DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the calibration laboratory

MAGNET-PHYSIK Dr. Steingroever GmbH
Emil-Hoffmann-Straße 3, 50996 Köln

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out calibrations in the following fields:

Magnetic quantities
- **Magnetic flux density**
- **Magnetic field strength**

The accreditation certificate shall only apply in connection with the notice of accreditation of 23.06.2014 with the accreditation number D-K-19647-01 and is valid until 22.06.2019. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 04 pages.

Registration number of the certificate: **D-K-19647-01-00**

Braunschweig, 23.06.2014

signed Dr. Michael Wolf
Head of Division

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

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60594 Frankfurt am Main

Office Braunschweig
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The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-19647-01-00 according to ISO/IEC 17025:2005

Period of validity: 23.06.2014 to 22.06.2019 Date of issue: 23.06.2014

Holder of certificate:

MAGNET-PHYSIK Dr. Steingroever GmbH
Emil-Hoffmann-Straße 3, 50996 Köln

Head: Dr. rer. nat. Klaus Wagner
Deputy: B.Sc. Jan Kai Hutzenlaub

Accredited as calibration laboratory since: 05.01.2001

Calibrations in the fields:

Magnetic quantities
- **Magnetic flux density**
- **Magnetic field strength**

Abbreviations used: see last page

Permanent Laboratory

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Magnetic field strength Reference magnet systems Reference magnets	8 A/m to $64 \cdot 10^3$ A/m	23 °C Fluxmeter and field sensing coil, magnetometer and Hall probe	$1.1 \cdot 10^{-3} + 0.24 \cdot (A/m)/H$	H = measurement result
	> $64 \cdot 10^3$ A/m to $13 \cdot 10^5$ A/m	Nuclear magnetic resonance magnetometer (air gap > 8.5 mm, high homogeneity), otherwise fluxmeter and field sensing coil or magnetometer and Hall probe	$0.14 \cdot 10^{-3}$	
	> $13 \cdot 10^5$ A/m to $24 \cdot 10^5$ A/m	Fluxmeter and field sensing coil, magnetometer and Hall probe	$2 \cdot 10^{-3}$	
Magnetic field strength Hall effect and other magnetometers together with probes	DC; 23 °C 0.8 A/m to 80 A/m > 80 A/m to $8 \cdot 10^2$ A/m > $8 \cdot 10^2$ A/m to $10.7 \cdot 10^3$ A/m > $10.7 \cdot 10^3$ A/m to $64 \cdot 10^3$ A/m > $64 \cdot 10^3$ A/m to $13 \cdot 10^5$ A/m > $13 \cdot 10^5$ A/m to $24 \cdot 10^5$ A/m	Measurement in a field generating system a) Substitution method b) By means of a calibrated reference magnet c) By means of a calibrated field generating coil	$1 \cdot 10^{-3} + 7.2 \cdot 10^{-3}$ (A/m)/H $1 \cdot 10^{-3}$ $1.6 \cdot 10^{-3}$ $2.6 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $3 \cdot 10^{-3}$	H = measurement result
Magnetic flux density Reference magnet systems Reference magnets	$1 \cdot 10^{-5}$ T to $8 \cdot 10^{-2}$ T	23 °C Fluxmeter and field sensing coil, magnetometer and Hall probe	$1.1 \cdot 10^{-3} + 0.3 \cdot 10^{-6}$ T/B	B = measurement result
	> $8 \cdot 10^{-2}$ T to 1.7 T	Nuclear magnetic resonance magnetometer (air gap > 8.5 mm, high homogeneity), otherwise fluxmeter and field sensing coil or magnetometer and Hall probe	$0.14 \cdot 10^{-3}$	
	> 1.7 T to 3 T	Fluxmeter and field sensing coil, magnetometer and Hall probe	$2 \cdot 10^{-3}$	
Magnetic flux density Hall effect and other magnetometers together with probes	DC; 23 °C $1 \cdot 10^{-6}$ T to $1 \cdot 10^{-4}$ T > $1 \cdot 10^{-4}$ T to $1 \cdot 10^{-3}$ T > $1 \cdot 10^{-3}$ T to $13.5 \cdot 10^{-3}$ T > $13.5 \cdot 10^{-3}$ T to $8 \cdot 10^{-2}$ T > $8 \cdot 10^{-2}$ T to 1.7 T > 1.7 T to 3 T	Measurement in a field generating system a) Substitution method b) By means of a calibrated reference magnet c) By means of a calibrated field generating coil	$1 \cdot 10^{-3} + 9 \cdot 10^{-9}$ T/B $1 \cdot 10^{-3}$ $1.6 \cdot 10^{-3}$ $2.6 \cdot 10^{-3}$ $0.17 \cdot 10^{-3}$ $3 \cdot 10^{-3}$	B = measurement result
Magnetic flux density Nuclear magnetic resonance magnetometers	$8 \cdot 10^{-2}$ T to 1.7 T	DC; 23 °C Measurement in a field generating system, substitution method	$0.17 \cdot 10^{-3}$	Comparison of nuclear magnetic resonance magnetometers

[1)] The best measurement capabilities are stated according to EA-4/02. These are expanded uncertainties of measurement with a coverage probability of 95% and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Magnetic moment Reference magnet systems Magnet etalon	$8{\cdot}10^{-4}$ Am² to $24{\cdot}10^{-3}$ Am² > $24{\cdot}10^{-3}$ Am² to 54 Am²	23 °C Fluxmeter and Helmholtz coils	$3{\cdot}10^{-3} + 12{\cdot}10^{-6}$ Am²/m $2.1{\cdot}10^{-3} + 33{\cdot}10^{-6}$ Am²/m	m = measurement result
Magnetic dipole moment Reference magnet systems Magnet etalon	$1{\cdot}10^{-9}$ Vsm to $3{\cdot}10^{-8}$ Vsm > $3{\cdot}10^{-8}$ Vsm to $68{\cdot}10^{-6}$ Vsm	23 °C Fluxmeter and Helmholtz coils	$3{\cdot}10^{-3} + 15{\cdot}10^{-12}$ Vsm/j $2.1{\cdot}10^{-3} + 42{\cdot}10^{-12}$ Vsm/j	j = measurement result
Sensitivity Magnetic field sensors	$1{\cdot}10^{-2}$ V/T to $1{\cdot}10^{3}$ V/T	DC; 23 °C at $1{\cdot}10^{-3}$ T to $13.5{\cdot}10^{-3}$ T at > $13.5{\cdot}10^{-3}$ T to $8{\cdot}10^{-2}$ T at > $8{\cdot}10^{-2}$ T to 1.7 T at > 1.7 T to 3 T Measurement in a field generating system a) Substitution method b) By means of a calibrated reference magnet c) By means of a calibrated field generating coil	$1.6{\cdot}10^{-3} + 4{\cdot}10^{-6}$ V/($S{\cdot}B$) $2.6{\cdot}10^{-3} + 4{\cdot}10^{-6}$ V/($S{\cdot}B$) $0.2{\cdot}10^{-3} + 4{\cdot}10^{-6}$ V/($S{\cdot}B$) $3{\cdot}10^{-3} + 4{\cdot}10^{-6}$ V/($S{\cdot}B$)	$S = U/B$ = sensitivity value at given supply voltage or supply current, U = sensor output voltage, B = magnetic flux density
Magnetic flux Fluxmeters	$1{\cdot}10^{-4}$ Vs to $2.7{\cdot}10^{-4}$ Vs > $2.7{\cdot}10^{-4}$ Vs to $8{\cdot}10^{-4}$ Vs	DC; 23 °C Calibrated Helmholtz coil and field sensing coil	$4.1{\cdot}10^{-7}$ Vs/Φ + $1.2{\cdot}10^{-3}$ $8{\cdot}10^{-7}$ Vs/Φ + $2.2{\cdot}10^{-3}$	Φ = measurement result of magnetic flux
	> $8{\cdot}10^{-4}$ Vs to $3.4{\cdot}10^{-2}$ Vs > $3.4{\cdot}10^{-2}$ Vs to 0.34 Vs	DC; 23 °C Electromagnet with yoke, measurement of flux density by means of nuclear magnetic resonance, calibrated field sensing coil	$1.5{\cdot}10^{-3}$ $3{\cdot}10^{-3}$	
	$1.98{\cdot}10^{-3}$ Vs	DC; 23 °C Reference magnet calibrated by nuclear magnetic resonance, calibrated field sensing coil	$1.6{\cdot}10^{-3}$	
Magnetic flux Flux etalon	$1{\cdot}10^{-2}$ Vs	23 °C Measurement by means of a calibrated fluxmeter	$2.2{\cdot}10^{-3}$	
Winding area Field sensing coils	$1{\cdot}10^{-4}$ m² to 20 m²	DC; 23 °C a) Measurement of flux in a reference magnet or in a field generating coil b) Comparison with a known winding area	$1.5{\cdot}10^{-3} + 1.5{\cdot}10^{-6}$ m²/A	A = measurement result of winding area
Measuring constant Moment detection coils	$1{\cdot}10^{-6}$ m to $1{\cdot}10^{-2}$ m > $1{\cdot}10^{-2}$ m to 1 m	DC; 23 °C Substitution method, comparison with a calibrated moment detection coil by means of a permanent magnet	$0.6{\cdot}10^{-3}$ $1{\cdot}10^{-3} + 4{\cdot}10^{-2}$ k_M/m	k_M = measurement result

[1)] The best measurement capabilities are stated according to EA-4/02. These are expanded uncertainties of measurement with a coverage probability of 95% and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Magnetic field to current constant Field generating coils	$1\ m^{-1}$ to $1{\cdot}10^{2}\ m^{-1}$ $> 1{\cdot}10^{2}\ m^{-1}$ to $1{\cdot}10^{6}\ m^{-1}$	DC; 23 °C Measurement of the current through the coil and the magnetic field strength in the coil centre. Measurement of the current through the coil and the magnetic field strength along the coil axis.	$1{\cdot}10^{-3} + 4{\cdot}10^{-2}\ /(m{\cdot}k_F)$ $0.6{\cdot}10^{-3}$	$k_F = H_{Zentr}/I$ = value of the magnetic field to current constant I = measurement result of current through the coil H_{Zentr} = measurement result of magnetic field strength in the centre of the coil

Abbreviations used:

EA-4/02 „Expression of the Uncertainty of Measurement in Calibration"

[1)] The best measurement capabilities are stated according to EA-4/02. These are expanded uncertainties of measurement with a coverage probability of 95% and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.