversal probe in plastic.

To the contrary to the transverse probe, with the axial probe, magnetic flux density B in direction of the probe is measured.

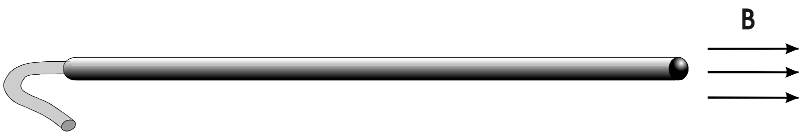

Fig. 3: Axial Probe

Axial probes are used e.g. in order to measure the magnetic flux density inside an air coil. Also, at countersunk magnets, if it is not possible to position a transversal probe flat on the active surface, it can be favorable to use an axial probe.

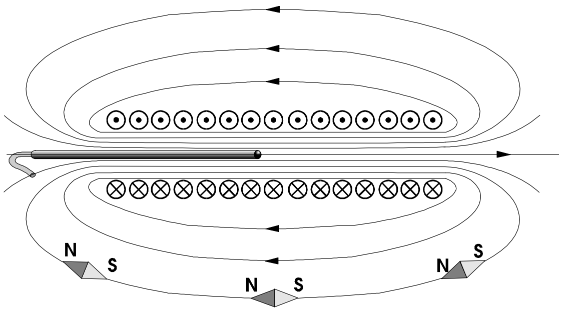

Fig 4: Measurement inside an Air Coil

Dependence on the Sign and Angle

Transverse Probes

A positive display value results, if the magnetic field lines enter into the white (ceramic) surface of the transversal probe, or on the side of the engraved cross of the transversal probe with brass protective pipe.

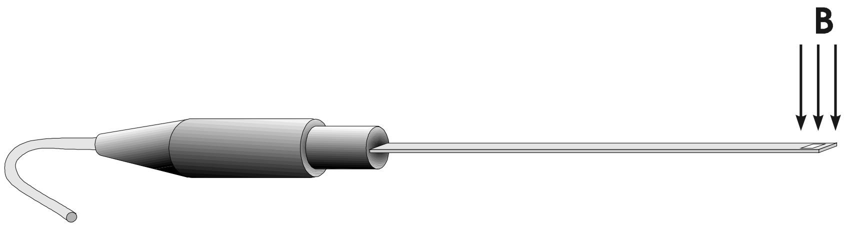

Fig. 5: Positive Field Direction for Transverse Probe

The maximum value will be measured, if the magnetic lines of flux traverse the Hall sensor perpendicularly! If the magnetic field lines do not enter the Hall sensor.

perpendicularly, the displayed value of the magnetic flow density will result in:

$$B = B_{max} \cdot \cos \alpha$$

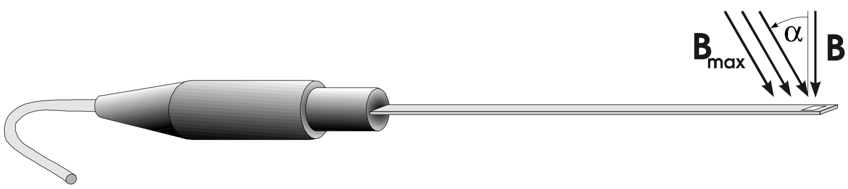

Fig. 6: Angle Dependence of Transverse Probe

Axial probes

A positive value will be displayed, if the magnetic lines of flux run out perpendicularly from the black front of the axial probe.

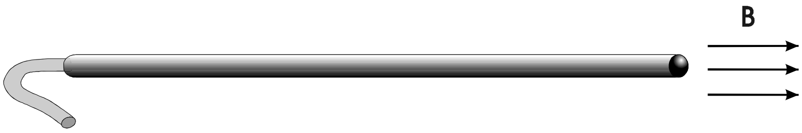

Fig. 7: Positive Field Direction for Axial Probe

The maximum field value is measured, if the magnetic lines of flux run in parallel to the axial probe! If the magnetic lines of flux do not run in parallel to the probe, only the part of flow density parallel to the probe will be indicated. On the other hand, the perpendicular part of flow density will not be displayed.

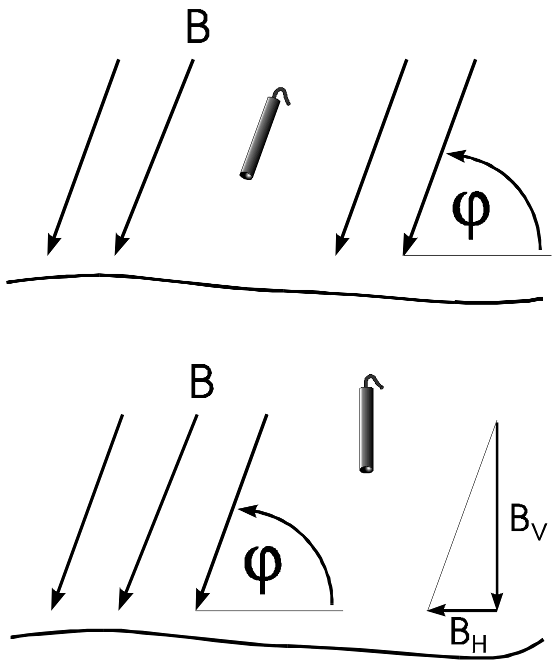

Fig. 8 Angle Dependence of Axial Probe

Magnetic Misalignment of ultra low active Probes

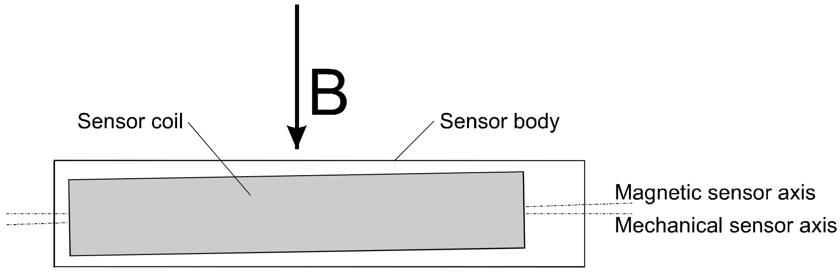

Fig. 9 Magnetic Misalignment

Due to production tolerance, a misalignment between mechanical and magnetic sensor axis of maximally 2 degrees may occur with the ultra low AS-active probes (UAP). Therefore, for measurements perpendicular to the field line particularly attention must be given to the orientation of the probe.

For high reproducibility it is important that the marking attached lengthways the probe is always aligned under the same angle of rotation.

For absolute precision it is important that the marking lies in the plain spanned by sensor axis and vector of magnetic flux density.

Insufficient alignment to the marking may yield an additional error up to 3.5% of the transversal field intensity.

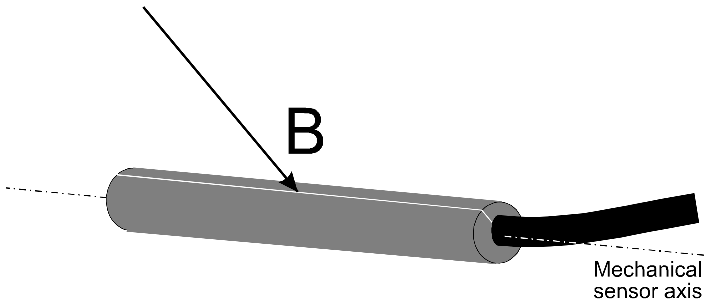

Fig. 10 Orientation of the probe marking

Angular error at uniaxial measurement

Flow density may be represented as a vector. In order to measure the exact absolute value of this vector, the probe must be positioned accurately perpendicularly to the direction of flux density. As an example: in order to measure a flow density of 1 T as exact as 1 mT, the angular error cannot be larger than 2.56°. As an illustration: At rotation of a disk with a radius of 100 mm, this corresponds to 4.5 mm at the circumference. If the flow density is to be measured by 1 T as exact as 0.1 µT, angular error cannot be larger than 0.0256°. This corresponds to 1 arc minute and 32 arc seconds. At rotation of a disk with a radius of 100 mm, this corresponds to only 45 µm at the circumference. The reproducibility of the result of measurement depends extremely on the quality of the mechanical clamping of the probe.