Trescal

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC)

THIS DOCUMENT CONTAINS:

- ACCREDITATION CERTIFICATE + ANNEX D-K-15015-01-00
- PARTIAL ACCREDITATION CERTIFICATE + ANNEX D-K-15015-01-01
- PARTIAL ACCREDITATION CERTIFICATE + ANNEX D-K-15015-01-02
- ANNEX FLEXIBLE ACCREDITATION

DAkkS
Deutsche
Akkreditierungsstelle

Accreditation

The Deutsche Akkreditierungsstelle attests with this **Accreditation Certificate** that the calibration laboratory

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

meets the requirements of DIN EN ISO/IEC 17025:2018 for the conformity assessment activities specified in the following partial accreditation certificates. This includes additional existing legal and normative requirements for the calibration laboratory, including those in relevant sectoral schemes, provided that these are explicitly confirmed in the annexes to the partial accreditation certificates listed below.

D-K-15015-01-01
D-K-15015-01-02

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the general principles of DIN EN ISO 9001.

This accreditation was issued in accordance with Art. 5 Para. 1 Sentence 2 of Regulation (EC) 765/2008, after an accreditation procedure was carried out in compliance with the minimum requirements of DIN EN ISO/IEC 17011 and on the basis of a review and decision of the appointed accreditation committees.

This accreditation certificate consists of this cover sheet, the reverse side of the cover sheet and the following annex. It only applies in connection with the partial accreditation certificates listed above and the notices referred to there.

Registration number of the certificate: **D-K-15015-01-00**

Berlin, 15.06.2023 Dipl.-Ing. Gabriel Zrenner
Head of Department

Translation issued:
10.10.2023 Dipl.-Ing. Gabriel Zrenner
Head of Department

The certificate together with the annex reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH (www.dakks.de).

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

See notes overleaf

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The Deutsche Akkreditierungsstelle GmbH (DAkkS) is the entrusted national accreditation body of the Federal Republic of Germany according to § 8 section 1 AkkStelleG in conjunction with § 1 section 1 AkkStelleGBV. DAkkS is designated as the national accreditation authority by Germany according to Art. 4 Para. 4 of Regulation (EC) 765/2008 and clause 4.7 of DIN EN ISO/IEC 17000.

Pursuant to Art. 11 section 2 of Regulation (EC) 765/2008, the accreditation certificate shall be recognised as equivalent by the national authorities within the scope of this Regulation as well as by the WTO member states that have committed themselves in bilateral or multilateral mutual agreements to recognise the certificates of accreditation bodies that are members of ILAC or IAF as equivalent.

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 Co-operation (ILAC).

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

Annex to the Accreditation Certificate D-K-15015-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: **15.06.2023**

Date of issue: 10.10.2023

Holder of accreditation certificate:

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

The calibration laboratory meets the requirements of DIN EN ISO/IEC 17025:2018 to carry out the conformity assessment activities listed in this annex. The calibration laboratory meets additional legal and normative requirements, if applicable, including those in relevant sectoral schemes, provided that these are explicitly confirmed in the annexes to the partial accreditation certificates listed below.

D-K-15015-01-01

D-K-15015-01-02

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the general principles of DIN EN ISO 9001.

This certificate annex is only valid together with the written accreditation certificate and reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at https://www.dakks.de.

DAkkS
Deutsche
Akkreditierungsstelle

Accreditation

The Deutsche Akkreditierungsstelle attests with this **Partial Accreditation Certificate** that the calibration laboratory

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

meets the requirements according to DIN EN ISO/IEC 17025:2018 for the conformity assessment activities listed in the annex to this certificate. This includes additional existing legal and normative requirements for the calibration laboratory, including those in relevant sectoral schemes, provided they are explicitly confirmed in the annex to this certificate.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the principles of DIN EN ISO 9001.

This accreditation was issued in accordance with Art. 5 Para. 1 Sentence 2 of Regulation (EC) 765/2008, after an accreditation procedure was carried out in compliance with the minimum requirements of DIN EN ISO/IEC 17011 and on the basis of a review and decision of the appointed accreditation committees.

This partial accreditation certificate only applies in connection with the notice of 15.05.2025 with accreditation number D-K-15015-01.
It consists of this cover sheet, the reverse side of the cover sheet and the following annex with a total of 68 pages.

Registration number of the partial accreditation certificate: **D-K-15015-01-01**
It is a part of the accreditation certificate: D-K-15015-01-00.

Berlin, 15.05.2025 Dr. Florian Witt
Head of Technical Unit

Translation issued: 15.05.2025 Dr. Florian Witt
Head of Technical Unit

The certificate together with the annex reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH (www.dakks.de).

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

See notes overleaf

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Office Braunschweig
Bundesallee 100
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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

Annex to the Partial Accreditation Certificate D-K-15015-01-01 according to DIN EN ISO/IEC 17025:2018

Valid from: **15.05.2025**

Date of issue: 15.05.2025

This annex is a part of the accreditation certificate D-K-15015-01-00.

Holder of partial accreditation certificate:

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

with the locations

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

Trescal GmbH
Branch Neustadt
Ernst-Abbe-Straße 18, 01844 Neustadt

Trescal GmbH
Branch Esslingen
Limburgstraße 6, 73734 Esslingen

Trescal GmbH
Branch Parchim
Ludwigsluster Chaussee 5, 19370 Parchim

This certificate annex is only valid together with the written accreditation certificate and reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at https://www.dakks.de.

Trescal GmbH
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Trescal GmbH
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Trescal GmbH
Branch Nürnberg
Poststraße 15a, 90471 Nürnberg

The calibration laboratory meets the requirements of DIN EN ISO/IEC 17025:2018 to carry out the conformity assessment activities listed in this annex. The calibration laboratory meets additional legal and normative requirements, if applicable, including those in relevant sectoral schemes, provided that these are explicitly confirmed below.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the general principles of DIN EN ISO 9001.

Calibration in the fields:

Dimensional quantities

Length

- **Length measuring devices** [b)]
- **Length measuring instruments** [a) c)]
- **Length gauges**
- **Diameter** [c)]
- **Thread**
- **Form error**
- **Straightness** [b)]
- **Flatness** [b)]

Coordinate measuring technology

- **Coordinate measuring machines** [b)]

Electrical quantities

DC and low frequency quantities

- **DC voltage** [a)]
- **AC voltage** [a)]
- **DC current** [a)]
- **AC current** [a)]
- **DC resistance** [a)]
- **Capacitance** [a)]
- **Inductance**
- **Electric power** [a)]
- **Power factor** [a)]
- **Voltage ratio** [a)]

Time and frequency

- **Frequency** [a)]
- **Time intervall** [a)]

High frequency and radiation quantities

High frequency quantities

- **HF voltage**
- **Oscilloscope quantities** [a)]
- **Rise time** [a)]
- **Band width** [a)]

[a)] also as On-site calibration [b)] only as On-site calibration [c)] also in mobile laboratory

Within the measurands/calibration items marked with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates.

The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

Darmstadt

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage	0 V		0.5 µV	Short circuit adaptor
Measurement instruments	0.1 V 1 V 10 V; 100 V; 1000 V		$13 \cdot 10^{-6} \cdot U$ $1.7 \cdot 10^{-6} \cdot U$ $2.5 \cdot 10^{-6} \cdot U$	U = measured value Calibration with Fluke 732A and 752A
	0 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 11 V > 11 V to 22 V > 22 V to 220 V > 220 V to 1100 V		$6 \cdot 10^{-6} \cdot U$ + 2 µV $7 \cdot 10^{-6} \cdot U$ + 3 µV $8 \cdot 10^{-6} \cdot U$ + 6 µV $6 \cdot 10^{-6} \cdot U$ + 20 µV $10 \cdot 10^{-6} \cdot U$ + 0.25 mV $10 \cdot 10^{-6} \cdot U$ + 1.3 mV	Calibration with Calibrator Fluke 5700A
	0 mV to 0.2 V > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V		$2 \cdot 10^{-6} \cdot U$ + 2 µV $2 \cdot 10^{-6} \cdot U$ + 3 µV $2 \cdot 10^{-6} \cdot U$ + 20 µV $4 \cdot 10^{-6} \cdot U$ + 0.24 mV $5 \cdot 10^{-6} \cdot U$ + 1.2 mV	Calibration via substitution method with DMM Fluke 8508A
DC voltage Sources	0.1 V 1 V 10 V; 100 V; 1000 V		$16 \cdot 10^{-6} \cdot U$ $1.9 \cdot 10^{-6} \cdot U$ $2.5 \cdot 10^{-6} \cdot U$	Calibration with Fluke 732A and 752A
	0 mV to 0.12 V > 0.12 V to 1.2 V > 1.2 V to 12 V > 12 V to 100 V > 100 V to 200 V > 200 V to 500 V > 500 V to 700 V > 700 V to 1000 V		$5 \cdot 10^{-6} \cdot U$ + 2 µV $4.5 \cdot 10^{-6} \cdot U$ + 2 µV $7 \cdot 10^{-6} \cdot U$ + 3 µV $15 \cdot 10^{-6} \cdot U$ + 40 µV $7 \cdot 10^{-6} \cdot U$ + 0.17 mV $10 \cdot 10^{-6} \cdot U$ + 0.17 mV $13 \cdot 10^{-6} \cdot U$ + 0.17 mV $20 \cdot 10^{-6} \cdot U$ + 0.17 mV	Calibration with DMM HP 3458A
DC voltage Sources	0 mV to 0.2 V > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V		$1 \cdot 10^{-6} \cdot U$ + 2 µV $2 \cdot 10^{-6} \cdot U$ + 3 µV $2 \cdot 10^{-6} \cdot U$ + 20 µV $3 \cdot 10^{-6} \cdot U$ + 0.23 mV $4 \cdot 10^{-6} \cdot U$ + 1.2 mV	Calibration with DMM Fluke 8508A
	1 kV to 6 kV		$1 \cdot 10^{-3} \cdot U$	Calibration with multimeter and high voltage divider

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC voltage Sources	0 V 50 mV 100 mV 500 mV 1 V 1.9 V 4 V 5 V 6 V 8 V 10 V 12 V 15 V 19 V 50 V 100 V 500 V 1000 V		1.5 µV 2 µV 2 µV 2.5 µV 3 µV 15 µV 15 µV 20 µV 20 µV 25 µV 25 µV 35 µV 40 µV 45 µV 0.2 mV 0.32 mV 2.2 mV 3.3 mV	Calibration with DMM Fluke 8508A
DC current Measurement instruments	1 µA to 0.12 mA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 0.12 A > 0.12 A to 1.05 A > 1.05 A to 11 A > 11 A to 20 A		$20 \cdot 10^{-6} \cdot I +$ 2 nA $20 \cdot 10^{-6} \cdot I +$ 15 nA $20 \cdot 10^{-6} \cdot I +$ 0.15 µA $40 \cdot 10^{-6} \cdot I +$ 1.5 µA $0.12 \cdot 10^{-3} \cdot I +$ 15 µA $30 \cdot 10^{-6} \cdot I +$ 0.4 mA $35 \cdot 10^{-6} \cdot I +$ 0.22 mA	I = measured value Substitution method with DMM HP 3458A and Shunt Fluke Y5020
	100 nA to 200 µA > 200 µA to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 0.2 A to 2 A > 2 A to 20 A		$11 \cdot 10^{-6} \cdot I +$ 1 nA $11 \cdot 10^{-6} \cdot I +$ 10 nA $12 \cdot 10^{-6} \cdot I +$ 0.1 µA $40 \cdot 10^{-6} \cdot I +$ 1 µA $0.15 \cdot 10^{-3} \cdot I +$ 20 µA $0.35 \cdot 10^{-3} \cdot I +$ 0.5 mA	Substitution method with DMM HP 8508A
	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I +$ 5 mA	Substitution method with DMM HP 3458A / H&B 0.01 Ω
DC current Measurement instruments with converter method	> 10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A		$6 \cdot 10^{-3} \cdot I +$ 0.1 A $6 \cdot 10^{-3} \cdot I +$ 0.2 A $6 \cdot 10^{-3} \cdot I +$ 0.5 A	Calibration with Fluke 5500A / Coil
DC current Sources	1µA to 0.12 mA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 0.12 A > 0.12 A to 1.05 A		$20 \cdot 10^{-6} \cdot I +$ 2 nA $20 \cdot 10^{-6} \cdot I +$ 8 nA $20 \cdot 10^{-6} \cdot I +$ 80 nA $40 \cdot 10^{-6} \cdot I +$ 0.7 µA $0.12 \cdot 10^{-3} \cdot I +$ 15 µA	Calibration with DMM HP 3458A
	> 1.05 A to 11 A > 11 A to 20 A		$30 \cdot 10^{-6} \cdot I +$ 0.4 mA $35 \cdot 10^{-6} \cdot I +$ 0.22 mA	Calibration with DMM HP 3458A and Shunt Fluke Y 5020

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC current Sources	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I$ + 5 mA	Calibration with DMM HP 3458A and H&B 0.01 Ω
	100 nA to 200 µA > 200 µA to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 0.2 A to 2 A > 2 A to 20 A		$10 \cdot 10^{-6} \cdot I$ + 1 nA $10 \cdot 10^{-6} \cdot I$ + 10 nA $10 \cdot 10^{-6} \cdot I$ + 0.1 µA $38 \cdot 10^{-6} \cdot I$ + 1 µA $0.15 \cdot 10^{-3} \cdot I$ + 20 µA $0.34 \cdot 10^{-3} \cdot I$ + 0.5 mA	I = measured value Calibration with Fluke 8508A
DC power Measurement instruments	0.1 W to 336 W 1 W to 3059 W 10 W to 20.9 kW	0.33 mA to < 0.33 A 0.33 A to < 3 A 3 A to 20.5 A	$0.7 \cdot 10^{-3} \cdot P$ $0.7 \cdot 10^{-3} \cdot P$ $1 \cdot 10^{-3} \cdot P$	P = measured value
DC resistance Resistors	10 mΩ 1 Ω; 10 kΩ		$35 \cdot 10^{-6} \cdot R$ $5.2 \cdot 10^{-6} \cdot R$	R = measured value
	1 mΩ to 10 mΩ > 10 mΩ to 0.1 Ω > 0.1 Ω to 1 Ω		$40 \cdot 10^{-6} \cdot R$ + 1 µΩ $20 \cdot 10^{-6} \cdot R$ + 10 µΩ $10 \cdot 10^{-6} \cdot R$ + 25 µΩ	Comparison with Shunt Fluke Y 5020 and Standard resistor Tinsley 5685B-1 Ω
	> 1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 kΩ > 1.2 kΩ to 12 kΩ > 12 kΩ to 120 kΩ > 120 kΩ to 1.2 MΩ > 1.2 MΩ to 12 MΩ > 12 MΩ to 120 MΩ		$19 \cdot 10^{-6} \cdot R$ + 70 µΩ $13 \cdot 10^{-6} \cdot R$ + 0.7 mΩ $11 \cdot 10^{-6} \cdot R$ + 1.5 mΩ $11 \cdot 10^{-6} \cdot R$ + 15 mΩ $11 \cdot 10^{-6} \cdot R$ + 0.15 Ω $15 \cdot 10^{-6} \cdot R$ + 4 Ω $60 \cdot 10^{-6} \cdot R$ + 0.2 kΩ $0.6 \cdot 10^{-3} \cdot R$ + 2 kΩ	Calibration with DMM HP 3458A
	> 1 Ω to < 2 Ω 2 Ω to < 20 Ω 20 Ω to < 200 Ω 200 Ω to < 2 kΩ 2 kΩ to < 20 kΩ 20 kΩ to < 200 kΩ 200 kΩ to < 2 MΩ 2 MΩ to < 20 MΩ 20 MΩ to < 200 MΩ 200 MΩ to < 2 GΩ		$15 \cdot 10^{-6} \cdot R$ + 10 µΩ $8 \cdot 10^{-6} \cdot R$ + 50 µΩ $7 \cdot 10^{-6} \cdot R$ + 0.5 mΩ $6 \cdot 10^{-6} \cdot R$ + 5 mΩ $6 \cdot 10^{-6} \cdot R$ + 50 mΩ $6 \cdot 10^{-6} \cdot R$ + 0.5 Ω $7 \cdot 10^{-6} \cdot R$ + 5 Ω $10 \cdot 10^{-6} \cdot R$ + 50 Ω $40 \cdot 10^{-6} \cdot R$ + 1.5 kΩ $0.4 \cdot 10^{-3} \cdot R$ + 0.1 MΩ	Calibration with Fluke 8508A
DC resistance Resistances-measurement instruments	0 Ω		20 µΩ	Short circuit adaptor on Fluke 8508A

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Resistance-measurement instruments	10 mΩ 0.1 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ		$40 \cdot 10^{-6} \cdot R$ $0.13 \cdot 10^{-3} \cdot R$ $5.2 \cdot 10^{-6} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $35 \cdot 10^{-6} \cdot R$ $33 \cdot 10^{-6} \cdot R$ $23 \cdot 10^{-6} \cdot R$ $23 \cdot 10^{-6} \cdot R$ $16 \cdot 10^{-6} \cdot R$ $16 \cdot 10^{-6} \cdot R$ $5 \cdot 10^{-6} \cdot R$ $15 \cdot 10^{-6} \cdot R$ $16 \cdot 10^{-6} \cdot R$ $18 \cdot 10^{-6} \cdot R$ $22 \cdot 10^{-6} \cdot R$ $25 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $60 \cdot 10^{-6} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$	Calibration with Calibrator Fluke 5700A, Calibration at 0.01 Ω with Shunt Fluke Y5020, Calibration at 1 Ω & 10 kΩ with Standard resistors Tinsley 5685B-1 Ω & 10 kΩ
	0.01 Ω to 0.1 Ω > 0.1 Ω to 1 Ω > 1 Ω to 10 Ω		$0.1 \cdot 10^{-3} \cdot R +$ 20 µΩ $0.1 \cdot 10^{-3} \cdot R +$ 0.2 mΩ $0.1 \cdot 10^{-3} \cdot R +$ 2 mΩ	Calibration with Shunt Fluke Y5020 and HP 3458 via current/voltage-method
	10 Ω to 100 Ω > 100 Ω to 1 kΩ > 1 kΩ to 10 kΩ > 10 kΩ to 100 kΩ > 100 kΩ to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ > 100 MΩ to 10 GΩ		$0.1 \cdot 10^{-3} \cdot R +$ 20 mΩ $0.1 \cdot 10^{-3} \cdot R +$ 0.2 Ω $0.1 \cdot 10^{-3} \cdot R +$ 2 Ω $0.1 \cdot 10^{-3} \cdot R +$ 20 Ω $0.1 \cdot 10^{-3} \cdot R +$ 0.2 kΩ $0.1 \cdot 10^{-3} \cdot R +$ 2 kΩ $0.6 \cdot 10^{-3} \cdot R +$ 20 kΩ $7 \cdot 10^{-3} \cdot R +$ 0.2 MΩ	Calibration via substitution method with a resistor and a multimeter
AC voltage Measurement instruments	0.1 V	20 Hz; 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 100 kHz	25 µV 25 µV 40 µV 50 µV	Calibration with calibrator Fluke 5700A / 5725A
	1 V	20 Hz 40 Hz; 1 kHz; 10 kHz 20 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.1 mV 70 µV 80 µV 0.1 mV 0.2 mV 1 mV 2 mV	
	4 V	1 kHz; 10 kHz	0.25 mV	
	6 V	1 kHz; 10 kHz	0.35 mV	
	8 V	1 kHz; 10 kHz	0.4 mV	

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	Calibration with calibrator Fluke 5700A / 5725A
	13 V	1 kHz; 10 kHz	0.5 mV	
	15 V	1 kHz; 10 kHz	0.8 mV	
	18 V	1 kHz; 10 kHz	1 mV	
	20 V	1 kHz; 10 kHz	1.1 mV	
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV	
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV	
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V	
AC voltage Measurement instruments	2 mV to 2.2 mV	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.61 \cdot 10^{-3} \cdot U$ + 7 µV $0.24 \cdot 10^{-3} \cdot U$ + 7 µV $0.13 \cdot 10^{-3} \cdot U$ + 7 µV $0.41 \cdot 10^{-3} \cdot U$ + 7 µV $1.1 \cdot 10^{-3} \cdot U$ + 10 µV $1.4 \cdot 10^{-3} \cdot U$ + 18 µV $2 \cdot 10^{-3} \cdot U$ + 35 µV $3 \cdot 10^{-3} \cdot U$ + 40 µV	U = measured value
	> 2.2 mV to 22 mV	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.59 \cdot 10^{-3} \cdot U$ + 10 µV $0.22 \cdot 10^{-3} \cdot U$ + 10 µV $0.11 \cdot 10^{-3} \cdot U$ + 10 µV $0.39 \cdot 10^{-3} \cdot U$ + 10 µV $1 \cdot 10^{-3} \cdot U$ + 12 µV $1.4 \cdot 10^{-3} \cdot U$ + 20 µV $2 \cdot 10^{-3} \cdot U$ + 40 µV $3.8 \cdot 10^{-3} \cdot U$ + 40 µV	
	> 22 mV to 0.22 V	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.63 \cdot 10^{-3} \cdot U$ + 20 µV $0.25 \cdot 10^{-3} \cdot U$ + 15 µV $0.12 \cdot 10^{-3} \cdot U$ + 15 µV $0.37 \cdot 10^{-3} \cdot U$ + 15 µV $0.9 \cdot 10^{-3} \cdot U$ + 35 µV $1.2 \cdot 10^{-3} \cdot U$ + 40 µV $2 \cdot 10^{-3} \cdot U$ + 50 µV $3.8 \cdot 10^{-3} \cdot U$ + 0.13 mV	

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	> 0.22 V to 2.2 V	10 Hz to 20 Hz > 20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U +$ 0.13 mV $0.2 \cdot 10^{-3} \cdot U +$ 40 µV $85 \cdot 10^{-6} \cdot U +$ 18 µV $0.15 \cdot 10^{-3} \cdot U +$ 30 µV $0.3 \cdot 10^{-3} \cdot U +$ 90 µV $0.5 \cdot 10^{-3} \cdot U +$ 0.17 mV $1.3 \cdot 10^{-3} \cdot U +$ 0.45 mV $2.5 \cdot 10^{-3} \cdot U +$ 1.2 mV	U = measured value Calibration with calibrator Fluke 5700A / 5725A
	> 2.2 V to 22 V	10 Hz to 20 Hz > 20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U +$ 1.3 mV $0.2 \cdot 10^{-3} \cdot U +$ 0.35 mV $90 \cdot 10^{-6} \cdot U +$ 0.13 mV $0.15 \cdot 10^{-3} \cdot U +$ 0.25 mV $0.3 \cdot 10^{-3} \cdot U +$ 0.45 mV $0.6 \cdot 10^{-3} \cdot U +$ 2 mV $1.6 \cdot 10^{-3} \cdot U +$ 5.5 mV $3.2 \cdot 10^{-3} \cdot U +$ 10 mV	
	> 22 V to 220 V	10 Hz to 20 Hz > 20 Hz tot < 40 Hz 40 Hz o 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.65 \cdot 10^{-3} \cdot U +$ 12 mV $0.2 \cdot 10^{-3} \cdot U +$ 3.5 mV $0.1 \cdot 10^{-3} \cdot U +$ 1.7 mV $0.25 \cdot 10^{-3} \cdot U +$ 4.8 mV $0.7 \cdot 10^{-3} \cdot U +$ 10 mV	
	> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$80 \cdot 10^{-6} \cdot U +$ 25 mV $80 \cdot 10^{-6} \cdot U +$ 25 mV $0.15 \cdot 10^{-3} \cdot U +$ 20 mV	
AC voltage Sources	0.1 V	20 Hz; 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 100 kHz	25 µV 25 µV 40 µV 50 µV	Substitution method with calibrator Fluke 5700A / 5725A
	1 V	20 Hz 40 Hz; 1 kHz; 10 kHz 20 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.1 mV 70 µV 80 µV 0.1 mV 0.2 mV 1 mV 2 mV	
	4 V	1 kHz; 10 kHz	0.25 mV	
	6 V	1 kHz; 10 kHz	0.35 mV	
	8 V	1 kHz; 10 kHz	0.4 mV	
	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	
	13 V	1 kHz; 10 kHz	0.5 mV	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	15 V	1 kHz; 10 kHz	0.8 mV	Substitution method with calibrator Fluke 5700A / 5725A
	18 V	1 kHz; 10 kHz	1 mV	
	20 V	1 kHz; 10 kHz	1.1 mV	
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV	
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV	
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V	
	0.1 V to 0.22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U$ + 15 µV $0.12 \cdot 10^{-3} \cdot U$ + 15 µV $0.37 \cdot 10^{-3} \cdot U$ + 15 µV $0.9 \cdot 10^{-3} \cdot U$ + 35 µV	U = measured value
	> 0.22 V to 2.2 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U$ + 40 µV $80 \cdot 10^{-6} \cdot U$ + 25 µV $0.15 \cdot 10^{-3} \cdot U$ + 30 µV $0.3 \cdot 10^{-3} \cdot U$ + 90 µV $0.5 \cdot 10^{-3} \cdot U$ + 0.17 mV $1.3 \cdot 10^{-3} \cdot U$ + 0.45 mV $2.5 \cdot 10^{-3} \cdot U$ + 1.2 mV	
	> 2.2 V to 22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U$ + 0.35 mV $0.1 \cdot 10^{-3} \cdot U$ + 0.15 mV $0.15 \cdot 10^{-3} \cdot U$ + 0.28 mV $0.3 \cdot 10^{-3} \cdot U$ + 0.45 mV $0.6 \cdot 10^{-3} \cdot U$ + 2 mV $1.6 \cdot 10^{-3} \cdot U$ + 5.5 mV $3.2 \cdot 10^{-3} \cdot U$ + 10 mV	
	> 22 V to 220 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.22 \cdot 10^{-3} \cdot U$ + 3.5 mV $0.12 \cdot 10^{-3} \cdot U$ + 1.7 mV $0.25 \cdot 10^{-3} \cdot U$ + 4.8 mV $0.7 \cdot 10^{-3} \cdot U$ + 10 mV	
	> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$90 \cdot 10^{-6} \cdot U$ + 25 mV $90 \cdot 10^{-6} \cdot U$ + 25 mV $0.15 \cdot 10^{-3} \cdot U$ + 20 mV	
	1 mV to 2.2 mV	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$1.6 \cdot 10^{-3} \cdot U$ + 3 µV $0.6 \cdot 10^{-3} \cdot U$ + 3 µV $0.3 \cdot 10^{-3} \cdot U$ + 3 µV $0.75 \cdot 10^{-3} \cdot U$ + 4 µV $1.1 \cdot 10^{-3} \cdot U$ + 4 µV $2.3 \cdot 10^{-3} \cdot U$ + 6 µV $2.6 \cdot 10^{-3} \cdot U$ + 10 µV $3.7 \cdot 10^{-3} \cdot U$ + 11 µV	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	> 2.2 mV to 7 mV	10 Hz to 20 Hz	$0.8 \cdot 10^{-3} \cdot U + 4\ \mu V$	U = measured value Calibration with Fluke 5790A in direct measurement
		> 20 Hz to 40 Hz	$0.29 \cdot 10^{-3} \cdot U + 4\ \mu V$	
		> 40 Hz to 20 kHz	$0.14 \cdot 10^{-3} \cdot U + 4\ \mu V$	
		> 20 kHz to 50 kHz	$0.36 \cdot 10^{-3} \cdot U + 4\ \mu V$	
		> 50 kHz to 100 kHz	$0.58 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 100 kHz to 300 kHz	$1.2 \cdot 10^{-3} \cdot U + 7\ \mu V$	
		> 300 kHz to 500 kHz	$1.4 \cdot 10^{-3} \cdot U + 11\ \mu V$	
		> 500 kHz to 1 MHz	$2.4 \cdot 10^{-3} \cdot U + 12\ \mu V$	
	> 7 mV to 22 mV	10 Hz to 20 Hz	$0.23 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 20 Hz to 40 Hz	$0.13 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 40 Hz to 20 kHz	$0.16 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 20 kHz to 50 kHz	$0.16 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 50 kHz to 100 kHz	$0.29 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 100 kHz to 300 kHz	$0.8 \cdot 10^{-3} \cdot U + 9\ \mu V$	
		> 300 kHz to 500 kHz	$0.95 \cdot 10^{-3} \cdot U + 12\ \mu V$	
		> 500 kHz to 1 MHz	$1.8 \cdot 10^{-3} \cdot U + 15\ \mu V$	
	> 22 mV to 70 mV	10 Hz to 20 Hz	$0.24 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 Hz to 40 Hz	$0.11 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 40 Hz to 20 kHz	$50 \cdot 10^{-6} \cdot U + 6\ \mu V$	
		> 20 kHz to 50 kHz	$0.12 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 50 kHz to 100 kHz	$0.27 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 100 kHz to 300 kHz	$0.56 \cdot 10^{-3} \cdot U + 8\ \mu V$	
		> 300 kHz to 500 kHz	$0.74 \cdot 10^{-3} \cdot U + 12\ \mu V$	
		> 500 kHz to 1 MHz	$1.2 \cdot 10^{-3} \cdot U + 15\ \mu V$	
	> 70 mV to 220 mV	10 Hz to 20 Hz	$0.23 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 Hz to 40 Hz	$80 \cdot 10^{-6} \cdot U + 8\ \mu V$	
		> 40 Hz to 20 kHz	$30 \cdot 10^{-6} \cdot U + 9\ \mu V$	
		> 20 kHz to 50 kHz	$65 \cdot 10^{-6} \cdot U + 8\ \mu V$	
		> 50 kHz to 100 kHz	$0.17 \cdot 10^{-3} \cdot U + 7\ \mu V$	
		> 100 kHz to 300 kHz	$0.25 \cdot 10^{-3} \cdot U + 16\ \mu V$	
		> 300 kHz to 500 kHz	$0.41 \cdot 10^{-3} \cdot U + 17\ \mu V$	
		> 500 kHz to 1 MHz	$1.1 \cdot 10^{-3} \cdot U + 27\ \mu V$	
	> 220 mV to 700 mV	10 Hz to 20 Hz	$0.23 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 Hz to 40 Hz	$80 \cdot 10^{-6} \cdot U + 7\ \mu V$	
		> 40 Hz to 20 kHz	$30 \cdot 10^{-6} \cdot U + 11\ \mu V$	
		> 20 kHz to 50 kHz	$55 \cdot 10^{-6} \cdot U + 9\ \mu V$	
		> 50 kHz to 100 kHz	$85 \cdot 10^{-6} \cdot U + 9\ \mu V$	
		> 100 kHz to 300 kHz	$0.18 \cdot 10^{-6} \cdot U + 33\ \mu V$	
		> 300 kHz to 500 kHz	$0.32 \cdot 10^{-3} \cdot U + 28\ \mu V$	
		> 500 kHz to 1 MHz	$1.1 \cdot 10^{-3} \cdot U + 35\ \mu V$	
	> 700 mV to 2.2 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 Hz to 40 Hz	$75 \cdot 10^{-6} \cdot U + 8\ \mu V$	
		> 40 Hz to 20 kHz	$25 \cdot 10^{-6} \cdot U + 17\ \mu V$	
		> 20 kHz to 50 kHz	$50 \cdot 10^{-6} \cdot U + 11\ \mu V$	
		> 50 kHz to 100 kHz	$75 \cdot 10^{-6} \cdot U + 12\ \mu V$	
		> 100 kHz to 300 kHz	$0.16 \cdot 10^{-3} \cdot U + 80\ \mu V$	
		> 300 kHz to 500 kHz	$0.28 \cdot 10^{-3} \cdot U + 56\ \mu V$	
		> 500 kHz to 1 MHz	$1 \cdot 10^{-3} \cdot U + 78\ \mu V$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	> 2.2 V to 7 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U +$ 12 µV	U = measured value Calibration with Fluke 5790A in direct measurement
		> 20 Hz to 40 Hz	$75 \cdot 10^{-6} \cdot U +$ 17 µV	
		> 40 Hz to 20 kHz	$25 \cdot 10^{-6} \cdot U +$ 40 µV	
		> 20 kHz to 50 kHz	$55 \cdot 10^{-6} \cdot U +$ 23 µV	
		> 50 kHz to 100 kHz	$90 \cdot 10^{-6} \cdot U +$ 28 µV	
		> 100 kHz to 300 kHz	$0.19 \cdot 10^{-3} \cdot U +$ 0.2 mV	
		> 300 kHz to 500 kHz	$0.45 \cdot 10^{-3} \cdot U +$ 0.11 mV	
		> 500 kHz to 1 MHz	$1.4 \cdot 10^{-3} \cdot U +$ 0.17 mV	
	> 7 V to 22 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U +$ 40 µV	
		> 20 Hz to 40 Hz	$75 \cdot 10^{-6} \cdot U +$ 83 µV	
		> 40 Hz to 20 kHz	$25 \cdot 10^{-6} \cdot U +$ 0.16 mV	
		> 20 kHz to 50 kHz	$55 \cdot 10^{-6} \cdot U +$ 0.11 mV	
		> 50 kHz to 100 kHz	$90 \cdot 10^{-6} \cdot U +$ 95 µV	
		> 100 kHz to 300 kHz	$0.19 \cdot 10^{-3} \cdot U +$ 0.7 mV	
		> 300 kHz to 500 kHz	$0.44 \cdot 10^{-3} \cdot U +$ 0.38 mV	
		> 500 kHz to 1 MHz	$1.3 \cdot 10^{-3} \cdot U +$ 0.59 mV	
	> 22 V to 70 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U +$ 0.18 mV	
		> 20 Hz to 40 Hz	$75 \cdot 10^{-6} \cdot U +$ 0.36 mV	
		> 40 Hz to 20 kHz	$30 \cdot 10^{-6} \cdot U +$ 0.62 mV	
		> 20 kHz to 50 kHz	$65 \cdot 10^{-6} \cdot U +$ 0.42 mV	
		> 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U +$ 0.38 mV	
		> 100 kHz to 300 kHz	$0.21 \cdot 10^{-3} \cdot U +$ 1.1 mV	
		> 300 kHz to 500 kHz	$0.46 \cdot 10^{-3} \cdot U +$ 0.55 mV	
		> 500 kHz to 1 MHz	$1.4 \cdot 10^{-3} \cdot U +$ 0.77 mV	
	> 70 V to 220 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U +$ 1 mV	
		> 20 Hz to 40 Hz	$75 \cdot 10^{-6} \cdot U +$ 1.7 mV	
		> 40 Hz to 20 kHz	$30 \cdot 10^{-6} \cdot U +$ 2.8 mV	
		> 20 kHz to 50 kHz	$65 \cdot 10^{-6} \cdot U +$ 1.7 mV	
		> 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U +$ 2.6 mV	
	> 220 V to 700 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U +$ 5.3 mV	
		> 20 Hz to 40 Hz	$0.1 \cdot 10^{-3} \cdot U +$ 9.7 mV	
		> 40 Hz to 20 kHz	$35 \cdot 10^{-6} \cdot U +$ 16 mV	
		> 20 kHz to 50 kHz	$0.14 \cdot 10^{-3} \cdot U +$ 7.8 mV	
		> 50 kHz to 100 kHz	$0.56 \cdot 10^{-3} \cdot U +$ 8.2 mV	
	> 700 V to 1000 V	10 Hz to 20 Hz	$0.22 \cdot 10^{-3} \cdot U +$ 8.5 mV	
		> 20 Hz to 40 Hz	$0.11 \cdot 10^{-3} \cdot U +$ 13 mV	
		> 40 Hz to 20 kHz	$35 \cdot 10^{-6} \cdot U +$ 25 mV	
		> 20 kHz to 50 kHz	$0.14 \cdot 10^{-3} \cdot U +$ 13 mV	
		> 50 kHz to 100 kHz	$0.57 \cdot 10^{-3} \cdot U +$ 10 mV	
	1 kV to 6 kV	50 Hz	$2 \cdot 10^{-3} \cdot U$	Calibration with multimeter and high voltage divider

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	1 mV to 2.2 mV	> 1.2 kHz to 120 kHz	$0.4 \cdot 10^{-3} \cdot U + 2\ \mu V$	U = measured value Calibration with calibrator Fluke 5790A (Wide Band) in direct measurement
		> 120 kHz to 500 kHz	$0.7 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 500 kHz to 1.2 MHz	$0.5 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 1.2 MHz to 2 MHz	$0.5 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 2 MHz to 10 MHz	$1.3 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 10 MHz to 20 MHz	$2.8 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 MHz to 30 MHz	$7.6 \cdot 10^{-3} \cdot U + 3\ \mu V$	
	> 2.2 mV to 7 mV	> 1.2 kHz to 120 kHz	$0.5 \cdot 10^{-3} \cdot U + 3\ \mu V$	
		> 120 kHz to 500 kHz	$0.8 \cdot 10^{-3} \cdot U + 3\ \mu V$	
		> 500 kHz to 1.2 MHz	$0.6 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 1.2 MHz to 2 MHz	$0.6 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 2 MHz to 10 MHz	$1 \cdot 10^{-3} \cdot U + 6\ \mu V$	
		> 10 MHz to 20 MHz	$1.8 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 MHz to 30 MHz	$4.2 \cdot 10^{-3} \cdot U + 4\ \mu V$	
	> 7 mV to 22 mV	> 1.2 kHz to 120 kHz	$0.6 \cdot 10^{-3} \cdot U + 4\ \mu V$	
		> 120 kHz to 500 kHz	$0.8 \cdot 10^{-3} \cdot U + 3\ \mu V$	
		> 500 kHz to 1.2 MHz	$0.7 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 1.2 MHz to 2 MHz	$0.7 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 2 MHz to 10 MHz	$1.1 \cdot 10^{-3} \cdot U + 7\ \mu V$	
		> 10 MHz to 20 MHz	$2 \cdot 10^{-3} \cdot U + 5\ \mu V$	
		> 20 MHz to 30 MHz	$4.3 \cdot 10^{-3} \cdot U + 3\ \mu V$	
	> 22 mV to 70 mV	> 1.2 kHz to 120 kHz	$0.6 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 120 kHz to 500 kHz	$0.6 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 500 kHz to 1.2 MHz	$0.6 \cdot 10^{-3} \cdot U + 3\ \mu V$	
		> 1.2 MHz to 2 MHz	$0.6 \cdot 10^{-3} \cdot U + 3\ \mu V$	
		> 2 MHz to 10 MHz	$1.2 \cdot 10^{-3} \cdot U + 3\ \mu V$	
		> 10 MHz to 20 MHz	$1.8 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 20 MHz to 30 MHz	$4.1 \cdot 10^{-3} \cdot U + 1\ \mu V$	
	> 70 mV to 220 mV	> 1.2 kHz to 120 kHz	$0.5 \cdot 10^{-3} \cdot U + 1\ \mu V$	
		> 120 kHz to 500 kHz	$0.5 \cdot 10^{-3} \cdot U + 1\ \mu V$	
		> 500 kHz to 1.2 MHz	$0.6 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 1.2 MHz to 2 MHz	$0.6 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 2 MHz to 10 MHz	$1.2 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 10 MHz to 20 MHz	$1.8 \cdot 10^{-3} \cdot U + 1\ \mu V$	
		> 20 MHz to 30 MHz	$4.1 \cdot 10^{-3} \cdot U + 1\ \mu V$	
	> 220 mV to 700 mV	> 1.2 kHz to 120 kHz	$0.4 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 120 kHz to 500 kHz	$0.4 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 500 kHz to 1.2 MHz	$0.6 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 1.2 MHz to 2 MHz	$0.6 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 2 MHz to 10 MHz	$1.2 \cdot 10^{-3} \cdot U + 2\ \mu V$	
		> 10 MHz to 20 MHz	$1.8 \cdot 10^{-3} \cdot U + 1\ \mu V$	
		> 20 MHz to 30 MHz	$4.1 \cdot 10^{-3} \cdot U + 1\ \mu V$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	> 700 mV to 2.2 V	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.4 \cdot 10^{-3} \cdot U$ + 2 µV $0.4 \cdot 10^{-3} \cdot U$ + 2 µV $0.61 \cdot 10^{-3} \cdot U$ + 2 µV $0.61 \cdot 10^{-3} \cdot U$ + 2 µV $1.2 \cdot 10^{-3} \cdot U$ + 2 µV $1.8 \cdot 10^{-3} \cdot U$ + 1 µV $4.1 \cdot 10^{-3} \cdot U$ + 1 µV	U = measured value Calibration with calibrator Fluke 5790A (Wide Band) in direct measurement
	> 2.2 V to 7 V	> 1.2 kHz to 120 kHz > 120 kHz to 500 kHz > 500 kHz to 1.2 MHz > 1.2 MHz to 2 MHz > 2 MHz to 10 MHz > 10 MHz to 20 MHz > 20 MHz to 30 MHz	$0.4 \cdot 10^{-3} \cdot U$ + 11 µV $0.4 \cdot 10^{-3} \cdot U$ + 11 µV $0.61 \cdot 10^{-3} \cdot U$ + 8 µV $0.61 \cdot 10^{-3} \cdot U$ + 8 µV $1.2 \cdot 10^{-3} \cdot U$ + 4 µV $1.8 \cdot 10^{-3} \cdot U$ + 3 µV $4.1 \cdot 10^{-3} \cdot U$ + 1 µV	
AC current Measurement instruments	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	Calibration with calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 µA	
	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 µA	
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 µA	
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 µA	
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 µA	
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 µA	
	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 µA	
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 µA	Calibration with calibrator Fluke 5700A / 5725A
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 µA	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz; 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	Calibration with calibrator Fluke 5700A / 5725A
	50 µA to 220 µA	10 Hz to 20 Hz	$0.81 \cdot 10^{-3} \cdot I +$ 50 nA	I = measured value
		> 20 Hz to 40 Hz	$0.44 \cdot 10^{-3} \cdot I +$ 50 nA	
		> 40 Hz to 1 kHz	$0.16 \cdot 10^{-3} \cdot I +$ 50 nA	
		> 1 kHz to 5 kHz	$0.7 \cdot 10^{-3} \cdot I +$ 0.1 µA	
		> 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I +$ 0.2 µA	
	> 220 µA to 2.2 mA	10 Hz to 20 Hz	$0.81 \cdot 10^{-3} \cdot I +$ 0.1 µA	
		> 20 Hz to 40 Hz	$0.44 \cdot 10^{-3} \cdot I +$ 0.1 µA	
		> 40 Hz to 1 kHz	$0.16 \cdot 10^{-3} \cdot I +$ 0.1 µA	
		> 1 kHz to 5 kHz	$0.7 \cdot 10^{-3} \cdot I +$ 0.8 µA	
		> 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I +$ 1.5 µA	
	> 2.2 mA to 22 mA	10 Hz to 20 Hz	$0.81 \cdot 10^{-3} \cdot I +$ 0.7 µA	
		> 20 Hz to 40 Hz	$0.44 \cdot 10^{-3} \cdot I +$ 0.7 µA	
		> 40 Hz to 1 kHz	$0.16 \cdot 10^{-3} \cdot I +$ 0.7 µA	
		> 1 kHz to 5 kHz	$0.7 \cdot 10^{-3} \cdot I +$ 7 µA	
		> 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I +$ 15 µA	
	> 22 mA to 220 mA	10 Hz to 20 Hz	$0.81 \cdot 10^{-3} \cdot I +$ 6 µA	
		> 20 Hz to 40 Hz	$0.44 \cdot 10^{-3} \cdot I +$ 6 µA	
		> 40 Hz to 1 kHz	$0.16 \cdot 10^{-3} \cdot I +$ 7 µA	
		> 1 kHz to 5 kHz	$0.7 \cdot 10^{-3} \cdot I +$ 60 µA	
		> 5 kHz to 10 kHz	$2 \cdot 10^{-3} \cdot I +$ 0.15 mA	
	> 220 mA to 2.2 A	> 20 Hz to 1 kHz	$0.75 \cdot 10^{-3} \cdot I +$ 60 µA	
		> 1 kHz to 5 kHz	$0.87 \cdot 10^{-3} \cdot I +$ 0.14 mA	
		> 5 kHz to 10 kHz	$11 \cdot 10^{-3} \cdot I +$ 0.24 mA	
	> 2.2 A to 11 A	> 40 Hz to 1 kHz	$0.45 \cdot 10^{-3} \cdot I +$ 0.38 mA	
		> 1 kHz to 5 kHz	$0.98 \cdot 10^{-3} \cdot I +$ 0.53 mA	
		> 5 kHz to 10 kHz	$4 \cdot 10^{-3} \cdot I +$ 0.9 mA	
AC current Measurement instruments converter method, Toroid	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$5 \cdot 10^{-3} \cdot I +$ 0.1 A $5 \cdot 10^{-3} \cdot I +$ 0.2 A $5 \cdot 10^{-3} \cdot I +$ 0.2 A	I = measured value Calibration with calibrator Fluke 5500A/Coil
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	$11 \cdot 10^{-3} \cdot I +$ 0.1 A $11 \cdot 10^{-3} \cdot I +$ 0.2 A $11 \cdot 10^{-3} \cdot I +$ 0.2 A	
AC current Measurement instruments converter method	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$8 \cdot 10^{-3} \cdot I +$ 0.1 A $8 \cdot 10^{-3} \cdot I +$ 0.3 A $8 \cdot 10^{-3} \cdot I +$ 1 A	
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	$14 \cdot 10^{-3} \cdot I +$ 0.1 A $14 \cdot 10^{-3} \cdot I +$ 0.3 A $14 \cdot 10^{-3} \cdot I +$ 1 A	
AC current Sources	1 mA to 10 mA	10 Hz to 20 Hz	$0.23 \cdot 10^{-3} \cdot I +$ 0.3 µA	I = measured value Direct measurement with Shunt Fluke A40
		> 20 Hz to 40 Hz	$82 \cdot 10^{-6} \cdot I +$ 0.4 µA	
		> 40 Hz to 10 kHz	$50 \cdot 10^{-6} \cdot I +$ 0.4 µA	
	> 10 mA to 20 mA	10 Hz to 20 Hz	$0.24 \cdot 10^{-3} \cdot I +$ 0.2 µA	
		> 20 Hz to 40 Hz	$95 \cdot 10^{-6} \cdot I +$ 0.3 µA	
		> 40 Hz to 10 kHz	$60 \cdot 10^{-6} \cdot I +$ 0.5 µA	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Sources	> 20 mA to 50 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.26 \cdot 10^{-3} \cdot I + 0.8$ µA $0.1 \cdot 10^{-3} \cdot I + 1.4$ µA $70 \cdot 10^{-6} \cdot I + 1.6$ µA	I = measured value Direct measurement Shunt Fluke A40
	> 50 mA to 100 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 0.9$ µA $0.1 \cdot 10^{-3} \cdot I + 2$ µA $70 \cdot 10^{-6} \cdot I + 2.5$ µA	
	> 100 mA to 200 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 1.5$ µA $0.1 \cdot 10^{-3} \cdot I + 3$ µA $70 \cdot 10^{-6} \cdot I + 4$ µA	
	> 200 mA to 500 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 30$ µA $0.11 \cdot 10^{-3} \cdot I + 40$ µA $95 \cdot 10^{-6} \cdot I + 40$ µA	
	> 500 mA to 1 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.25 \cdot 10^{-3} \cdot I + 25$ µA $0.12 \cdot 10^{-3} \cdot I + 41$ µA $0.95 \cdot 10^{-3} \cdot I + 50$ µA	
	> 1 A to 2 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.25 \cdot 10^{-3} \cdot I + 32$ µA $0.12 \cdot 10^{-3} \cdot I + 60$ µA $90 \cdot 10^{-6} \cdot I + 65$ µA	
	> 2 A to 3 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.1$ mA $75 \cdot 10^{-6} \cdot I + 0.18$ mA $40 \cdot 10^{-6} \cdot I + 0.24$ mA	
	> 3 A to 5 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.13$ mA $75 \cdot 10^{-6} \cdot I + 0.13$ mA $40 \cdot 10^{-6} \cdot I + 0.13$ mA	
	> 5 A to 10 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 53$ µA $95 \cdot 10^{-6} \cdot I + 0.15$ mA $50 \cdot 10^{-6} \cdot I + 0.22$ mA	
	> 10 A to 20 A	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 10 kHz	$0.24 \cdot 10^{-3} \cdot I + 60$ µA $95 \cdot 10^{-6} \cdot I + 0.15$ mA $50 \cdot 10^{-6} \cdot I + 0.22$ mA	
	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	Substitution method with calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 µA	
	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 µA	
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 µA	
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 µA	
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 µA	
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 µA	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Sources	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 µA	Substitution method with calibrator Fluke 5700A / 5725A
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 µA	
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 µA	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA 0.5 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	
	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	
	220 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A > 11 A to 20 A	40 Hz to 1 kHz	$0.15 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.15 \cdot 10^{-3} \cdot I$ + 0.8 µA $0.37 \cdot 10^{-3} \cdot I$ + 7 µA $0.75 \cdot 10^{-3} \cdot I$ + 60 µA $0.44 \cdot 10^{-3} \cdot I$ + 0.35 mA $0.31 \cdot 10^{-3} \cdot I$ + 0.5 mA	I = measured value with Shunt Y5020
AC active power Measurement instruments	0.1 W to 9.15 W 0.1 W to 33.5 W 0.1 W to 91.5 W 0.1 W to 336.5 W 1 W to 917 W 1 W to 2243 W 10 W to 4589 W 10 W to 20.9 kW	3.3 mA to < 9 mA 9 mA to < 33 mA 33 mA to < 90 mA 90 mA to < 0.33 A 0.33 A to < 0.9 A 0.9 A to < 2.2 A 2.2 A to < 4.5 A 4.5 A to 20.5 A 45 Hz to 65 Hz PF = 1	$2 \cdot 10^{-3} \cdot P$ $1.7 \cdot 10^{-3} \cdot P$ $2 \cdot 10^{-3} \cdot P$ $1.7 \cdot 10^{-3} \cdot P$ $2 \cdot 10^{-3} \cdot P$ $1.8 \cdot 10^{-3} \cdot P$ $2 \cdot 10^{-3} \cdot P$ $1.8 \cdot 10^{-3} \cdot P$	P = measured value PF = Power factor
	0.1 W to 9.15 W 0.1 W to 33.5 W 0.1 W to 91.5 W 0.1 W to 336.5 W 1 W to 917 W 1 W to 2243 W 10 W to 4589 W 10 W to 20.9 kW	3.3 mA to < 9 mA 9 mA to < 33 mA 33 mA to < 90 mA 90 mA to < 0.33 A 0.33 A to < 0.9 A 0.9 A to < 2.2 A 2.2 A to < 4.5 A 4.5 A to 20.5 A 45 Hz to 65 Hz 0.5 ≤ PF ≤ 1	$3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.9 \cdot 10^{-3} \cdot P$ $4.2 \cdot 10^{-3} \cdot P$	P = measured value PF = Power factor

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Power factor Measurement instruments	0.5 to 1.0	230 V; 2.5 A 45 Hz to 65 Hz	$2.2 \cdot 10^{-3} \cdot PF$	PF = Power factor
Capacitance Measurement instruments	0.19 nF to 0.39 nF 0.4 nF to 1.09 nF 1.1 nF to 3.29 nF 3.3 nF to 10.9 nF 11 nF to 32.9 nF 33 nF to 109.9 nF 110 nF to 329 nF 0.33 µF to 1.09 µF 1.1 µF to 3.29 µF 3.3 µF to 10.99 µF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 600 Hz 10 Hz to 300 Hz 10 Hz to 150 Hz	$40 \cdot 10^{-3} \cdot C$ $18 \cdot 10^{-3} \cdot C$ $12 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$	C = measured value with calibrator Fluke 5520A
Capacitance capacitors	1 pF; 10 pF	10 kHz	$0.63 \cdot 10^{-3}$	Direct measurement of capacitors
	100 pF; 1000 pF	1 kHz and 10 kHz 100 kHz	$0.63 \cdot 10^{-3}$ $0.67 \cdot 10^{-3}$	
	10 nF; 100 nF 1 µF	1 kHz 1 kHz	$0.63 \cdot 10^{-3}$ $0.61 \cdot 10^{-3}$	
	1 pF; 10 pF	10 kHz	$0.26 \cdot 10^{-3}$	Calibration of capacitors via Substitution method
	100 pF; 1000 pF	1 kHz and 10 kHz 100 kHz	$0.26 \cdot 10^{-3}$ $0.36 \cdot 10^{-3}$	
	10 nF; 100 nF; 1 µF	1 kHz	$0.26 \cdot 10^{-3}$	
Capacitance bridges	1 pF; 10 pF	10 kHz	$0.25 \cdot 10^{-3}$	
	100 pF; 1000 pF	1 kHz and 10 kHz 100 kHz	$0.25 \cdot 10^{-3}$ $0.30 \cdot 10^{-3}$	
	10 nF; 100 nF; 1 µF	1 kHz	$0.25 \cdot 10^{-3}$	
Inductance Inductors	100 µH 1 mH; 10 mH; 100 mH; 1 H	1 kHz and 10 kHz 100 Hz and 1 kHz	$1.5 \cdot 10^{-3}$ $1.5 \cdot 10^{-3}$	Direct measurement of inductances
Inductors	100 µH	1 kHz 10 kHz	$0.50 \cdot 10^{-3}$ $0.55 \cdot 10^{-3}$	Calibration of inductances via Substitution method
	1 mH; 10 mH; 100 mH; 1 H	100 Hz 1 kHz	$0.50 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$	
Inductance bridges	100 µH	1 kHz 10 kHz	$0.50 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$	
	1 mH; 10 mH; 100 mH; 1 H	100 Hz 1 kHz	$0.50 \cdot 10^{-3}$ $0.50 \cdot 10^{-3}$	
DC voltage Square wave generators	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V > 120 V to 1000 V	DC	$19 \cdot 10^{-6} \cdot U$ + 3 µV $10 \cdot 10^{-6} \cdot U$ + 3 µV $7 \cdot 10^{-6} \cdot U$ + 3 µV $10 \cdot 10^{-6} \cdot U$ + 30 µV $12 \cdot 10^{-6} \cdot U$ + 0.10 mV	U = measured value Determination with DMM; HP 3458

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Square wave voltage Square wave generators	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V > 120 V to 1000 V	10 Hz, 100 Hz, 1 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 6 µV $0.3 \cdot 10^{-3} \cdot U$ + 6 µV $0.3 \cdot 10^{-3} \cdot U$ + 6 µV $0.3 \cdot 10^{-3} \cdot U$ + 0.2 mV $0.3 \cdot 10^{-3} \cdot U$ + 0.2 mV	Determination with Sample-DMM; HP 3458
	0.06 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V	10 kHz, 100 kHz	$0.7 \cdot 10^{-3} \cdot U$ + 0.1 mV $0.7 \cdot 10^{-3} \cdot U$ + 0.9 mV $0.7 \cdot 10^{-3} \cdot U$ + 9 mV $0.7 \cdot 10^{-3} \cdot U$ + 90 mV	
Impulse amplitude Impulse generators	5 mV to 50 V	50 Ω	$85 \cdot 10^{-3} \cdot U$	Determination with oscilloscope t_r, $t_H > 10 \cdot t_{r\,System}$ t_r : impuls rise time, t_H : puls half-power bandwith $t_{r,\,System}$: rise time of measurement system
Rise time Impulse generators	825 ps to 100 ms		$60 \cdot 10^{-3} \cdot t_r + U_{Tf}$	The system rise time has to be considered when determining t_r by oscilloscope
Time of oscillation Impulse generators	1 ns to 1 s		$3.5 \cdot 10^{-3} \cdot t$ + 0.2 ns	Determination via oscilloscope
	0.33 ns to 1 s		$1 \cdot 10^{-10} \cdot t + U_{Tf}$	Determination via 1/frequency U_{Tf} : trigger uncertainty
Vertical deflection	6 mV to 200 V	1 MΩ (1 kHz)	$5 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.1 % for DSOs with self-recording raster.
	6 mV to 3 V	50 Ω (1 kHz)	$5 \cdot 10^{-3} \cdot U$	
	6 mV to 200 V	1 MΩ (1 kHz)	$6 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.3 % for picture tubes with fixed raster.
	6 mV to 3 V	50 Ω (1 kHz)	$6 \cdot 10^{-3} \cdot U$	
Horizontal deflection Time of oscillation	10 ns; 80 ns; 160 ns 400 ns to 5 s		$4 \cdot 10^{-3} \cdot t$	Reading error of 0.3 % for picture tubes with fixed raster
	10 ns; 80 ns; 160 ns 400 ns to 5 s		$2.5 \cdot 10^{-3} \cdot t$	Reading error of 0.1 % for DSOs with self-recording raster
Band width	100 kHz to 1 GHz	0.1 V to 1 V	$40 \cdot 10^{-3} \cdot b$	b = measured value Determination of 3-dB-point with power splitter and HF-voltage measurement
	> 1 GHz to 3 GHz	0.1 V to 1 V	$60 \cdot 10^{-3} \cdot b$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Rise time	360 ps to 10 ns		15 ps	repetition rate 10 Hz to 1 MHz, with Tektronix-Puls head
HF-voltage HF generators	0.1 V to 2 V	100 kHz to 1 GHz > 1 GHz to 3 GHz > 3 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot U$ $30 \cdot 10^{-3} \cdot U$ $40 \cdot 10^{-3} \cdot U$	Direct measurement of voltage with R&S Z-51
HF-voltage HF-Measurement instruments HF-Generators	0.5 V to 1 V	100 kHz to 10 MHz > 10 MHz to 30 MHz > 30 MHz to 50 MHz > 50 MHz to 500 MHz > 500 MHz to 1 GHz	$2 \cdot 10^{-3} \cdot U$ $3 \cdot 10^{-3} \cdot U$ $5 \cdot 10^{-3} \cdot U$ $10 \cdot 10^{-3} \cdot U$ $15 \cdot 10^{-3} \cdot U$	Voltage generation with T-Piece, N-Connector, the uncertainty rises with different connectors
HF-voltage HF-Measurement instruments	0.1 V to 1 V	100 kHz to 10 MHz > 1 GHz to 3 GHz	$15 \cdot 10^{-3} \cdot U$ $35 \cdot 10^{-3} \cdot U$	Direct measurement at Generator R&S SMT-03
	0.1 V to 1 V	100 kHz to 1 GHz > 1 GHz to 3 GHz > 3 GHz to 18 GHz	$15 \cdot 10^{-3} \cdot U$ $30 \cdot 10^{-3} \cdot U$ $45 \cdot 10^{-3} \cdot U$	Voltage generation with power splitter; voltage metering with R&S Z-51
Time and Frequency				
Frequency	100 kHz; 1 MHz 5 MHz; 10 MHz	Deviation measurement of phasing time with test time ≥ 2 h	$5 \cdot 10^{-11} \cdot f$	f = frequency
	1 Hz to 3 GHz	Digital frequency-measurement on count basis	$1 \cdot 10^{-10} \cdot f + U_{Tf}$	U_{Tf} = trigger uncertainty
	3 GHz to 26.5 GHz		$2 \cdot 10^{-10} \cdot f + 1$ Hz	
	1 Hz to 10 kHz		3.3 mHz	Optical procedure (tachometer)
Time interval	10 ms to 10 s		$6 \cdot 10^{-11} \cdot t + 2$ ns $+ U_{Tt}$	U_{Tt} = trigger uncertainty t = time interval

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage Measurement instruments	0 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 11 V > 11 V to 22 V > 22 V to 220 V > 220 V to 1.1 kV		$8 \cdot 10^{-6} \cdot U +$ 3 µV $9 \cdot 10^{-6} \cdot U +$ 3 µV $10 \cdot 10^{-6} \cdot U +$ 6 µV $8 \cdot 10^{-6} \cdot U +$ 20 µV $12 \cdot 10^{-6} \cdot U +$ 0.25 mV $12 \cdot 10^{-6} \cdot U +$ 1.3 mV	U = measured value Calibration with Calibrator Fluke 5700A

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC voltage Sources	0 mV to 0.12 V > 0.12 V to 1.2 V > 1.2 V to 12 V > 12 V to 100 V > 100 V to 200 V > 200 V to 500 V > 500 V to 700 V > 700 V to 1 kV		$6 \cdot 10^{-6} \cdot U$ + 2.5 µV $5.5 \cdot 10^{-6} \cdot U$ + 2.5 µV $10 \cdot 10^{-6} \cdot U$ + 3 µV $15 \cdot 10^{-6} \cdot U$ + 80 µV $8 \cdot 10^{-6} \cdot U$ + 0.17 mV $11 \cdot 10^{-6} \cdot U$ + 0.17 mV $14 \cdot 10^{-6} \cdot U$ + 0.17 mV $21 \cdot 10^{-6} \cdot U$ + 0.17 mV	Calibration with DMM HP 3458A
DC voltage Sources	1 kV to 6 kV		$1 \cdot 10^{-3} \cdot U$	Calibration with multimeter and high voltage divider
DC current Measurement instruments	1 µA to 0.12 mA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 0.12 A > 0.12 A to 1.05 A > 1.05 A to 11 A > 11 A to 20 A		$25 \cdot 10^{-6} \cdot I$ + 3 nA $25 \cdot 10^{-6} \cdot I$ + 25 nA $25 \cdot 10^{-6} \cdot I$ + 0.25 µA $45 \cdot 10^{-6} \cdot I$ + 2 µA $0.13 \cdot 10^{-3} \cdot I$ + 21 µA $50 \cdot 10^{-6} \cdot I$ + 0.4 mA $60 \cdot 10^{-6} \cdot I$ + 0.25 mA	I = measured value Substitution method with DMM HP 3458A
	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I$ + 5 mA	Substitution method with DMM HP 3458 / Shunt H&B 0.01 Ω
DC current Measurement instruments with converter method	> 10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A		$6 \cdot 10^{-3} \cdot I$ + 0.1 A $6 \cdot 10^{-3} \cdot I$ + 0.2 A $6 \cdot 10^{-3} \cdot I$ + 0.5 A	Calibration with Fluke 5500A / Coil
DC current Sources	1 µA to 0.12 mA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 0.12 A > 0.12 A to 1.05 A		$25 \cdot 10^{-6} \cdot I$ + 2 nA $25 \cdot 10^{-6} \cdot I$ + 15 nA $25 \cdot 10^{-6} \cdot I$ + 0.15 µA $45 \cdot 10^{-6} \cdot I$ + 1.3 µA $0.13 \cdot 10^{-3} \cdot I$ + 21 µA	Calibration with DMM HP 3458A
	> 1.05 A to 11 A > 11 A to 20 A		$50 \cdot 10^{-6} \cdot I$ + 0.4 mA $55 \cdot 10^{-6} \cdot I$ + 0.25 mA	Calibration with DMM HP 3458A & Shunt Fluke Y5020
	> 20 A to 50 A		$0.5 \cdot 10^{-3} \cdot I$ + 5 mA	Substitution method with HP 3458A and H&B 0.01 Ω
DC resistance Resistors	1 mΩ to 10 mΩ > 10 mΩ to 100 mΩ > 0.1 Ω to 1 Ω		$45 \cdot 10^{-6} \cdot R$ + 5 µΩ $45 \cdot 10^{-6} \cdot R$ + 50 µΩ $40 \cdot 10^{-6} \cdot R$ + 0.1 mΩ	R = measured value Comparison with Shunt Fluke Y 5020 and standard resistor Tinsley 5685B-1 Ω

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Resistors	> 1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 kΩ > 1.2 kΩ to 12 kΩ > 12 kΩ to 120 kΩ > 120 kΩ to 1.2 MΩ > 1.2 MΩ to 12 MΩ > 12 MΩ to 120 MΩ		$26 \cdot 10^{-6} \cdot R$ + 0.1 mΩ $21 \cdot 10^{-6} \cdot R$ + 1 mΩ $17 \cdot 10^{-6} \cdot R$ + 1 mΩ $17 \cdot 10^{-6} \cdot R$ + 10 mΩ $17 \cdot 10^{-6} \cdot R$ + 0.1 Ω $20 \cdot 10^{-6} \cdot R$ + 8 Ω $80 \cdot 10^{-6} \cdot R$ + 250 Ω $0.7 \cdot 10^{-3} \cdot R$ + 2.5 kΩ	R = measured value Calibration with DMM HP 3458A
DC resistance Measurement instruments	0.01 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ		$0.13 \cdot 10^{-3} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $42 \cdot 10^{-6} \cdot R$ $49 \cdot 10^{-6} \cdot R$ $27 \cdot 10^{-6} \cdot R$ $24 \cdot 10^{-6} \cdot R$ $19 \cdot 10^{-6} \cdot R$ $19 \cdot 10^{-6} \cdot R$ $18 \cdot 10^{-6} \cdot R$ $18 \cdot 10^{-6} \cdot R$ $21 \cdot 10^{-6} \cdot R$ $29 \cdot 10^{-6} \cdot R$ $28 \cdot 10^{-6} \cdot R$ $0.12 \cdot 10^{-3} \cdot R$ $82 \cdot 10^{-6} \cdot R$ $0.64 \cdot 10^{-3} \cdot R$ $0.61 \cdot 10^{-3} \cdot R$	Calibration at 0.01 Ω with Shunt Fluke Y 5020, Calibration starting at 1 Ω with Calibrator Fluke 5700A
	0.01 Ω to 0.1 Ω > 0.1 Ω to 1 Ω > 1 Ω to 10 Ω		$0.1 \cdot 10^{-3} \cdot R$ + 20 µΩ $0.1 \cdot 10^{-3} \cdot R$ + 0.2 mΩ $0.1 \cdot 10^{-3} \cdot R$ + 2 mΩ	Calibration with Shunt Fluke Y5020 and HP 3458 via current/voltage method
	10 Ω to 100 Ω > 100 Ω to 1 kΩ > 1 kΩ to 10 kΩ > 10 kΩ to 100 kΩ > 100 kΩ to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ > 100 MΩ to 10 GΩ		$0.1 \cdot 10^{-3} \cdot R$ + 20 mΩ $0.1 \cdot 10^{-3} \cdot R$ + 0.2 Ω $0.1 \cdot 10^{-3} \cdot R$ + 2 Ω $0.1 \cdot 10^{-3} \cdot R$ + 20 Ω $0.1 \cdot 10^{-3} \cdot R$ + 0.2 kΩ $0.1 \cdot 10^{-3} \cdot R$ + 2 kΩ $0.6 \cdot 10^{-3} \cdot R$ + 20 kΩ $7 \cdot 10^{-3} \cdot R$ + 0.2 MΩ	Calibration with a resistor and a multimeter via substitution method
DC power Measurement instruments	0.1 W to 336 W 1 W to 3059 W 10 W to 20.9 kW	3.3 mA to < 0.33 A 0.33 A to < 3 A 3 A to 20.5 A	$0.7 \cdot 10^{-3} \cdot P$ $0.7 \cdot 10^{-3} \cdot P$ $1 \cdot 10^{-3} \cdot P$	P = measured value
AC voltage Measurement instruments	0.1 V	20 Hz; 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 100 kHz	25 µV 25 µV 40 µV 50 µV	Calibration with Calibrator Fluke 5700A

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	1 V	20 Hz 40 Hz; 1 kHz; 10 kHz 20 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.1 mV 70 µV 80 µV 0.1 mV 0.2 mV 1 mV 2 mV	Calibration with Calibrator Fluke 5700A
	4 V	1 kHz; 10 kHz	0.25 mV	
	6 V	1 kHz; 10 kHz	0.35 mV	
	8 V	1 kHz; 10 kHz	0.4 mV	
	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	
	13 V	1 kHz; 10 kHz	0.5 mV	
	15 V	1 kHz; 10 kHz	0.8 mV	
	18 V	1 kHz; 10 kHz	1 mV	
	20 V	1 kHz; 10 kHz	1.1 mV	
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV	
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV	
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V	
	2 mV to 2.2 mV	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.61 \cdot 10^{-3} \cdot U$ + 7 µV $0.24 \cdot 10^{-3} \cdot U$ + 7 µV $0.13 \cdot 10^{-3} \cdot U$ + 7 µV $0.41 \cdot 10^{-3} \cdot U$ + 7 µV $1.1 \cdot 10^{-3} \cdot U$ + 10 µV $1.4 \cdot 10^{-3} \cdot U$ + 18 µV $2 \cdot 10^{-3} \cdot U$ + 35 µV $3 \cdot 10^{-3} \cdot U$ + 40 µV	U = measured value Calibration with Calibrator Fluke 5700A/5725A
	> 2.2 mV to 22 mV	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.59 \cdot 10^{-3} \cdot U$ + 10 µV $0.22 \cdot 10^{-3} \cdot U$ + 10 µV $0.11 \cdot 10^{-3} \cdot U$ + 10 µV $0.39 \cdot 10^{-3} \cdot U$ + 10 µV $1 \cdot 10^{-3} \cdot U$ + 12 µV $1.4 \cdot 10^{-3} \cdot U$ + 20 µV $2 \cdot 10^{-3} \cdot U$ + 40 µV $3.8 \cdot 10^{-3} \cdot U$ + 40 µV	

On-site Calibration - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	> 22 mV to 220 mV	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.63 \cdot 10^{-3} \cdot U +$ 20 µV $0.25 \cdot 10^{-3} \cdot U +$ 15 µV $0.12 \cdot 10^{-3} \cdot U +$ 15 µV $0.37 \cdot 10^{-3} \cdot U +$ 15 µV $0.9 \cdot 10^{-3} \cdot U +$ 35 µV $1.2 \cdot 10^{-3} \cdot U +$ 40 µV $2 \cdot 10^{-3} \cdot U +$ 50 µV $3.8 \cdot 10^{-3} \cdot U +$ 0.13 mV	U = measured value Calibration with Calibrator Fluke 5700A/5725A
	> 0.22 V to 2.2 V	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U +$ 0.13 mV $0.2 \cdot 10^{-3} \cdot U +$ 40 µV $85 \cdot 10^{-6} \cdot U +$ 18 µV $0.15 \cdot 10^{-3} \cdot U +$ 30 µV $0.3 \cdot 10^{-3} \cdot U +$ 90 µV $0.5 \cdot 10^{-3} \cdot U +$ 0.17 mV $1.3 \cdot 10^{-3} \cdot U +$ 0.45 mV $2.5 \cdot 10^{-3} \cdot U +$ 1.2 mV	
	> 2.2 V to 22 V	10Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.64 \cdot 10^{-3} \cdot U +$ 1.3 mV $0.2 \cdot 10^{-3} \cdot U +$ 0.35 mV $90 \cdot 10^{-6} \cdot U +$ 0.13 mV $0.15 \cdot 10^{-3} \cdot U +$ 0.25 mV $0.3 \cdot 10^{-3} \cdot U +$ 0.45 mV $0.6 \cdot 10^{-3} \cdot U +$ 2 mV $1.6 \cdot 10^{-3} \cdot U +$ 5.5 mV $3.2 \cdot 10^{-3} \cdot U +$ 10 mV	
	> 22 V to 220 V	10 Hz to 20 Hz > 20 Hz to 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.65 \cdot 10^{-3} \cdot U +$ 12 mV $0.2 \cdot 10^{-3} \cdot U +$ 3.5 mV $0.1 \cdot 10^{-3} \cdot U +$ 1.7 mV $0.25 \cdot 10^{-3} \cdot U +$ 4.8 mV $0.7 \cdot 10^{-3} \cdot U +$ 10 mV	
	> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$80 \cdot 10^{-6} \cdot U +$ 25 mV $80 \cdot 10^{-6} \cdot U +$ 25 mV $0.15 \cdot 10^{-3} \cdot U +$ 20 mV	
AC voltage Sources	0.1 V	20 Hz; 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 100 kHz	25 µV 25 µV 40 µV 50 µV	substitution method with Calibrator Fluke 5700A
	1 V	20 Hz 40 Hz; 1 kHz; 10 kHz 20 kHz 50 kHz; 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.1 mV 70 µV 80 µV 0.1 mV 0.2 mV 1 mV 2 mV	
	4 V	1 kHz; 10 kHz	0.25 mV	
	6 V	1 kHz; 10 kHz	0.35 mV	
	8 V	1 kHz; 10 kHz	0.4 mV	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage sources	10 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz; 100 kHz 200 kHz 500 kHz 1 MHz	0.7 mV 0.5 mV 0.6 mV 1 mV 1.2 mV 3 mV 10 mV 15 mV	substitution method with Calibrator Fluke 5700A
	13 V	1 kHz; 10 kHz	0.5 mV	
	15 V	1 kHz; 10 kHz	0.8 mV	
	18 V	1 kHz; 10 kHz	1 mV	
	20 V	1 kHz; 10 kHz	1.1 mV	
	100 V	20 Hz 40 Hz; 1 kHz 10 kHz; 20 kHz 50 kHz 70 kHz 100 kHz	10 mV 7 mV 7 mV 20 mV 30 mV 37 mV	
	700 V	50 Hz; 500 Hz; 1 kHz	80 mV	
	1000 V	50 Hz; 500 Hz; 1 kHz	0.1 V	
	1 kV to 6 kV	50 Hz	$2 \cdot 10^{-3} \cdot U$	U = measured value Calibration with multimeter and high frequency divider
	0.1 V to 0.22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U$ + 15 µV $0.12 \cdot 10^{-3} \cdot U$ + 15 µV $0.37 \cdot 10^{-3} \cdot U$ + 15 µV $0.9 \cdot 10^{-3} \cdot U$ + 35 µV	
	> 0.22 V to 2.2 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U$ + 40 µV $80 \cdot 10^{-6} \cdot U$ + 25 µV $0.15 \cdot 10^{-3} \cdot U$ + 30 µV $0.3 \cdot 10^{-3} \cdot U$ + 90 µV $0.5 \cdot 10^{-3} \cdot U$ + 0.17 mV $1.3 \cdot 10^{-3} \cdot U$ + 0.45 mV $2.5 \cdot 10^{-3} \cdot U$ + 1.2 mV	
	> 2.2 V to 22 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U$ + 0.35 mV $0.1 \cdot 10^{-3} \cdot U$ + 0.15 mV $0.15 \cdot 10^{-3} \cdot U$ + 0.28 mV $0.3 \cdot 10^{-3} \cdot U$ + 0.45 mV $0.6 \cdot 10^{-3} \cdot U$ + 2 mV $1.6 \cdot 10^{-3} \cdot U$ + 5.5 mV $3.2 \cdot 10^{-3} \cdot U$ + 10 mV	
	> 22 V to 220 V	20 Hz to < 40 Hz 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.22 \cdot 10^{-3} \cdot U$ + 3.5 mV $0.12 \cdot 10^{-3} \cdot U$ + 1.7 mV $0.25 \cdot 10^{-3} \cdot U$ + 4.8 mV $0.7 \cdot 10^{-3} \cdot U$ + 10 mV	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage sources	> 220 V to 1.1 kV	40 Hz to < 50 Hz 50 Hz to 1 kHz > 1 kHz to 20 kHz	$90 \cdot 10^{-6} \cdot U$ + 25 mV $90 \cdot 10^{-6} \cdot U$ + 25 mV $0.15 \cdot 10^{-3} \cdot U$ + 20 mV	U = Measured value
AC current Measurement instruments	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	Calibration with Calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 µA	
AC current Measurement instruments	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 µA	Calibration with Calibrator Fluke 5700A / 5725A
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 µA	
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 µA	
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 µA	
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 µA	
	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 µA	
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 µA	
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 µA	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA 0.5 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	
	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	
	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	
	220 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A	40 Hz to 1 kHz	$0.15 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.15 \cdot 10^{-3} \cdot I$ + 0.7 µA $0.37 \cdot 10^{-3} \cdot I$ + 6 µA $0.75 \cdot 10^{-3} \cdot I$ + 60 µA $0.44 \cdot 10^{-3} \cdot I$ + 0.35 mA	I = measured value Calibration with Calibrator Fluke 5700A / 5725A

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments converter method, toroid	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$5 \cdot 10^{-3} \cdot I +$ 0.1 A $5 \cdot 10^{-3} \cdot I +$ 0.2 A $5 \cdot 10^{-3} \cdot I +$ 0.2 A	Calibration with Calibrator Fluke 5500A / Coil
	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	$11 \cdot 10^{-3} \cdot I +$ 0.1 A $11 \cdot 10^{-3} \cdot I +$ 0.2 A $11 \cdot 10^{-3} \cdot I +$ 0.2 A	
AC current Measurement instruments converter method	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	45 Hz to 65 Hz	$8 \cdot 10^{-3} \cdot I +$ 0.1 A $8 \cdot 10^{-3} \cdot I +$ 0.3 A $8 \cdot 10^{-3} \cdot I +$ 1 A	
AC current Measurement instruments converter method	10 A to 16.5 A > 16.5 A to 150 A > 150 A to 1025 A	> 65 Hz to 440 Hz	$14 \cdot 10^{-3} \cdot I +$ 0.1 A $14 \cdot 10^{-3} \cdot I +$ 0.3 A $14 \cdot 10^{-3} \cdot I +$ 1 A	Calibration with Calibrator Fluke 5500A / Coil
AC current Sources	0.2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	90 nA	substitution method with Calibrator Fluke 5700A / 5725A
	0.5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.14 µA	
	1 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.24 µA	
	2 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.4 µA	
	5 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 µA	
	10 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	2 µA	
	20 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 µA	
	50 mA	40 Hz; 100 Hz; 500 Hz; 1 kHz	10 µA	
	0.1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	20 µA	
	0.2 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	40 µA	
	0.5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.12 mA	
	1 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	0.22 mA	
	2 A	40 Hz 100 Hz 500 Hz; 1 kHz	0.4 mA 0.45 mA 0.5 mA	
	3 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1 mA	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Sources	5 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	1.5 mA	substitution method with Calibrator Fluke 5700A / 5725A
	10 A	40 Hz; 100 Hz; 500 Hz; 1 kHz	3 mA	
	220 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A > 11 A to 20 A	40 Hz to 1 kHz	$0.15 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.15 \cdot 10^{-3} \cdot I$ + 0.8 µA $0.37 \cdot 10^{-3} \cdot I$ + 7 µA $0.75 \cdot 10^{-3} \cdot I$ + 60 µA $0.44 \cdot 10^{-3} \cdot I$ + 0.35 mA $0.31 \cdot 10^{-3} \cdot I$ + 0.5 mA	I = measured value with Shunt Y 5020
AC active power Measurement instruments	0.1 W to 9.15 W 0.1 W to 33.5 W 0.1 W to 91.5 W 0.1 W to 336.5 W 1 W to 917 W 1 W to 2243 W 10 W to 4589 W 10 W to 20.9 kW	3.3 mA to < 9 mA 9 mA to < 33 mA 33 mA to < 90 mA 90 mA to < 0.33 mA 0.33 A to < 0.9 A 0.9 A to < 2.2 A 2.2 A to < 4.5 A 4.5 A to 20.5 A 45 Hz to 65 Hz PF = 1	$2 \cdot 10^{-3} \cdot P$ $1.7 \cdot 10^{-3} \cdot P$ $2 \cdot 10^{-3} \cdot P$ $1.7 \cdot 10^{-3} \cdot P$ $2 \cdot 10^{-3} \cdot P$ $1.8 \cdot 10^{-3} \cdot P$ $2 \cdot 10^{-3} \cdot P$ $1.8 \cdot 10^{-3} \cdot P$	P = measured value PF = Power factor
	0.1 W to 9.15 W 0.1 W to 33.5 W 0.1 W to 91.5 W 0.1 W to 336.5 W 1 W to 917 W 1 W to 2243 W 10 W to 4589 W 10 W to 20.9 kW	3.3 mA to < 9 mA 9 mA to < 33 mA 33 mA to < 90 mA 90 mA to < 0.33 A 0.33 A to < 0.9 A 0.9 A to < 2.2 A 2.2 A to < 4.5 A 4.5 A to 20.5 A 45 Hz to 65 Hz 0.5 ≤ PF ≤ 1	$3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.8 \cdot 10^{-3} \cdot P$ $3.9 \cdot 10^{-3} \cdot P$ $4.2 \cdot 10^{-3} \cdot P$	P = measured value PF = Power factor
Power factor Measurement instruments	0.5 to 1.0	230 V; 2.5 A 45 Hz to 65 Hz	$2.2 \cdot 10^{-3} \cdot PF$	PF = Power factor
Capacitance Measurement instruments	0.19 nF to 0.39 nF 0.4 nF to 1.09 nF 1.1 nF to 3.29 nF 3.3 nF to 10.9 nF 11 nF to 32.9 nF 33 nF to 109.9 nF 110 nF to 329 nF 0.33 µF to 1.09 µF 1.1 µF to 3.29 µF 3.3 µF to 10.99 µF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 600 Hz 10 Hz to 300 Hz 10 Hz to 150 Hz	$40 \cdot 10^{-3} \cdot C$ $18 \cdot 10^{-3} \cdot C$ $12 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$ $5 \cdot 10^{-3} \cdot C$	C = measured value with Calibrator Fluke 5520A

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC voltage Square wave generators	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V > 120 V to 1000 V	DC	$25 \cdot 10^{-6} \cdot U$ + 5 µV $15 \cdot 10^{-6} \cdot U$ + 5 µV $10 \cdot 10^{-6} \cdot U$ + 5 µV $15 \cdot 10^{-6} \cdot U$ + 70 µV $15 \cdot 10^{-6} \cdot U$ + 0.20 mV	U = measured value Determination with DMM HP 3458
Square wave voltage Square wave generators	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V > 120 V to 1000 V	10 Hz, 100 Hz, 1 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 6 µV $0.3 \cdot 10^{-3} \cdot U$ + 6 µV $0.3 \cdot 10^{-3} \cdot U$ + 6 µV $0.3 \cdot 10^{-3} \cdot U$ + 0.2 mV $0.3 \cdot 10^{-3} \cdot U$ + 0.2 mV	Determination with Sample-DMM; HP 3458
	0 V to < 0.12 V 0.12 V to < 1.2 V 1.2 V to 12 V > 12 V to 120 V	10 kHz, 100 kHz	$0.7 \cdot 10^{-3} \cdot U$ + 0.1 mV $0.7 \cdot 10^{-3} \cdot U$ + 0.9 mV $0.7 \cdot 10^{-3} \cdot U$ + 9 mV $0.7 \cdot 10^{-3} \cdot U$ + 90 mV	
Impulse amplitude Impulse generators	5 mV to 50 V	50 Ω	$85 \cdot 10^{-3} \cdot U$	Determination with oscilloscope t_r, $t_H > 10 \cdot t_{r\,System}$ t_r = impulse rise time, t_H = pulse half-power bandwith $t_{r,\,System}$ = rise time of measurement system
Rise time Impulse generators	825 ps to 100 ms		$60 \cdot 10^{-3} \cdot t_r + U_{Tf}$	The system rise time t_r has to be considered when determining t_r by oscilloscope
Time of oscillation Impulse generators	1 ns to 1 s		$3.5 \cdot 10^{-3} \cdot t$ + 0.2 ns	Determination with oscilloscope
	0.33 ns to 1 s		$1 \cdot 10^{-10} \cdot t + U_{Tf}$	Determination via 1/frequency U_{Tf} : trigger uncertainty
Vertical deflection	6 mV to 200 V	1 MΩ (1 kHz)	$5 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.1 % for DSOs with self-recording raster
	6 mV to 3 V	50 Ω (1 kHz)	$5 \cdot 10^{-3} \cdot U$	
	6 mV to 200 V	1 MΩ (1 kHz)	$6 \cdot 10^{-3} \cdot U$	The uncertainty refers to generation of calibration signals incl. a reading error of 0.3 % for picture tubes with fixed raster
	6 mV to 3 V	50 Ω (1 kHz)	$6 \cdot 10^{-3} \cdot U$	
Horizontal deflection	10 ns; 80 ns; 160 ns 400 ns to 5 s		$4 \cdot 10^{-3} \cdot t$	Reading error of 0.3 % for picture tubes with fixed raster
	10 ns; 80 ns; 160 ns 400 ns to 5 s		$2.5 \cdot 10^{-3} \cdot t$	Reading error of 0.1 % for DSOs with self-recording raster

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure			Expanded measurement of uncertainty	Remarks
Band width	100 kHz	to	1 GHz	0.1 V	to	1 V	$40 \cdot 10^{-3} \cdot b$	b = measured value Determination of 3-dB-point with power splitter and HF-voltage measurement
	> 1 GHz	to	3 GHz	0.1 V	to	1 V	$60 \cdot 10^{-3} \cdot b$	
Rise time	360 ps	to	10 ns	Range of voltage 20 mV to 1 V R_i = 50 Ω			15 ps	t_r = rise time repetition rate 10 Hz to 1 MHz with Tektronix-Pulse head
Time and Frequency Frequency	1 Hz	to	3 GHz	Digital frequency-measurement on count basis			$2 \cdot \sqrt{(10^{-10} \cdot f)^2 + U_{Tf}^2}$	f = frequency U_{Tf} : trigger uncertainty
	3 GHz	to	26.5 GHz				$2 \cdot \sqrt{(10^{-10} \cdot f)^2 + (1\,\mathrm{Hz})^2/3}$	
Time interval	10 ms	to	10 s				$2 \cdot \sqrt{(10^{-10} \cdot t)^2 + (1\,\mathrm{ns})^2/3 + U_{Tf}^2}$	t = time interval U_{Tt} : trigger uncertainty

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_o and f_u from the central length by 5 points comparison measurement	For the central length: 0.08 µm + 0.8 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.07 µm	in the nominal values of references l = gauge block length Measuring surface quality as stated in QMH rsp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat
Gauge blocks * made of ceramics according to DIN EN ISO 3650:1999	0.5 mm to 100 mm		For the central length: 0.1 µm + 0.9 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.07 µm	
Cylindrical setting gauges * Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006	0.8 µm + 5 · 10^{-6} · d	d = measured diameter of the ring
Roundness deviation	3 mm to 200 mm		0.1 µm	
Straightness and parallelism deviation	5 mm to 300 mm		1 µm	Length of profile line
Setting plug gauges Diameter	1 mm to 200 mm		0.8 µm + 5 · 10^{-6} · d	d = measured diameter of the plug
Roundness deviation	1 mm to 200 mm		0.1 µm	
Straightness and parallelism deviation	5 mm to 500 mm		1 µm	Length of profile line
Testing cylinder Roundness deviation	60 mm to 200 mm	Trescal KA27 01.1/2021	0.1 µm	Diameter
Straightness and parallelism deviation	5 mm to 300 mm		1 µm	Length of profile line
Angular deviation between front surface and surface line			1 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Cylindrical plug gauge with taper		Trescal KA32 01.1/2021		
Cylinder	axial length			
Diameter	to 400 mm		0.6 µm	
Form error			0.5 µm	
Taper				
Form error	Diameter		0.5 µm	
Taper angle	to 50 mm		0.8"	
Coaxiality deviation			1.8 µm	
Balls Diameter	5 mm to 50 mm	Trescal KA67 01.1/2021	1 µm + 5 · 10^{-6} · d	d = diameter of balls 2-point-diameter via mechanical probing
Roundness deviation			0.1 µm	
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	2 µm + 10 · 10^{-6} · l	l = measured length
Feeler gauges	0.01 mm to 2 mm	Trescal KA29 01.1/2021	1 µm	
Limit gauges Distance at measuring points of plan-parallel areas	1 mm to 300 mm	Trescal KA66 01.1/2021	1 µm + 5 · 10^{-6} · l	l = distance between measuring surfaces distance by 2-Point-Measurement
Polygon plug gauges with plan-parallel measuring surfaces	1 mm to 100 mm	Trescal KA66 01.1/2021	1 µm + 5 · 10^{-6} · l	
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile and positive flank angle, nominal thread angle ≥ 55°)				
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead ≥ 0.25 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	3 µm + 10 · 10^{-6} · d	d = pitch diameter Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead ≥ 0.50 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	3 µm + 10 · 10^{-6} · d	
Knife straight edges * Straightness deviation	to 1000 mm	VDI/VDE/DGQ 2618 Part 5.2:2013	1 µm + 2.8 · 10^{-6} · l	l = test edge length
Steal squares 90° (Flat and try aquare) * Squarness deviation	to 800 mm	VDI/VDE/DGQ/DKD 2618 Part 7.1:2019	1 µm + 2.8 · 10^{-6} · l_z	l_z = leg length

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Protractors Angle deviation	0° to 360°	Trescal KA28 01.1/2021	30"	graduation of the scale = 1'
			2'	graduation of the scale = 5'
Straightness deviation	to 300 mm		1 µm	
Parallelism deviation			1.5 µm	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length
	> 300 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	l = measured length
	> 300 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	30 µm + 30 · 10^{-6} · l	
Calipers with prismatic measuring surfaces	1 mm to 105 mm	Trescal KA16-3 01.1/2021	30 µm + 30 · 10^{-6} · d	d = measured diameter
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = measured length 300 mm = final value of the measuring range
	> 300 mm to 500 mm		5 µm + 10 · 10^{-6} · l	500 mm = final value of the measuring range
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	2 µm + 10 · 10^{-6} · l	l = measured length
Micrometers with prismatic measuring surfaces form D10	1 mm to 105 mm	Trescal KA16-8 01.1/2021	3 µm + 10 · 10^{-6} · d	d = measured diameter 105 mm = final value of the measuring range
Micrometers for screw thread measurement form D18 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.2:2010	3 µm + 10 · 10^{-6} · l	l = measured length
Micrometers with dial indicator form D13 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	3 µm + 10 · 10^{-6} · l	
Micrometer heads *	0 mm to 50 mm	VDI/VDE/DGQ 2618 Part 10.4:2008	3 µm + 5 · 10^{-6} · l	final value of the measuring range
Depth micrometers with extensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.5:2010	5 µm + 10 · 10^{-6} · l	final value of the measuring range; Measuring element generally 25 mm range
Internal micrometers with jaws	5 mm to 200 mm	Trescal KA16-6 01.1/2021	5 µm + 10 · 10^{-6} · l	final value of the measuring range
Internal transverse groove micrometers	0 mm to 100 mm	Trescal KA16-7 01.1/2021	5 µm + 10 · 10^{-6} · l	final value of the measuring range

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	
Internal micrometers with three-point contact *	3 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	$3\ \mu m + 10 \cdot 10^{-6} \cdot d$	d = measured diameter
Dial gauges with analogue display *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Dial gauges with digital display *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	measured in vertical position
Lever gauges (quicktests) for external measurements	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	$7\ \mu m + 10 \cdot 10^{-6} \cdot l$	l = measured length
Lever gauges (quicktests) for internal measurements	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	$7\ \mu m + 10 \cdot 10^{-6} \cdot l$	
Thickness gauges	0 mm to 200 mm	Trescal KA70 01.1/2021	$7\ \mu m + 10 \cdot 10^{-6} \cdot l$	
DC and Low frequency				
DC voltage Measurement instruments	0 mV to 220 mV > 0.22 V to 2.2 V > 2.2 V to 11 V > 11 V to 22 V > 22V to 220 V > 220 V to 1000 V		$9 \cdot 10^{-6} \cdot U + 2\ \mu V$ $6 \cdot 10^{-6} \cdot U + 1\ \mu V$ $4 \cdot 10^{-6} \cdot U + 3\ \mu V$ $4 \cdot 10^{-6} \cdot U + 5\ \mu V$ $6 \cdot 10^{-6} \cdot U + 47\ \mu V$ $8 \cdot 10^{-6} \cdot U + 0.5\ mV$	U = measured value
DC voltage Calibrators	1 mV to 100 mV > 0.1 V to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$12 \cdot 10^{-6} \cdot U + 2\ \mu V$ $9 \cdot 10^{-6} \cdot U + 0.7\ \mu V$ $9 \cdot 10^{-6} \cdot U + 0.8\ \mu V$ $12 \cdot 10^{-6} \cdot U + 35\ \mu V$ $11 \cdot 10^{-6} \cdot U + 0.6\ mV$	
DC power Measurement instruments	20 µA to 220 µA > 0.22 mA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 0.22 A to 2.1 A		$36 \cdot 10^{-6} \cdot I + 10\ nA$ $39 \cdot 10^{-6} \cdot I + 10\ nA$ $41 \cdot 10^{-6} \cdot I + 50\ nA$ $52 \cdot 10^{-6} \cdot I + 0.8\ \mu A$ $93 \cdot 10^{-6} \cdot I + 14\ \mu A$	I = measured value
DC power Calibrators	1 µA to 10 µA > 10 µA to 100 µA > 0.1 mA to 1 mA > 1 mA to 10 mA > 10 mA to 100 mA > 0.1 A to 1 A		$1 \cdot 10^{-6} \cdot I + 10\ nA$ $5 \cdot 10^{-6} \cdot I + 10\ nA$ $19 \cdot 10^{-6} \cdot I + 10\ nA$ $22 \cdot 10^{-6} \cdot I + 80\ nA$ $39 \cdot 10^{-6} \cdot I + 0.8\ \mu A$ $0.13 \cdot 10^{-3} \cdot I + 13\ \mu A$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	220 µV to 2.2 mV	10 Hz to 20 Hz > 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 7 µV $0.1 \cdot 10^{-3} \cdot U$ + 7 µV $0.2 \cdot 10^{-3} \cdot U$ + 7 µV $0.5 \cdot 10^{-3} \cdot U$ + 8 µV	U = measured value
	> 2.2 mV to 22 mV	10 Hz to 20 Hz > 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 7 µV $0.1 \cdot 10^{-3} \cdot U$ + 7 µV $0.2 \cdot 10^{-3} \cdot U$ + 7 µV $0.6 \cdot 10^{-3} \cdot U$ + 8 µV	
	> 22 mV to 220 mV	10 Hz to 20 Hz > 20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 14 µV $0.1 \cdot 10^{-3} \cdot U$ + 8 µV $0.2 \cdot 10^{-3} \cdot U$ + 8 µV $0.5 \cdot 10^{-3} \cdot U$ + 20 µV	
AC voltage Measurement instruments	> 0.22 V to 2.2 V	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 46 µV $0.1 \cdot 10^{-3} \cdot U$ + 17 µV $0.1 \cdot 10^{-3} \cdot U$ + 9 µV $0.1 \cdot 10^{-3} \cdot U$ + 12 µV $0.2 \cdot 10^{-3} \cdot U$ + 35 µV	U = measured value
	> 2.2 V to 22 V	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 0.5 mV $0.1 \cdot 10^{-3} \cdot U$ + 0.2 mV $0.1 \cdot 10^{-3} \cdot U$ + 58 µV $0.1 \cdot 10^{-3} \cdot U$ + 0.1 mV $0.1 \cdot 10^{-3} \cdot U$ + 0.2 mV	
	> 22 V to 220 V	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 4.6 mV $0.1 \cdot 10^{-3} \cdot U$ + 1.7 mV $0.1 \cdot 10^{-3} \cdot U$ + 0.7 mV $0.1 \cdot 10^{-3} \cdot U$ + 1.2 mV $0.2 \cdot 10^{-3} \cdot U$ + 2.9 mV	
	> 220 V to 1100 V	50 Hz to 1 kHz	$0.1 \cdot 10^{-3} \cdot U$ + 4.1 mV	
AC voltage Calibrators	1 mV to 10 mV	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 7 µV $0.2 \cdot 10^{-3} \cdot U$ + 5 µV $0.3 \cdot 10^{-3} \cdot U$ + 5 µV $0.9 \cdot 10^{-3} \cdot U$ + 5 µV $5.5 \cdot 10^{-3} \cdot U$ + 5 µV	
	> 10 mV to 100 mV	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U$ + 7 µV $0.1 \cdot 10^{-3} \cdot U$ + 5 µV $0.7 \cdot 10^{-3} \cdot U$ + 5 µV $0.7 \cdot 10^{-3} \cdot U$ + 5 µV $1.1 \cdot 10^{-3} \cdot U$ + 5 µV	
	> 0.1 V to 10 V	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U$ + 0.5 mV $0.1 \cdot 10^{-3} \cdot U$ + 0.2 mV $0.2 \cdot 10^{-3} \cdot U$ + 0.2 mV $0.4 \cdot 10^{-3} \cdot U$ + 0.2 mV $0.9 \cdot 10^{-3} \cdot U$ + 0.2 mV	
	> 10 V to 100 V	10 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U$ + 4.7 mV $0.3 \cdot 10^{-3} \cdot U$ + 2.4 mV $0.4 \cdot 10^{-3} \cdot U$ + 2.4 mV $1.4 \cdot 10^{-3} \cdot U$ + 2.4 mV	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Calibrators	> 100 V to 1000 V	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.5 \cdot 10^{-3} \cdot U$ + 47 mV $0.5 \cdot 10^{-3} \cdot U$ + 24 mV $0.7 \cdot 10^{-3} \cdot U$ + 24 mV $1.4 \cdot 10^{-3} \cdot U$ + 24 mV $3.5 \cdot 10^{-3} \cdot U$ + 24 mV	U = measured value
AC current Measurement instruments	22 µA to 220 µA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I$ + 30 nA $0.2 \cdot 10^{-3} \cdot I$ + 20 nA $0.2 \cdot 10^{-3} \cdot I$ + 20 nA $0.4 \cdot 10^{-3} \cdot I$ + 20 nA $1.3 \cdot 10^{-3} \cdot I$ + 80 nA	I = measured value
AC current Measurement instruments	> 0.22 mA to 2.2 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.2 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.2 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.2 \cdot 10^{-3} \cdot I$ + 0.2 µA $1.3 \cdot 10^{-3} \cdot I$ + 0.8 µA	I = measured value
	> 2.2 mA to 22 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.4 \cdot 10^{-3} \cdot I$ + 0.1 µA $0.2 \cdot 10^{-3} \cdot I$ + 0.4 µA $0.2 \cdot 10^{-3} \cdot I$ + 0.4 µA $0.2 \cdot 10^{-3} \cdot I$ + 0.7 µA $1.3 \cdot 10^{-3} \cdot I$ + 5.8 µA	
	> 22 mA to 220 mA	10 Hz to 20 Hz > 20 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I$ + 4.6 µA $0.3 \cdot 10^{-3} \cdot I$ + 4.1 µA $0.3 \cdot 10^{-3} \cdot I$ + 2.9 µA $0.3 \cdot 10^{-3} \cdot I$ + 4.1 µA $1.3 \cdot 10^{-3} \cdot I$ + 12 µA	
	> 0.22 A to 2.2 A	20 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3 \cdot 10^{-3} \cdot I$ + 41 µA $0.5 \cdot 10^{-3} \cdot I$ + 93 µA $8.1 \cdot 10^{-3} \cdot I$ + 19 µA	
AC current Calibrators	10 µA to 100 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz	$4.6 \cdot 10^{-3} \cdot I$ + 0.2 µA $1.7 \cdot 10^{-3} \cdot I$ + 0.2 µA $0.7 \cdot 10^{-3} \cdot I$ + 0.2 µA	
	> 0.1 mA to 100 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$4.6 \cdot 10^{-3} \cdot I$ + 23 µA $1.7 \cdot 10^{-3} \cdot I$ + 23 µA $0.7 \cdot 10^{-3} \cdot I$ + 23 µA $1.7 \cdot 10^{-3} \cdot I$ + 23 µA	
	> 0.1 A to 1 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$4.6 \cdot 10^{-3} \cdot I$ + 0.2 mA $1.9 \cdot 10^{-3} \cdot I$ + 0.2 mA $0.9 \cdot 10^{-3} \cdot I$ + 0.2 mA $1.2 \cdot 10^{-3} \cdot I$ + 0.2 mA	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC resistance Measurement instruments	1 Ω; 1.9 Ω 10 Ω; 19 Ω 100 Ω; 190 Ω 1 kΩ; 1.9 kΩ 10 kΩ; 19 kΩ 100 kΩ; 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ		$0.1 \cdot 10^{-3} \cdot R$ $27 \cdot 10^{-6} \cdot R$ $12 \cdot 10^{-6} \cdot R$ $10 \cdot 10^{-6} \cdot R$ $10 \cdot 10^{-6} \cdot R$ $14 \cdot 10^{-6} \cdot R$ $24 \cdot 10^{-6} \cdot R$ $26 \cdot 10^{-6} \cdot R$ $47 \cdot 10^{-6} \cdot R$ $58 \cdot 10^{-6} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$	R = measured value
DC resistance Resistors	> 0 Ω to 10 Ω > 10 Ω to 100 Ω > 0.1 kΩ to 1 kΩ > 1 kΩ to 10 kΩ > 10 kΩ to 100 kΩ > 0.1 MΩ to 1 MΩ > 1 MΩ to 10 MΩ > 10 MΩ to 100 MΩ		$17 \cdot 10^{-6} \cdot R$ + 60 µΩ $14 \cdot 10^{-6} \cdot R$ + 0.6 mΩ $12 \cdot 10^{-6} \cdot R$ + 0.6 mΩ $12 \cdot 10^{-6} \cdot R$ + 6 mΩ $12 \cdot 10^{-6} \cdot R$ + 58 mΩ $17 \cdot 10^{-6} \cdot R$ + 2.3 Ω $58 \cdot 10^{-6} \cdot R$ + 0.1 kΩ $0.6 \cdot 10^{-3} \cdot R$ + 1.1 kΩ	

On-site Calibration - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	300 mm = final value of the measuring range
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	l = measured length
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	measured in vertical position
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Dgital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	measured in vertical position
Horizontal length measuring devices	0 mm to 300 mm Measuring element with max. 300 mm range, scope up to 1000 mm	Trescal KA06-1 01.1/2021	0.2 µm + 2.5 · 10^{-6} · l	l = measured length no calibration of additional axis (z-axis)
Vertical length measuring devices	0 mm to 1000 mm	Trescal KA06-2 01.1/2021	1.7 µm + 1.6 · 10^{-6} · l	l = measured length
Perpendicularity deviation	to 30 µm		2.5 µm + 1.2 · 10^{-6} · l_z	l_z = lead length up to 800 mm
Dial gauge testers	to 100 mm	Trescal KA02 01.1/2021	0.4 µm + 2 · 10^{-6} · l	l = measured length with incremental probe IKF 100
Plane areas for example hard stone straigth edge Straightness deviation	to 50 µm	Trescal KA58 01.1/2021 to 10 m edge length	1 µm + 0.5 · 10^{-6} · l	l = edge length of the standard
Horizontal flatness embodiment, for example surface plates according to DIN 876:1984 Flatness deviation	to 50 µm	Trescal KA58 01.1/2021 to 10 m edge length	1 µm + 0.5 · 10^{-6} · l	

Mobile Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Cylindrical setting gauges * Ring gauges Diameter	10 mm to 100 mm	VDI/VDE/DGQ 2618 part 4.1:2006 option 3 and 4	1.0 µm + 14 · 10^{-6} · d	d = measured diameter of ring
Setting plug gauges Diameter	3 mm to 100 mm		1.0 µm + 14 · 10^{-6} · d	d = measured diameter of plug
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	300 mm = final value of the measuring range l = measured length
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	measured in vertical position
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	measured in vertical position

Esslingen

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Cylindrical setting gauges * Plug gauges Diameter	1 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006, Option 3 and 4	0.8 µm + 2 · 10^{-6} · d	d = measured diameter
Ring gauges Diameter	10 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006, Option 3 and 4	0.8 µm + 2 · 10^{-6} · d	
Measuring pins, pins for screw threads * Diameter	1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007, Option 3	0.8 µm + 2 · 10^{-6} · d	
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile and positive flank angle, nominal thread angle ≥ 55°)				
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	3 µm + 10 · 10^{-6} · d	d = pitch diameter
Thread gauges * Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	3 µm + 10 · 10^{-6} · d	Simple pitch diameter
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length
	> 300 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	
	> 300 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	30 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	300 mm = final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	3 µm + 10 · 10^{-6} · l	l = measured length
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	3 µm + 10 · 10^{-6} · d	d = measured diameter

Permanent Laboratory - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	l = measured length Vertically measured
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.8 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	7 µm + 10 · 10^{-6} · l	l = measured length
Lever gauges for internal measurements (quick tests) *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	7 µm + 10 · 10^{-6} · l	
DC and Low frequency Voltage ratio	0 mV/V to 2 mV/V	DC voltage, 225 Hz; 4800 Hz	0.33 · 10^{-3} mV/V	

On-site Calibration - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency Voltage ratio	0 mV/V to 2 mV/V	DC voltage, 225 Hz; 4800 Hz	0.33 · 10^{-3} mV/V	

Parchim

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in the nominal values of the references Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_0 and f_u from the central length by 5 points comparison measurement	For the central length: $0.08\ \mu m + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: 0.08 µm	l = gauge block length Measuring surface quality as stated in QMH rsp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat.
Cylindrical setting gauges *				
Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006, Option 3 and 4	$0.8\ \mu m + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Plug gauges Diameter	3 mm to 200 mm		$0.8\ \mu m + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile and positive flank angle, nominal thread angle ≥ 55°)				
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	$3\ \mu m + 10 \cdot 10^{-6} \cdot d$	d = pitch diameter Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	$3\ \mu m + 10 \cdot 10^{-6} \cdot d$	
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$2\ \mu m + 10 \cdot 10^{-6} \cdot l$	l = measured length
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2\ \mu m + 10 \cdot 10^{-6} \cdot l$	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	Vertically measured l = measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	l = measured length
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	7 µm + 10 · 10^{-6} · l	l = Length of reference gauge
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	7 µm + 10 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = measured length 300 mm = final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	3 µm + 10 · 10^{-6} · l	
Internal micrometers with three-point contact *	3 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	3 µm + 10 · 10^{-6} · d	d = measured diameter 300 mm = final value of the measuring range

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in the nominal values of the references Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_0 and f_u from the central length by 5 points comparison measurement	For the central length: $0.08\ \mu m + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: 0.08 µm	l = gauge block length Measuring surface quality as stated in QMH rsp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat.
Cylindrical setting gauges *				
Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006 Option 3 and 4	$0.8\ \mu m + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Plug gauges Diameter	3 mm to 200 mm		$0.8\ \mu m + 5 \cdot 10^{-6} \cdot d$	d = measured diameter
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile and positive flank angle, nominal thread angle ≥ 55°)				
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006, Option 1	$3\ \mu m + 10 \cdot 10^{-6} \cdot d$	d = pitch diameter Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006, Option 1	$3\ \mu m + 10 \cdot 10^{-6} \cdot d$	
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	$2\ \mu m + 10 \cdot 10^{-6} \cdot l$	l = measured length
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	$2\ \mu m + 10 \cdot 10^{-6} \cdot l$	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	Vertically measured l = measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	$3\ \mu m + 10 \cdot 10^{-6} \cdot l$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length
	> 300 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	l = measured length
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	30 µm + 30 · 10^{-6} · l	
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	7 µm + 10 · 10^{-6} · l	
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	7 µm + 10 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	300 mm = final value of the measuring range
	> 300 mm to 500 mm		5 µm + 10 · 10^{-6} · l	500 mm = final value of the measuring range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	3 µm + 10 · 10^{-6} · l	300 mm = final value of the measuring range
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	3 µm + 10 · 10^{-6} · d	d = measured diameter 200 mm = final value of the measuring range
Straight edges * Flatness and parallelism deviation	to 500 mm	VDI/VDE/DGQ 2618 Part 5.1:2013	7 µm + 5 · 10^{-6} · l_z	l_z = length of form embodiment
Steel squares * Squareness deviation	to 500 mm	VDI/VDE/DGQ/DKD 2618 Part 7.1:2019	8 µm + 5 · 10^{-6} · l_z	l_z = leg length
Flatness deviation			7 µm + 5 · 10^{-6} · l_z	

Donauwörth

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage Measurement instruments	1 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 22 V > 22 V to 220 V > 220 V to 1100 V		$15 \cdot 10^{-6} \cdot U +$ 3 µV $15 \cdot 10^{-6} \cdot U +$ 3 µV $15 \cdot 10^{-6} \cdot U +$ 25 µV $15 \cdot 10^{-6} \cdot U +$ 0.4 mV $15 \cdot 10^{-6} \cdot U +$ 3 mV	U = measured value
DC voltage Sources	1 mV to 120 mV > 0.12 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$30 \cdot 10^{-6} \cdot U +$ 3 µV $30 \cdot 10^{-6} \cdot U +$ 10 µV $30 \cdot 10^{-6} \cdot U +$ 80 µV $30 \cdot 10^{-6} \cdot U +$ 1.3 mV $30 \cdot 10^{-6} \cdot U +$ 11 mV	
DC current Measurement instruments	1 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A		$80 \cdot 10^{-6} \cdot I +$ 0.1 µA $80 \cdot 10^{-6} \cdot I +$ 0.3 µA $90 \cdot 10^{-6} \cdot I +$ 5 µA $90 \cdot 10^{-6} \cdot I +$ 0.18 mA	I = measured value
DC current Sources	1 µA to 120 µA > 0.12 mA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A		$30 \cdot 10^{-6} \cdot I +$ 0.1 µA $30 \cdot 10^{-6} \cdot I +$ 0.2 µA $30 \cdot 10^{-6} \cdot I +$ 0.5 µA $50 \cdot 10^{-6} \cdot I +$ 6 µA $50 \cdot 10^{-6} \cdot I +$ 0.14 mA	
DC resistance Measurement instruments	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ		$0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.7 \cdot 10^{-3} \cdot R$	R = measured value
DC resistance Resistors	1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 kΩ > 1.2 kΩ to 12 kΩ > 12 kΩ to 120 kΩ > 120 kΩ to 1.2 MΩ > 1.2 MΩ to 12 MΩ > 12 MΩ to 120 MΩ		$15 \cdot 10^{-6} \cdot R +$ 0.4 mΩ $15 \cdot 10^{-6} \cdot R +$ 2.5 mΩ $15 \cdot 10^{-6} \cdot R +$ 15 mΩ $15 \cdot 10^{-6} \cdot R +$ 0.1 Ω $15 \cdot 10^{-6} \cdot R +$ 1.5 Ω $15 \cdot 10^{-6} \cdot R +$ 20 Ω $30 \cdot 10^{-6} \cdot R +$ 1 kΩ $0.3 \cdot 10^{-3} \cdot R +$ 80 kΩ	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	220 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A	40 Hz to 1 kHz	$0.2 \cdot 10^{-3} \cdot I +$ 0.6 µA $0.2 \cdot 10^{-3} \cdot I +$ 2.0 µA $0.5 \cdot 10^{-3} \cdot I +$ 50 µA $1.2 \cdot 10^{-3} \cdot I +$ 0.22 mA	I = measured value
AC current Sources	1 µA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A	45 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot I +$ 0.5 µA $0.5 \cdot 10^{-3} \cdot I +$ 5 µA $0.5 \cdot 10^{-3} \cdot I +$ 50 µA $1 \cdot 10^{-3} \cdot I +$ 0.5 mA	
AC voltage Measurement instruments	0.1 V to 0.22 V	20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U +$ 30 µV $0.4 \cdot 10^{-3} \cdot U +$ 30 µV $1.2 \cdot 10^{-3} \cdot U +$ 30 µV	U = measured value
	> 0.22 V to 2.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U +$ 0.2 mV $0.15 \cdot 10^{-3} \cdot U +$ 0.07 mV $0.2 \cdot 10^{-3} \cdot U +$ 0.07 mV $0.35 \cdot 10^{-3} \cdot U +$ 0.2 mV $0.6 \cdot 10^{-3} \cdot U +$ 0.6 mV $1.2 \cdot 10^{-3} \cdot U +$ 2 mV $3 \cdot 10^{-3} \cdot U +$ 2.6 mV	
	> 2.2 V to 22 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U +$ 2.0 mV $0.15 \cdot 10^{-3} \cdot U +$ 0.5 mV $0.2 \cdot 10^{-3} \cdot U +$ 1 mV $0.35 \cdot 10^{-3} \cdot U +$ 1.5 mV $0.75 \cdot 10^{-3} \cdot U +$ 6 mV $1.5 \cdot 10^{-3} \cdot U +$ 20 mV $4 \cdot 10^{-3} \cdot U +$ 20 mV	
	> 22 V to 220 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U +$ 20 mV $0.1 \cdot 10^{-3} \cdot U +$ 8 mV $0.25 \cdot 10^{-3} \cdot U +$ 25 mV $1 \cdot 10^{-3} \cdot U +$ 20 mV	
	> 220 V to 1100 V	50 Hz to 1 kHz	$0.1 \cdot 10^{-3} \cdot U +$ 0.25 V	
AC voltage Sources	0.1 V to 0.12 V	20 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U +$ 50 µV $0.2 \cdot 10^{-3} \cdot U +$ 50 µV $1 \cdot 10^{-3} \cdot U +$ 50 µV	
	> 0.12 V to 1.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.1 \cdot 10^{-3} \cdot U +$ 0.15 mV $0.2 \cdot 10^{-3} \cdot U +$ 0.1 mV $0.35 \cdot 10^{-3} \cdot U +$ 0.1 mV $1 \cdot 10^{-3} \cdot U +$ 0.15 mV $3.5 \cdot 10^{-3} \cdot U +$ 0.4 mV $12 \cdot 10^{-3} \cdot U +$ 2 mV	
	> 1.2 V to 12 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.1 \cdot 10^{-3} \cdot U +$ 1.5 mV $0.15 \cdot 10^{-3} \cdot U +$ 1 mV $0.35 \cdot 10^{-3} \cdot U +$ 1.5 mV $1 \cdot 10^{-3} \cdot U +$ 1 mV $3.5 \cdot 10^{-3} \cdot U +$ 4 mV $12 \cdot 10^{-3} \cdot U +$ 15 mV	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Sources	> 12 V to 120 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U +$ 15 mV $0.25 \cdot 10^{-3} \cdot U +$ 10 mV $0.4 \cdot 10^{-3} \cdot U +$ 35 mV $1.5 \cdot 10^{-3} \cdot U +$ 25 mV	U = measured value
	> 120 V to 700 V	40 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot U +$ 0.2 V	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Cylindrical setting gauges * Ring gauges Diameter	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006 Option 3 and 4	0.8 µm + 5 · 10^{-6} · d	d = measured diameter
Plug gauges Diameter	3 mm to 200 mm		0.8 µm + 5 · 10^{-6} · d	
Measuring pins, pins for screw threads Diameter	0.1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007 Option 3	1 µm + 2 · 10^{-6} · d	
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile and positive flank angle, nominal thread angle ≥ 55°)				
Thread gauges * Pitch diameter on external thread	1 mm to 200 mm Lead 0.25 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1	3 µm + 10 · 10^{-6} · d	d = pitch diameter Simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1	3 µm + 10 · 10^{-6} · d	
Reference gauges for micrometers *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	2 µm + 10 · 10^{-6} · l	l = measured length
Gap gauges *	10 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	2 µm + 10 · 10^{-6} · l	l = measured length
Calipers for external, internal and depth dimensions *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	
Height calipers *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	30 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	300 mm = final value of measuring range

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Micrometers with dial indicator form D 13 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	3 µm + 10 · 10^{-6} · l	
Depth micrometers with extensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.5:2010	5 µm + 10 · 10^{-6} · l	final value of the measuring range; Measuring element generally 25 mm range
Internal micrometers with two-point contact *	25 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	3 µm + 10 · 10^{-6} · l	
Internal micrometers with three-point contact *	3 mm to 150 mm	VDI/VDE/DGQ/DKD 2618 Part 10.8:2024	3 µm + 10 · 10^{-6} · d	d = measured diameter
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	l = measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	7 µm + 10 · 10^{-6} · l	l = measured length
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	7 µm + 10 · 10^{-6} · l	
DC and Low frequency				
DC voltage Measurement instruments	100 mV to < 0.33 V 0.33 V to < 3.3 V 3.3 V to < 33 V 33 V to < 330 V 330 V to 1000 V		24 · 10^{-6} · U + 1.1 µV 14 · 10^{-6} · U + 2.2 µV 16 · 10^{-6} · U + 21 µV 22 · 10^{-6} · U + 0.16 mV 22 · 10^{-6} · U + 1.6 mV	U = measured value
DC voltage Sources	0.1 V to < 1 V 1 V to < 10 V 10 V to < 100 V 100 V to 1000 V		27 · 10^{-6} · U + 0.3 µV 13 · 10^{-6} · U + 0.2 µV 16 · 10^{-6} · U + 0.4 µV 17 · 10^{-6} · U + 0.8 µV	
DC current Measurement instruments	100 µA to < 330 µA 330 µA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 0.33 A 0.33 A to < 1.1 A 1.1 A to < 3 A 3 A to < 11 A 11 A to 20 A		0.19 · 10^{-3} · I + 0.1 µA 0.12 · 10^{-3} · I + 0.1 µA 0.12 · 10^{-3} · I + 0.3 µA 0.12 · 10^{-3} · I + 2.8 µA 0.24 · 10^{-3} · I + 44 µA 0.44 · 10^{-3} · I + 45 µA 0.58 · 10^{-3} · I + 0.57 mA 1.2 · 10^{-3} · I + 0.86 mA	I = measured value

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC current Sources	0.1 mA to < 1 mA 1 mA to < 10 mA 10 mA to < 100 mA 100 mA to 1 A		$58 \cdot 10^{-6} \cdot I + 2.3\ \mu A$ $60 \cdot 10^{-6} \cdot I + 2.3\ \mu A$ $0.12 \cdot 10^{-3} \cdot I + 5.7\ \mu A$ $0.22 \cdot 10^{-3} \cdot I + 9.9\ \mu A$	I = measured value
DC resistance Measurement instruments	1 Ω to < 11 Ω 11 Ω to < 33 Ω 33 Ω to < 110 Ω 110 Ω to < 330 Ω 330 Ω to < 1.1 kΩ 1.1 kΩ to < 3.3 kΩ 3.3 kΩ to < 11 kΩ 11 kΩ to < 33 kΩ 33 kΩ to < 110 kΩ 110 kΩ to < 330 kΩ 330 kΩ to < 1.1 MΩ 1.1 MΩ to < 3.3 MΩ 3.3 MΩ to 10 MΩ		$50 \cdot 10^{-6} \cdot R + 2.7\ \mu\Omega$ $38 \cdot 10^{-6} \cdot R + 0.1\ \mu\Omega$ $34 \cdot 10^{-6} \cdot R + 1.9\ \mu\Omega$ $34 \cdot 10^{-6} \cdot R + 0.6\ \mu\Omega$ $34 \cdot 10^{-6} \cdot R + 19\ \mu\Omega$ $34 \cdot 10^{-6} \cdot R + 5.9\ \mu\Omega$ $34 \cdot 10^{-6} \cdot R + 0.19\ m\Omega$ $34 \cdot 10^{-6} \cdot R + 59\ \mu\Omega$ $34 \cdot 10^{-6} \cdot R + 1.9\ m\Omega$ $38 \cdot 10^{-6} \cdot R + 0.51\ m\Omega$ $40 \cdot 10^{-6} \cdot R + 16\ m\Omega$ $75 \cdot 10^{-6} \cdot R + 0.11\ m\Omega$ $0.16 \cdot 10^{-3} \cdot R + 42\ m\Omega$	R = measured value
	1 Ω to < 10 Ω 10 Ω to < 100 Ω 100 Ω to < 1 kΩ 1 kΩ to < 10 kΩ 10 kΩ to < 100 kΩ 100 kΩ to < 1 MΩ		$40 \cdot 10^{-6} \cdot R + 1.2\ \mu\Omega$ $25 \cdot 10^{-6} \cdot R + 0.3\ \mu\Omega$ $19 \cdot 10^{-6} \cdot R + 0.4\ \mu\Omega$ $16 \cdot 10^{-6} \cdot R + 0.9\ \mu\Omega$ $18 \cdot 10^{-6} \cdot R + 4.2\ \mu\Omega$ $28 \cdot 10^{-6} \cdot R + 26\ \mu\Omega$	
AC voltage Measurement instruments	33 mV to < 330 mV	10 Hz to < 45 Hz 45 Hz to < 10 kHz 10 kHz to < 20 kHz 20 kHz to < 50 kHz 50 kHz to < 100 kHz 100 kHz to 500 kHz	$0.39 \cdot 10^{-3} \cdot U + 8.6\ \mu V$ $0.17 \cdot 10^{-3} \cdot U + 9.0\ \mu V$ $0.19 \cdot 10^{-3} \cdot U + 9.1\ \mu V$ $0.41 \cdot 10^{-3} \cdot U + 9.1\ \mu V$ $0.69 \cdot 10^{-3} \cdot U + 36\ \mu V$ $2.3 \cdot 10^{-3} \cdot U + 80\ \mu V$	U = measured value
	0.33 V to < 3.3 V	10 Hz to < 45 Hz 45 Hz to < 10 kHz 10 kHz to < 20 kHz 20 kHz to < 50 kHz 50 kHz to < 100 kHz 100 kHz to 500 kHz	$0.37 \cdot 10^{-3} \cdot U + 55\ \mu V$ $0.17 \cdot 10^{-3} \cdot U + 69\ \mu V$ $0.22 \cdot 10^{-3} \cdot U + 69\ \mu V$ $0.35 \cdot 10^{-3} \cdot U + 57\ \mu V$ $0.81 \cdot 10^{-3} \cdot U + 0.14\ mV$ $2.5 \cdot 10^{-3} \cdot U + 0.60\ mV$	
	3.3 V to < 33 V	10 Hz to < 45 Hz 45 Hz to < 10 kHz 10 kHz to < 20 kHz 20 kHz to < 50 kHz 50 kHz to 100 kHz	$0.37 \cdot 10^{-3} \cdot U + 0.72\ mV$ $0.17 \cdot 10^{-3} \cdot U + 0.68\ mV$ $0.27 \cdot 10^{-3} \cdot U + 0.69\ mV$ $0.40 \cdot 10^{-3} \cdot U + 0.69\ mV$ $1 \cdot 10^{-3} \cdot U + 1.8\ mV$	
	33 V to < 330 V	45 Hz to < 1 kHz 1 kHz to < 10 kHz 10 kHz to < 20 kHz 20 kHz to < 50 kHz 50 kHz to 100 kHz	$0.22 \cdot 10^{-3} \cdot U + 2.3\ mV$ $0.23 \cdot 10^{-3} \cdot U + 6.9\ mV$ $0.29 \cdot 10^{-3} \cdot U + 6.9\ mV$ $0.36 \cdot 10^{-3} \cdot U + 6.7\ mV$ $2.3 \cdot 10^{-3} \cdot U + 57\ mV$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	330 V to < 1000 V	45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz	$0.35 \cdot 10^{-3} \cdot U + 12$ mV $0.29 \cdot 10^{-3} \cdot U + 12$ mV $0.35 \cdot 10^{-3} \cdot U + 12$ mV	U = measured value
AC voltage Sources	0.1 V to < 1 V 1 V to < 10 V 10 V to < 100 V 100 V to 1000 V	45 Hz to 1 kHz	$0.30 \cdot 10^{-3} \cdot U + 79$ mV $0.25 \cdot 10^{-3} \cdot U + 53$ mV $0.26 \cdot 10^{-3} \cdot U + 54$ mV $0.30 \cdot 10^{-3} \cdot U + 99$ mV	
AC current Measurement instruments	100 µA to < 330 µA	10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz	$0.23 \cdot 10^{-2} \cdot I + 0.2$ µA $0.17 \cdot 10^{-2} \cdot I + 0.2$ µA $0.14 \cdot 10^{-2} \cdot I + 0.2$ µA $0.34 \cdot 10^{-2} \cdot I + 0.2$ µA $0.92 \cdot 10^{-2} \cdot I + 0.3$ µA	I = measured value
	0.33 mA to < 3.3 mA	10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz	$0.23 \cdot 10^{-2} \cdot I + 0.2$ µA $0.14 \cdot 10^{-2} \cdot I + 0.2$ µA $0.11 \cdot 10^{-2} \cdot I + 0.2$ µA $0.23 \cdot 10^{-2} \cdot I + 0.3$ µA $0.57 \cdot 10^{-2} \cdot I + 0.4$ µA	
	3.3 mA to < 33 mA	10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz	$0.20 \cdot 10^{-2} \cdot I + 2.3$ µA $0.10 \cdot 10^{-2} \cdot I + 2.3$ µA $0.46 \cdot 10^{-3} \cdot I + 2.3$µA $0.92 \cdot 10^{-3} \cdot I + 2.3$ µA $0.23 \cdot 10^{-2} \cdot I + 3.4$ µA	
	33 mA to < 330 mA	10 Hz to < 20 Hz 20 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz	$0.20 \cdot 10^{-2} \cdot I + 23$ µA $0.10 \cdot 10^{-2} \cdot I + 23$ µA $0.46 \cdot 10^{-3} \cdot I + 23$ µA $0.11 \cdot 10^{-2} \cdot I + 57$ µA $0.23 \cdot 10^{-2} \cdot I + 0.11$ mA	
	0.33 A to < 1.1 A	10 Hz to < 45 Hz 45 Hz to < 1 kHz 1 kHz to < 5 kHz 5 kHz to 10 kHz	$0.20 \cdot 10^{-2} \cdot I + 0.11$ mA $0.58 \cdot 10^{-3} \cdot I + 0.11$ mA $0.69 \cdot 10^{-2} \cdot I + 1.1$ mA $2.8 \cdot 10^{-2} \cdot I + 5.7$ mA	
	1.1 A to < 11 A	45 Hz to < 100 Hz 100 Hz to < 1 kHz 1 kHz to 5 kHz	$0.69 \cdot 10^{-3} \cdot I + 2.3$ mA $0.12 \cdot 10^{-2} \cdot I + 2.3$ mA $0.34 \cdot 10^{-2} \cdot I + 2.3$ mA	
	11 A to 20 A	45 Hz to < 100 Hz 100 Hz to < 1 kHz 1 kHz to 5 kHz	$0.14 \cdot 10^{-2} \cdot I + 5.7$ mA $0.17 \cdot 10^{-2} \cdot I + 5.7$ mA $3.4 \cdot 10^{-2} \cdot I + 5.7$ mA	
AC current Sources	0.1 mA to < 1 mA 1 mA to < 10 mA 10 mA to < 100 mA 100 mA to 1 A	45 Hz to 1 kHz	$0.23 \cdot 10^{-3} \cdot I + 0.11$ mA $0.23 \cdot 10^{-3} \cdot I + 0.11$ mA $0.30 \cdot 10^{-3} \cdot I + 0.11$ mA $0.93 \cdot 10^{-3} \cdot I + 0.2$ mA	
Time and Frequency				
Frequency Generators	1 Hz to 225 MHz		$0.2 \cdot 10^{-6} \cdot f$	f = measured value

Mobile Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty [1]	Remarks
Length				
Cylindrical setting gauges *				
Ring gauges Diameter	10 mm to 100 mm	VDI/VDE/DGQ 2618 Part 4.1:2006 Option 3 and 4	0.8 µm + 14 · 10^{-6} · d	d = measured diameter
Plug gauges Diameter	3 mm to 100 mm		0.8 µm + 14 · 10^{-6} · d	
Calipers for external, internal and depth dimensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length 300 mm = final value of the measuring range
Depth calipers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	300 mm = final value of the measuring range
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	

On-site Calibration - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Coordinate measuring technology				
Measuring projectors Measuring microscopes *	0 mm to 200 mm	Calibration of metrological characteristics according to guideline DKD-R 4-3 part 18.1:2018, and the following standards and guidelines DIN EN ISO 10360 VDI/VDE 2617 JIS B 7184:1999		
		Determination of probing error $PS\text{-}1D(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1:2021	0.8 µm	
		Determination of lentgh measurement error $E\text{-}1D(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1:2021	1.6 µm + 1 · 10^{-6} · l	l = measured length

Braunschweig

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC and Low frequency				
DC voltage Measurement instruments	1 mV to 0.22 V > 0.22 V to 2.2 V > 2.2 V to 22 V > 22 V to 220 V > 220 V to 1000 V		$15 \cdot 10^{-6} \cdot U$ + 3 µV $15 \cdot 10^{-6} \cdot U$ + 3 µV $15 \cdot 10^{-6} \cdot U$ + 25 µV $15 \cdot 10^{-6} \cdot U$ + 0.25 mV $15 \cdot 10^{-6} \cdot U$ + 2 mV	U = measured value
DC voltage Sources	1 mV to 1 V > 1 V to 10 V > 10 V to 100 V > 100 V to 1000 V		$30 \cdot 10^{-6} \cdot U$ + 3 µV $30 \cdot 10^{-6} \cdot U$ + 2 µV $30 \cdot 10^{-6} \cdot U$ + 50 µV $35 \cdot 10^{-6} \cdot U$ + 1 mV	
DC current Measurement instruments	1 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 20 A		$80 \cdot 10^{-6} \cdot I$ + 0.1 µA $80 \cdot 10^{-6} \cdot I$ + 0.3 µA $90 \cdot 10^{-6} \cdot I$ + 5 µA $0.16 \cdot 10^{-3} \cdot I$ + 50 µA $0.6 \cdot 10^{-3} \cdot I$ + 2.5 mA	I = measured value
DC current Sources	1 µA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A > 1 A to 10 A	with Shunt 0.01 Ω	$30 \cdot 10^{-6} \cdot I$ + 0.1 µA $35 \cdot 10^{-6} \cdot I$ + 0.1 µA $50 \cdot 10^{-6} \cdot I$ + 5 µA $0.15 \cdot 10^{-3} \cdot I$ + 50 µA $0.15 \cdot 10^{-3} \cdot I$ + 0.2 mA	
DC resistance Measurement instruments	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω; 190 Ω; 1 kΩ 1.9 kΩ; 10 kΩ; 19 kΩ 100 kΩ; 190 kΩ; 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ; 100 MΩ		$0.2 \cdot 10^{-3} \cdot R$ $0.15 \cdot 10^{-3} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $75 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $50 \cdot 10^{-6} \cdot R$ $0.2 \cdot 10^{-3} \cdot R$ $0.1 \cdot 10^{-3} \cdot R$ $0.7 \cdot 10^{-3} \cdot R$	R = measured value
DC resistance Resistors	1 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 kΩ > 1.2 kΩ to 12 kΩ > 12 kΩ to 120 kΩ > 120 kΩ to 1.2 MΩ > 1.2 MΩ to 12 MΩ > 12 MΩ to 120 MΩ		$15 \cdot 10^{-6} \cdot R$ + 0.3 mΩ $15 \cdot 10^{-6} \cdot R$ + 2.5 mΩ $15 \cdot 10^{-6} \cdot R$ + 15 mΩ $15 \cdot 10^{-6} \cdot R$ + 0.1 Ω $15 \cdot 10^{-6} \cdot R$ + 1.5 Ω $15 \cdot 10^{-6} \cdot R$ + 20 Ω $30 \cdot 10^{-6} \cdot R$ + 1 kΩ $0.3 \cdot 10^{-3} \cdot R$ + 80 kΩ	

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	0.1 V to 0.22 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.3 \cdot 10^{-3} \cdot U +$ 30 µV $0.3 \cdot 10^{-3} \cdot U +$ 30 µV $0.5 \cdot 10^{-3} \cdot U +$ 30 µV $1.2 \cdot 10^{-3} \cdot U +$ 30 µV	U = measured value
	> 0.22 V to 2.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U +$ 0.11 mV $0.15 \cdot 10^{-3} \cdot U +$ 0.07 mV $0.2 \cdot 10^{-3} \cdot U +$ 0.07 mV $0.35 \cdot 10^{-3} \cdot U +$ 0.2 mV $0.6 \cdot 10^{-3} \cdot U +$ 0.6 mV $2 \cdot 10^{-3} \cdot U +$ 1 mV $3.5 \cdot 10^{-3} \cdot U +$ 1.2 mV	
	> 2.2 V to 22 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 500 kHz > 500 kHz to 1 MHz	$0.25 \cdot 10^{-3} \cdot U +$ 1 mV $0.15 \cdot 10^{-3} \cdot U +$ 0.5 mV $0.2 \cdot 10^{-3} \cdot U +$ 1 mV $0.35 \cdot 10^{-3} \cdot U +$ 1.5 mV $0.75 \cdot 10^{-3} \cdot U +$ 6 mV $2.5 \cdot 10^{-3} \cdot U +$ 10 mV $4 \cdot 10^{-3} \cdot U +$ 20 mV	
	> 22 V to 220 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U +$ 10 mV $0.1 \cdot 10^{-3} \cdot U +$ 8 mV $0.3 \cdot 10^{-3} \cdot U +$ 20 mV $1 \cdot 10^{-3} \cdot U +$ 20 mV	
	> 220 V to 1100 V	50 Hz to 1 kHz	$0.1 \cdot 10^{-3} \cdot U +$ 0.25 V	
AC voltage Sources	0.1 V to 0.12 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.1 \cdot 10^{-3} \cdot U +$ 50 µV $0.1 \cdot 10^{-3} \cdot U +$ 50 µV $0.2 \cdot 10^{-3} \cdot U +$ 50 µV $1 \cdot 10^{-3} \cdot U +$ 50 µV	
	> 0.12 V to 1.2 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.2 \cdot 10^{-3} \cdot U +$ 0.2 mV $0.2 \cdot 10^{-3} \cdot U +$ 0.1 mV $0.35 \cdot 10^{-3} \cdot U +$ 0.1 mV $1 \cdot 10^{-3} \cdot U +$ 0.15 mV $3.5 \cdot 10^{-3} \cdot U +$ 0.4 mV $12 \cdot 10^{-3} \cdot U +$ 2 mV	
	> 1.2 V to 12 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz > 300 kHz to 1 MHz	$0.1 \cdot 10^{-3} \cdot U +$ 1.5 mV $0.15 \cdot 10^{-3} \cdot U +$ 1 mV $0.35 \cdot 10^{-3} \cdot U +$ 1.5 mV $1 \cdot 10^{-3} \cdot U +$ 1 mV $3.5 \cdot 10^{-3} \cdot U +$ 4 mV $12 \cdot 10^{-3} \cdot U +$ 15 mV	
	> 12 V to 120 V	20 Hz to 40 Hz > 40 Hz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U +$ 15 mV $0.25 \cdot 10^{-3} \cdot U +$ 10 mV $0.4 \cdot 10^{-3} \cdot U +$ 10 mV $1.5 \cdot 10^{-3} \cdot U +$ 20 mV	
	> 120 V to 700 V	40 Hz to 1 kHz	$0.55 \cdot 10^{-3} \cdot U +$ 20 mV	

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC current Measurement instruments	220 µA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 10 A	40 Hz to 1 kHz	$0.2 \cdot 10^{-3} \cdot I$ + 0.5 µA $0.25 \cdot 10^{-3} \cdot I$ + 1.5 µA $0.5 \cdot 10^{-3} \cdot I$ + 50 µA $1.2 \cdot 10^{-3} \cdot I$ + 0.22 mA $1.2 \cdot 10^{-3} \cdot I$ + 2.5 mA	I = measured value
AC current Sources	200 µA to 1.2 mA > 1.2 mA to 12 mA > 12 mA to 120 mA > 120 mA to 1 A	45 Hz to 1 kHz	$0.5 \cdot 10^{-3} \cdot I$ + 0.5 µA $0.5 \cdot 10^{-3} \cdot I$ + 5 µA $0.5 \cdot 10^{-3} \cdot I$ + 50 µA $1 \cdot 10^{-3} \cdot I$ + 0.5 mA	
Time and frequency				
Frequency Measurement instruments	5 MHz; 10 MHz		$7 \cdot 10^{-11} \cdot f + u_{Tf}$	f = measured value
	1 Hz to 100 kHz		$2 \cdot [(5 \cdot 10^{-11} \cdot f)^2 + (1\ \mu Hz)^2 + (u_{Tf})^2]^{1/2}$	
	> 100 kHz to 1 GHz		$2 \cdot [(5 \cdot 10^{-11} \cdot f)^2 + (1\ Hz)^2 + (u_{Tf})^2]^{1/2}$	u_{Tf} = trigger uncertainty
Frequency Generators	10 Hz to 1 GHz		$2 \cdot [(1 \cdot 10^{-9} \cdot f)^2 + (u_{Tf})^2]^{1/2}$	u_{Tf} = trigger uncertainty

Leipzig

Permanent Laboratory - Leipzig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length *				
Calipers for external, internal and depth dimensions	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	$30\ \mu m + 30 \cdot 10^{-6} \cdot l$	l = measured length

Ruhla

Permanent Laboratory – Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Calipers for external, internal and depth dimensions *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length
	> 500 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 600 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	
Height calipers *	0 mm to 600 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	30 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	
Internal micrometers with two-point contact *	25 mm to 100 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
Extensions for Internal micrometers with two-point contact *	25 mm to 500 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	2 µm + 5 · 10^{-6} · l	
	> 500 mm to 1000 mm		3.5 µm + 5 · 10^{-6} · l	
Internal micrometers with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ 2618 Part 10.8:2002	4 µm + 10 · 10^{-6} · d	d = measured diameter
Micrometers with dial indicator *	0 mm to 100 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	3 µm + 10 · 10^{-6} · l	l = measured length
Reference gauges for micrometers *	25 mm to 500 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	0.5 µm + 6 · 10^{-6} · l	
Lever gauges (quicktests) for external measurements *	0 mm to 100 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	7 µm + 10 · 10^{-6} · l	
Lever gauges (quicktests) for internal measurements *	2.5 mm to 500 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	7 µm + 10 · 10^{-6} · l	
Square 90° *	40 mm to 500 mm	VDI/VDE/DGQ/DKD 2618 Part 7.1:2019	4 µm + 6 · 10^{-6} · l_z	l_z = leg length
Protractors *	0° to 360°	VDI/VDE/DGQ 2618 Part 7.2:2008	1‘	
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	l = measured length
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.6 µm	
Lever gauges *	to 1.6 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.8 µm	

Permanent Laboratory – Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Plug gauges * Diameter	2 mm	to	200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006	0.8 µm + 10 · 10^{-6} · d	d = measured diamater
Roundness deviation		to	20 µm		0.4 µm	
Straightness deviation		to	20 µm		1.0 µm	
Parallelism deviation		to	20 µm		2.0 µm	
Ring gauges * Diameter	3 mm	to	200 mm		0.8 µm + 10 · 10^{-6} · d	
Roundness deviation		to	20 µm		0.4 µm	
Straightness deviation		to	20 µm		1.0 µm	
Parallelism deviation		to	20 µm		2.0 µm	
Measuring pins, pins for screw threads * Diameter	0.1 mm	to	20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007	0.8 µm	
Roundness deviation		to	20 µm		0.4 µm	starting at 1 mm diameter
Straightness deviation		to	20 µm		1.0 µm	starting at 1.5 mm diameterr
Parallelism deviation		to	20 µm		2.0 µm	starting at 1.5 mm diameter
Thread gauges * single-start cylindrical external and internal threads with straight flanks, symmetrical profile and nominal thread angle 60°						
External thread with nominal lead 0.25 mm to 5.5 mm Simple pitch diameter	2 mm	to	100 mm	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1	2.8 µm + 10 · 10^{-6} · d	d = measured pitch diameter
Internal thread with nominal lead 0.5 mm to 6 mm Simple pitch diameter	4 mm	to	100 mm	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1	2.8 µm + 10 · 10^{-6} · d	

On-site Calibration - Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Coordinate measuring technology Measuring projectors Measuring microscopes *	0 mm to 250 mm	DKD-R 4-3 Part 18.1:2018 Calibration of metrological characteristics of coordinate measuring machines (CMM) according to DIN EN ISO 10360 and VDI/VDE 2617		Visual probing with crosshair l = measured length
		Determination of probing error $PS\text{-}1D(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1:2021	0.6 µm	
		Determination of length measurement error $E\text{-}1D(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 Part 6.1: 2021	0.8 µm + 0.6 · 10^{-6} · l	

Nürnberg

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in the nominal values of the references Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_0 and f_u from the central length by 5 points comparison measurement	For the central length: 0.08 µm + 0.8 · 10^{-6} · l For the deviations f_0 and f_u from the central length: 0.08 µm	l = gauge block length Measuring surface quality as stated in QMH rsp. in the test specifications For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat.
Gauge blocks * made of ceramics according to DIN EN ISO 3650:1999	0.5 mm to 100 mm		For the central length: 0.1 µm + 0.9 · 10^{-6} · l For the deviations f_0 and f_u from the central length: 0.07 µm	
Gauge blocks * made of tungsten carbide according to DIN EN ISO 3650:1999	0.5 mm to 100 mm		For the central length: 0.1 µm + 0.9 · 10^{-6} · l For the deviations f_0 and f_u from the central length: 0.07 µm	
Gauge blocks * made of steel according to DIN EN ISO 3650:1999	> 100 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 3.1:2004 in nominal lengths, that deviate up to 50 mm from the length of the standards Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement	For the central length: 0.2 µm + 0.7 · 10^{-6} · l	l = gauge block length

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Cylindrical setting gauges * Ring gauges Diameter	2 mm to 200 mm	VDI/VDE/DGQ 2618 Part 4.1:2006	0.6 µm + 5 · 10^{-6} · d	d = measured diameter
Roundness deviation	to 20 µm		0.1 µm	starting at 2 mm diameter
Straightness and parallelism deviation	to 20 µm		1 µm	starting at 3 mm diameter
Plug gauges Diameter	1 mm to 200 mm		0.6 µm + 5 · 10^{-6} · d	d = measured diameter
Roundness deviation	to 20 µm		0.1 µm	starting at 1 mm diameter
Straightness and parallelism deviation	to 20 µm		1 µm	starting 1.5 mm diameter
Measuring pins, pins for screw theads Diameter	0.1 mm to 20 mm	VDI/VDE/DGQ 2618 Part 4.2:2007	0.6 µm	
Roundness deviation	to 20 µm		0.1 µm	starting at 1 mm diameter
Straightness and parallelism deviation	to 20 µm		1 µm	starting at 1.5 mm diameter
Reference gauges for micrometers *	25 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 4.4:2009	0.7 µm + 1.5 · 10^{-6} · l	l = measured length
Gap gauges *	5 mm to 160 mm	VDI/VDE/DGQ 2618 Part 4.7:2005	2 µm + 10 · 10^{-6} · l	l = measured length
Feeler gauges	0.01 mm to 2 mm	Trescal KA29 08.1/2021	3 µm	
Calipers for external, internal and depth dimensions *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.1:2006	30 µm + 30 · 10^{-6} · l	l = measured length
	> 500 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Depth calipers *	0 mm to 500 mm	VDI/VDE/DGQ 2618 Part 9.2:2006	30 µm + 30 · 10^{-6} · l	
	> 500 mm to 1000 mm		50 µm + 30 · 10^{-6} · l	
Height calipers *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 9.3:2006	30 µm + 30 · 10^{-6} · l	
Micrometers *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = measured length 300 mm = final value of the measuring range
	> 300 mm to 600 mm		5 µm + 10 · 10^{-6} · l	600 mm = final value of the measuring range
Micrometers for screw thread measurements form D18 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.2:2010	3 µm + 10 · 10^{-6} · l	l = measured length 300 mm = final value of the measuring range
Micrometers with dial indicator form D13 *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.3:2002	3 µm + 10 · 10^{-6} · l	

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Micrometer heads *	0 mm to 50 mm	VDI/VDE/DGQ 2618 Part 10.4:2008	3 µm + 5 · 10^{-6} · l	50 mm = final value of the measuring range
Depth micrometers with extensions *	0 mm to 300 mm	VDI/VDE/DGQ 2618 Part 10.5:2010	5 µm + 10 · 10^{-6} · l	300 mm = final value of the measuring range; Measuring element generally 25 mm range
Internal micrometers with two-point contact *	25 mm to 1000 mm	VDI/VDE/DGQ 2618 Part 10.7:2010	3 µm + 10 · 10^{-6} · l	
Internal micrometers and internal measuring instruments with three-point contact *	3 mm to 200 mm	VDI/VDE/DGQ/DKD 2618 Part 10.8:2024	3 µm + 10 · 10^{-6} · d	d = measured diameter
Internal micrometers with jaws	5 mm to 200 mm	Trescal KA16-6 01.1/2016	5 µm + 10 · 10^{-6} · l	200 mm = final value of the measuring range
Internal groove micrometers	0 mm to 100 mm	Trescal KA16-7 01.1/2016	5 µm + 10 · 10^{-6} · l	100 mm = final value of the measuring range
Mechanical dial gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.1:2021	3 µm + 10 · 10^{-6} · l	Vertically measured
Dial indicators *	to 3 mm	VDI/VDE/DGQ 2618 Part 11.2:2002	0.7 µm	
Lever gauges *	to 3.2 mm	VDI/VDE/DGQ 2618 Part 11.3:2002	0.9 µm	
Digital indicator gauges *	to 100 mm	VDI/VDE/DGQ/DKD 2618 Part 11.4:2020	3 µm + 10 · 10^{-6} · l	Vertically measured
Lever gauges for external measurements (quick tests) *	0 mm to 200 mm	VDI/VDE/DGQ 2618 Part 12.1:2005	7 µm + 10 · 10^{-6} · l	l = measured length
Lever gauges for internal measurements (quick tests) *	2.5 mm to 200 mm	VDI/VDE/DGQ 2618 Part 13.1:2005	7 µm + 10 · 10^{-6} · l	l = measured length
Thread gauges * (single- and multi-start cylindrical external and internal threads with straight flanks, symmetrical profile)				
Pitch diameter on external thread	1 mm to 200 mm Lead ≥ 0.25 mm	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1	3 µm + 10 · 10^{-6} · d	d = pitch diameter simple pitch diameter
Pitch diameter on internal thread	3 mm to 200 mm Lead ≥ 0.5 mm to 6 mm	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1	3 µm + 10 · 10^{-6} · d	

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Thread gauges * (single-and multi-start cylindrical external and internal threads with straight flanks, symmetrical and unsymmetrical profile)				
External thread Pitch diameter	1 mm to 150 mm Nominal diameter:	VDI/VDE/DGQ 2618 Part 4.8:2006 Option 1 to 4 Scanning method	3 µm + 5 · 10^{-6} · d	d = pitch diameter
Outside diameter, core diameter			3 µm + 5 · 10^{-6} · d	d = outside/core diameter
Lead or pitch	0.25 mm to 8 mm		1 µm	
Thread angle α	≥ 27°	(Specifying the thread angle α)	(1.2 + 3 mm / l_F)', but not lower than 6'	l_F = flank length
Internal thread Pitch diameter	2.5 mm to 160 mm Nominal diameter:	VDI/VDE/DGQ 2618 Part 4.9:2006 Option 1 to 4 Scanning method	3 µm + 5 · 10^{-6} · d	d = pitch diameter
Outside diameter, core diameter			3 µm + 5 · 10^{-6} · d	d = outside/ core diameter
Lead or pitch	0.25 mm to 8 mm		1 µm	
Thread angle α	≥ 27°	(Specifying the thread angle α)	(1.2 + 3 mm / l_F)', but not lower than 6'	l_F = flank length
DC and low frequency				
DC voltage Measurement instruments	0 mV to < 330 mV 0.33 V to < 3.3 V 3.3 V to < 33 V 33V to < 330 V 330 V to 1020 V		30 · 10^{-6} · U + 5.0 µV 30 · 10^{-6} · U + 20 µV 30 · 10^{-6} · U + 0.20 mV 30 · 10^{-6} · U + 2.0 mV 30 · 10^{-6} · U + 5.0 mV	U = measured value
DC voltage Sources	1 mV to 200 mV > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V		15 · 10^{-6} · U + 3.0 µV 15 · 10^{-6} · U + 4.0 µV 15 · 10^{-6} · U + 20 µV 15 · 10^{-6} · U + 0.23 mV 15 · 10^{-6} · U + 1.2 mV	
DC current Measurement instruments	1 µA to < 330 µA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA 0.33 A to < 1.1 A 1.1 A to < 3 A 3 A to < 11 A 11 A to 20.5 A		0.20 · 10^{-3} · I + 0.15 µA 0.15 · 10^{-3} · I + 0.20 µA 0.15 · 10^{-3} · I + 1.0 µA 0.15 · 10^{-3} · I + 20 µA 0.30 · 10^{-3} · I + 0.10 mA 0.60 · 10^{-3} · I + 0.10 mA 0.70 · 10^{-3} · I + 1.0 mA 1.5 · 10^{-3} · I + 2.0 mA	I = measured value

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
DC current Sources	1 µA to 200 µA > 0.2 mA to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 0.2 A to 2 A > 2 A to 20 A		$20 \cdot 10^{-6} \cdot I$ + 2.0 nA $20 \cdot 10^{-6} \cdot I$ + 20 nA $20 \cdot 10^{-6} \cdot I$ + 0.20 µA $70 \cdot 10^{-6} \cdot I$ + 2.0 µA $0.30 \cdot 10^{-3} \cdot I$ + 40 µA $0.70 \cdot 10^{-3} \cdot I$ + 1.0 mA	I = measured value
DC resistance Resistors	1 Ω to 2 Ω > 2 Ω to 20 Ω > 20 Ω to 200 Ω > 0.2 kΩ to 2 kΩ > 2 kΩ to 20 kΩ > 20 kΩ to 200 kΩ > 0.2 MΩ to 2 MΩ > 2 MΩ to 20 MΩ > 20 MΩ to 200 MΩ		$30 \cdot 10^{-6} \cdot R$ + 20 µΩ $20 \cdot 10^{-6} \cdot R$ + 50 µΩ $20 \cdot 10^{-6} \cdot R$ + 0.50 mΩ $20 \cdot 10^{-6} \cdot R$ + 5.0 mΩ $20 \cdot 10^{-6} \cdot R$ + 50 mΩ $20 \cdot 10^{-6} \cdot R$ + 0.40 Ω $20 \cdot 10^{-6} \cdot R$ + 5.0 Ω $40 \cdot 10^{-6} \cdot R$ + 0.20 kΩ $0.30 \cdot 10^{-3} \cdot R$ + 0.20 MΩ	R = measured value
DC resistance Measurement instruments	1 Ω to < 11 Ω 11 Ω to < 33 Ω 33 Ω to < 0.11 kΩ 0.11 kΩ to < 0.33 kΩ 0.33 kΩ to < 1.1 kΩ 1.1 kΩ to < 3.3 kΩ 3.3 kΩ to < 11 kΩ 11 kΩ to < 33 kΩ 33 kΩ to < 0.11 MΩ 0.11 MΩ to < 0.33 MΩ 0.33 MΩ to < 1.1 MΩ 1.1 MΩ to < 3.3 MΩ 3.3 MΩ to < 11 MΩ 11 MΩ to < 33 MΩ 33 MΩ to < 0.11 GΩ 0.11 GΩ to < 0.33 GΩ 0.33 GΩ to < 1.1 GΩ		$0.10 \cdot 10^{-3} \cdot R$ + 15 mΩ $0.10 \cdot 10^{-3} \cdot R$ + 20 mΩ $0.10 \cdot 10^{-3} \cdot R$ + 20 mΩ $0.15 \cdot 10^{-3} \cdot R$ + 25 mΩ $0.15 \cdot 10^{-3} \cdot R$ + 15 mΩ $0.15 \cdot 10^{-3} \cdot R$ + 0.40 Ω $0.15 \cdot 10^{-3} \cdot R$ + 0.10 Ω $0.15 \cdot 10^{-3} \cdot R$ + 1.5 Ω $0.15 \cdot 10^{-3} \cdot R$ + 1.0 Ω $0.15 \cdot 10^{-3} \cdot R$ + 26 Ω $0.15 \cdot 10^{-3} \cdot R$ + 20 Ω $0.15 \cdot 10^{-3} \cdot R$ + 0.30 kΩ $0.20 \cdot 10^{-3} \cdot R$ + 0.60 kΩ $0.35 \cdot 10^{-3} \cdot R$ + 8.0 kΩ $0.60 \cdot 10^{-3} \cdot R$ + 18 kΩ $3.5 \cdot 10^{-3} \cdot R$ + 0.30 MΩ $20 \cdot 10^{-3} \cdot R$ + 1.4 MΩ	R = measured value
AC voltage Measurement instruments	1 mV to < 33 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$0.90 \cdot 10^{-3} \cdot U$ + 20 µV $0.20 \cdot 10^{-3} \cdot U$ + 20 µV $0.25 \cdot 10^{-3} \cdot U$ + 20 µV $1.5 \cdot 10^{-3} \cdot U$ + 20 µV $4.5 \cdot 10^{-3} \cdot U$ + 30 µV $10 \cdot 10^{-3} \cdot U$ + 0.10 mV	U = measured value
	33 mV to < 330 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$0.40 \cdot 10^{-3} \cdot U$ + 30 µV $0.20 \cdot 10^{-3} \cdot U$ + 30 µV $0.20 \cdot 10^{-3} \cdot U$ + 30 µV $0.50 \cdot 10^{-3} \cdot U$ + 30 µV $1.0 \cdot 10^{-3} \cdot U$ + 80 µV $2.5 \cdot 10^{-3} \cdot U$ + 0.20 mV	

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
AC voltage Measurement instruments	0.33 V to < 3.3 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$0.40 \cdot 10^{-3} \cdot U$ + 0.10 mV $0.20 \cdot 10^{-3} \cdot U$ + 0.10 mV $0.25 \cdot 10^{-3} \cdot U$ + 0.10 mV $0.40 \cdot 10^{-3} \cdot U$ + 0.10 mV $1.0 \cdot 10^{-3} \cdot U$ + 0.20 mV $3.0 \cdot 10^{-3} \cdot U$ + 2.0 mV	U = measured value
	3.3 V to < 33 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.40 \cdot 10^{-3} \cdot U$ + 1.5 mV $0.20 \cdot 10^{-3} \cdot U$ + 1.0 mV $0.30 \cdot 10^{-3} \cdot U$ + 1.0 mV $0.50 \cdot 10^{-3} \cdot U$ + 1.0 mV $1.5 \cdot 10^{-3} \cdot U$ + 2.5 mV	
	33 V to < 330 V	45 Hz to 1 kHz > 1 kHz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.25 \cdot 10^{-3} \cdot U$ + 3.0 mV $0.30 \cdot 10^{-3} \cdot U$ + 10 mV $0.30 \cdot 10^{-3} \cdot U$ + 10 mV $0.40 \cdot 10^{-3} \cdot U$ + 10 mV $2.5 \cdot 10^{-3} \cdot U$ + 60 mV	
	330 V to 1020 V	45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.40 \cdot 10^{-3} \cdot U$ + 20 mV $0.30 \cdot 10^{-3} \cdot U$ + 20 mV $0.40 \cdot 10^{-3} \cdot U$ + 20 mV	
AC voltage Sources	0.1 V to 0.2 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U$ + 20 µV $0.20 \cdot 10^{-3} \cdot U$ + 20 µV $0.20 \cdot 10^{-3} \cdot U$ + 20 µV	
	> 0.2 V to 2 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U$ + 60 µV $0.20 \cdot 10^{-3} \cdot U$ + 60 µV $0.20 \cdot 10^{-3} \cdot U$ + 60 µV	
	> 2 V to 20 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U$ + 0.60 mV $0.20 \cdot 10^{-3} \cdot U$ + 0.60 mV $0.20 \cdot 10^{-3} \cdot U$ + 0.60 mV	
	> 20 V to 200 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz	$0.20 \cdot 10^{-3} \cdot U$ + 6.0 mV $0.20 \cdot 10^{-3} \cdot U$ + 6.0 mV $0.20 \cdot 10^{-3} \cdot U$ + 6.0 mV	
	> 200 V to 1050 V	40 Hz to 10 kHz	$0.40 \cdot 10^{-3} \cdot U$ + 80 mV	
AC current Measurement instruments	29 µA to < 330 µA 0.33 mA to < 3.3 mA 3.3 mA to < 33 mA 33 mA to < 330 mA 0.33 A to < 1.1 A 1.1 A to < 3 A 3 A to < 11 A 11 A to 20.5 A	45 Hz to 1 kHz	$1.6 \cdot 10^{-3} \cdot I$ + 0.40 µA $1.5 \cdot 10^{-3} \cdot I$ + 0.60 µA $0.50 \cdot 10^{-3} \cdot I$ + 6.0 µA $0.50 \cdot 10^{-3} \cdot I$ + 60 µA $0.60 \cdot 10^{-3} \cdot I$ + 0.30 mA $0.70 \cdot 10^{-3} \cdot I$ + 0.40 mA $1.5 \cdot 10^{-3} \cdot I$ + 5.0 mA $2.0 \cdot 10^{-3} \cdot I$ + 10 mA	I = measured value
AC current Sources	0.2 mA to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 200 mA to 2 A > 2 A to 20 A	45 Hz to 1 kHz	$0.50 \cdot 10^{-3} \cdot I$ + 0.60 µA $0.50 \cdot 10^{-3} \cdot I$ + 5.0 µA $0.50 \cdot 10^{-3} \cdot I$ + 50 µA $0.80 \cdot 10^{-3} \cdot I$ + 0.50 mA $1.1 \cdot 10^{-3} \cdot I$ + 5.0 mA	

Abbreviations used:

CMC	Calibration and measurement capabilities
DGQ	Deutsche Gesellschaft für Qualität e.V.
DIN	Deutsches Institut für Normung e.V.
DKD	Deutscher Kalibrierdienst
DKD-R	Guideline of Deutscher Kalibrierdienst, published by Physikalisch-Technischen Bundesanstalt
Trescal KA	Calibration guide of Trescal GmbH
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.

DAkkS
Deutsche
Akkreditierungsstelle

Accreditation

The Deutsche Akkreditierungsstelle attests with this **Partial Accreditation Certificate** that the calibration laboratory

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

meets the requirements according to DIN EN ISO/IEC 17025:2018 for the conformity assessment activities listed in the annex to this certificate. This includes additional existing legal and normative requirements for the calibration laboratory, including those in relevant sectoral schemes, provided they are explicitly confirmed in the annex to this certificate.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the principles of DIN EN ISO 9001.

This accreditation was issued in accordance with Art. 5 Para. 1 Sentence 2 of Regulation (EC) 765/2008, after an accreditation procedure was carried out in compliance with the minimum requirements of DIN EN ISO/IEC 17011 and on the basis of a review and decision of the appointed accreditation committees.

This partial accreditation certificate only applies in connection with the notice of 15.05.2025 with accreditation number D-K-15015-01.
It consists of this cover sheet, the reverse side of the cover sheet and the following annex with a total of 20 pages.

Registration number of the partial accreditation certificate: **D-K-15015-01-02**
It is a part of the accreditation certificate: D-K-15015-01-00.

Berlin, 15.05.2025
Dipl.-Wirtsch.-Ing. (BA) Tim Harnisch
Head of Technical Unit

Translation issued:
15.05.2025
Dipl.-Wirtsch.-Ing. (BA) Tim Harnisch
Head of Technical Unit

The certificate together with the annex reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH (www.dakks.de).

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

See notes overleaf

Deutsche Akkreditierungsstelle GmbH

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The Deutsche Akkreditierungsstelle GmbH (DAkkS) is the entrusted national accreditation body of the Federal Republic of Germany according to § 8 section 1 AkkStelleG in conjunction with § 1 section 1 AkkStelleGBV. DAkkS is designated as the national accreditation authority by Germany according to Art. 4 Para. 4 of Regulation (EC) 765/2008 and clause 4.7 of DIN EN ISO/IEC 17000.

Pursuant to Art. 11 section 2 of Regulation (EC) 765/2008, the accreditation certificate shall be recognised as equivalent by the national authorities within the scope of this Regulation as well as by the WTO member states that have committed themselves in bilateral or multilateral mutual agreements to recognise the certificates of accreditation bodies that are members of ILAC or IAF as equivalent.

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 Co-operation (ILAC).

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

Annex to the Partial Accreditation Certificate D-K-15015-01-02 according to DIN EN ISO/IEC 17025:2018

Valid from: **15.05.2025**

Date of issue: 15.05.2025

This annex is a part of the accreditation certificate D-K-15015-01-00.

Holder of partial accreditation certificate:

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

with the locations

Trescal GmbH
Borsigstraße 11, 64291 Darmstadt

Trescal GmbH
Niederlassung Neustadt
Ernst-Abbe-Straße 18, 01844 Neustadt

Trescal GmbH
Niederlassung Esslingen
Limburgstraße 6, 73734 Esslingen

Trescal GmbH
Niederlassung Halver
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This certificate annex is only valid together with the written accreditation certificate and reflects the status as indicated by the date of issue. The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at https://www.dakks.de.

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Trescal GmbH
Niederlassung Ruhla
Bahnhofstraße 25, 99842 Ruhla

Trescal GmbH
Niederlassung Nürnberg
Poststraße 15a, 90471 Nürnberg

The calibration laboratory meets the requirements of DIN EN ISO/IEC 17025:2018 to carry out the conformity assessment activities listed in this annex. The calibration laboratory meets additional legal and normative requirements, if applicable, including those in relevant sectoral schemes, provided that these are explicitly confirmed below.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories and they conform to the principles of DIN EN ISO 9001.

Calibration in the fields:

Thermodynamic quantities

Temperature quantities

- **Temperature indicators and simulators** [a)]
- **Direct reading thermometers** [a)]
- **Resistance thermometers** [a)]
- **Thermocouples** [a)]
- **Temperature transmitters, data loggers**
- **Temperature block calibrators**
- **Climatic chambers (temperature)** [b)]

Humidity quantities

- **Devices for relative humidity**
- **Climatic chambers (humidity)** [b)]

Mechanical quantities

- **Force**
- **Pressure** [a)]
- **Acceleration**
- **Torque** [a)]
- **Weighing instruments** [a)]
- **Mass (mass standards)**

Material testing machines (MTM)

- **Hardness (MTM)** [a)]
- **Force (MTM)**[b)]
- **Extension (MTM)** [b)]
- **Velocity (MTM)** [b)]
- **Mechanical work (MTM)** [b)]

Acoustical quantities

[a)] also as on-site Calibration
[b)] only as on-site Calibration

Within the measurands/calibration items marked with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates.

The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

DAkkS Deutsche Akkreditierungsstelle

Darmstadt

Permanent Laboratory - Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Temperature quantities	–200 °C	to	–100 °C	DKD-R 5-5:2018 without reference junction compensation	0.4 K	Characteristics according to DIN EN 60584-1:2014
Temperature indicators and simulators for thermocouples *	> –100 °C	to	120 °C		0.25 K	
	> 120 °C	to	1000 °C		0.35 K	
Type K and Type N	> 1000 °C	to	1300 °C		0.5 K	
Type J	–210 °C	to	–100 °C		0.35 K	
	> –100 °C	to	760 °C		0.25 K	
	> 760 °C	to	1200 °C		0.3 K	
Temperature indicators for resistance thermo-meters *	–200 °C	to	800 °C	DKD-R 5-5:2018	0.27 K	Characteristics according to DIN EN IEC 60751:2023
Temperature simulators for resistance thermo-meters *	–200 °C	to	800 °C		0.1 K	

On-Site Calibration – Darmstadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Temperature quantities	–200 °C	to	–100 °C	DKD-R 5-5:2018 without reference junction compensation	0.4 K	Characteristics according to DIN EN 60584-1:2014
Temperature indicators and simulators for thermocouples *	> –100 °C	to	120 °C		0.25 K	
	> 120 °C	to	1000 °C		0.35 K	
Type K and Type N	> 1000 °C	to	1300 °C		0.5 K	
Type J	–210 °C	to	–100 °C		0.35 K	
	> –100 °C	to	760 °C		0.25 K	
	> 760 °C	to	1200 °C		0.3 K	
Temperature indicators for resistance thermo-meters *	–200 °C	to	800 °C	DKD-R 5-5:2018	0.27 K	Characteristics according to DIN EN IEC 60751:2023
Temperature simulators for resistance thermo-meters *	–200 °C	to	800 °C		0.1 K	

DAkkS Deutsche Akkreditierungsstelle

Neustadt

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Hardness (MTM) * for hardness scale Shore A	0 Shore to 100 Shore	DIN ISO 48-9:2021	1 Shore	direct measurement with reference standards for distance and force
Measuring range	0 mm to 2.5 mm		2 µm	
Elastic force	0 mN to 8050 mN		2 mN	
Bore diameter of pressure plate d_1	2.9 mm to 3.1 mm		5 µm	
Shaft diameter of indenter d_2	1.1 mm to 1.4 mm		5 µm	
Upper truncated diameter of truncated cone d_3	0.78 mm to 0.8 mm		3 µm	
Diameter of pressure plate D	17.5 mm to 18.5 mm		10 µm	
Taper angle of indenter α	34° 45' to 35° 15'		4'	
Shore D	10 Shore to 100 Shore		1 Shore	
Measuring range	0 mm to 2.5 mm		2 µm	
Elastic force	0 mN to 44500 mN		3 mN	
Bore diameter of pressure plate d_1	2.9 mm to 3.1 mm		5 µm	
Shaft diameter of indenter d_2	1.1 mm to 1.4 mm		5 µm	
Radius of indenter r	0.09 mm to 0.11 mm		3 µm	
Diameter of pressure plate D	17.5 mm to 18.5 mm		10 µm	
Taper angle of indenter α	29° 45' to 30° 15'		4'	
IRHD - N	30 IRHD-N to 95 IRHD-N		1 IRHD - N	
Measuring range	0 mm to 1.8 mm		2 µm	
Bore diameter of pressure plate d_1	5 mm to 7 mm		10 µm	
Ball diameter of indenter d_2	2.49 mm to 2.51 mm		3 µm	
Diameter of pressure plate D	19 mm to 21 mm		20 µm	
Pre-load of indenter F_c	0.28 N to 0.32 N		3 mN	

DAkkS Deutsche Akkreditierungsstelle

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
IRHD - N				DIN ISO 48-9:2021		direct measurement with reference standards for distance and force
Total force on indenter F_t	5.67 N	to	5.73 N		3 mN	
Force on pressure plate F_f	6.8 N	to	9.8 N		3 mN	
IRHD - L	10 IRHD-L	to	35 IRHD-L		1 IRHD - L	
Measuring range	0 mm	to	3.2 mm		2 µm	
Bore diameter of pressure plate d_1	9 mm	to	11 mm		10 µm	
Ball diameter of indenter d_2	4.99 mm	to	5.01 mm		3 µm	
Diameter of pressure plate D	21 mm	to	23 mm		20 µm	
Pre-load on indenter F_c	0.28 N	to	0.32 N		3 mN	
Total force on indenter F_t	5.67 N	to	5.73 N		3 mN	
Force on pressure plate F_f	6.8 N	to	9.8 N		3 mN	
IRHD - M	30 IRHD-M	to	95 IRHD-M		4.5 IRHD - M	
Measuring range	0 mm	to	0.3 mm		2 µm	
Bore diameter of pressure plate d_1	0.85 mm	to	1.15 mm		5 µm	
Ball diameter of indenter d_2	0.39 mm	to	0.4 mm		3 µm	
Diameter of pressure plate D	3.2 mm	to	3.5 mm		10 µm	
Pre-load on indenter F_c	7.8 mN	to	8.8 mN		0.3 mN	
Total force on indenter F_t	152.3 mN	to	154.3 mN		0.3 mN	
Force on pressure plate F_f	205 mN	to	265 mN		0.3 mN	
Pressure *						
Absolute pressure p_{abs}	0 bar	to	2 bar	DKD-R 6-1:2014	0.15 mbar	Pressure medium: gas The uncertainty of the barometer has to be taken into account.
	> 2 bar	to	121 bar	Method of calibration up to 2 bar: $p_{abs} = p_e + p_{amb}$	$6.3 \cdot 10^{-5} \cdot p_{abs}$ + 0.45 mbar	
	1 bar; 2 bar	to	61 bar	DKD-R 6-1:2014	$6.8 \cdot 10^{-5} \cdot p_{abs}$ + 0.35 mbar	Pressure medium: oil The uncertainty of the barometer has to be taken into account.
	> 61 bar	to	1201 bar	Method of calibration: $p_{abs} = p_e + p_{amb}$	$9.7 \cdot 10^{-5} \cdot p_{abs}$ + 5.8 mbar	

DAkkS Deutsche Akkreditierungsstelle

Permanent Laboratory - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Negative and positive gauge pressure p_e	–1 bar to 1 bar	DKD-R 6-1:2014	0.11 mbar	Pressure medium: gas
	> 1 bar to 120 bar		$6.3 \cdot 10^{-5} \cdot p_e + 0.45$ mbar	
Positive gauge pressure p_e	> 1 bar to 60 bar		$6.8 \cdot 10^{-5} \cdot p_e + 0.35$ mbar	Pressure medium: oil
	> 60 bar to 1200 bar		$9.7 \cdot 10^{-5} \cdot p_e + 5.8$ mbar	
Weighing instruments * Nonautomatic electronic weighing instruments	to 600 g	EURAMET/cg-18/v.4.0:2015	$2 \cdot 10^{-6}$	with weights according to OIML R 111-1:2004, class E_2
	to 180 kg		$2 \cdot 10^{-5}$	with weights according to OIML R 111-1:2004, class F_1

On-Site Calibration - Neustadt

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Weighing instruments * Non automatic electronic weighing instruments	to 600 g	EURAMET/cg-18/v. 4.0:2015	$2 \cdot 10^{-6}$	with weights according to OIML R 111-1:2004, class E_2
	to 180 kg		$2 \cdot 10^{-5}$	with weights according to OIML R 111-1:2004, class F_1

Esslingen

Permanent Laboratory - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Pressure *				
Gauge pressure p_e	0 bar to 1.6 bar > 1.6 bar to 10 bar > 10 bar to 172 bar > 172 bar to 500 bar	DKD-R 6-1:2014	0.18 mbar 1.8 mbar 18 mbar $2 \cdot 10^{-4} \cdot p_e$	Pressure medium: gas
Absolute pressure p_{abs}	1 bar to 1.6 bar > 1.6 bar to 10 bar > 10 bar to 172 bar		0.18 mbar 1.8 mbar 18 mbar	Pressure medium: gas The uncertainty of the barometer has to be taken into account.
Acceleration	For sinusoidal excitation and narrow-band evaluation methods (sine approximation), the amplitudes of vibration acceleration, vibration velocity and vibration displacement are unambiguously linked to one another by the vibration frequency. This is why vibration velocity sensors and vibration displacement sensors can be calibrated using the measurand acceleration as stated in the table in ranges of velocity and displacement - converted accordingly for the stated frequency ranges.			
Acceleration *		DKD-R 3-1: part 3:2020 Sinusoidal excitation		
	0.1 m/s² to 10 m/s²	0.4 Hz to 160 Hz	1 % / 1.4°	Sensor weight up to 1 kg Displacement amplitude up to 150 mm pk-pk Calibration result: complex transfer coefficient (magnitude/phase)
	10 m/s² to 500 m/s²	10 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	1 % / 1° 1.5 % / 1.5° 2.5 % / 2°	Sensor weight up to 0.3 kg Displacement amplitude up to 10 mm pk-pk Calibration result: complex transfer coefficient (magnitude /phase)
Measurement Amplifier *	Input charge	DKD-R 3-2:2019		
Charge amplifier transfer coefficient	1 pC to 10 nC	0.2 Hz to < 1 Hz 1 Hz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz	0.5 % / 0.7° 0.4 % / 0.5° 0.4 % / 1° 0.6 % / 2° 1 % / 5°	Complex amplification coefficient (magnitude /phase)

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Permanent Laboratory - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Voltage and IEPE amplifier transfer coefficient	0.001 V/V to 1000 V/V	0.2 Hz to 1 Hz > 1 Hz to 20 kHz > 20 kHz to 50 kHz	0.4 % / 0.7° 0.3 % / 0.5° 1 % / 5°	
Vibration calibrator * Acceleration amplitude for frequence range of 20 Hz – 1 kHz	1 m/s² to 20 m/s²	DIN ISO 16063-44:2019	1.1 %	Magnitude
Frequency	20 Hz to 1 kHz		$5 \cdot 10^{-4} \cdot f$, but not less than 0.1 Hz	f = measured frequency
Harmonic distortion	20 Hz to 1 kHz		10 % (THD)	THD: Total Harmonic Distortion
Torque * Hand torque assembly tools, triggering / indicating	1 N·m to 1000 N·m	DIN EN ISO 6789-2:2017	$1 \cdot 10^{-2}$	
Force * Force sensors Force measuring devices	50 N to 250 kN	DIN EN ISO 376:2011, DKD-R 3-3:2018	$9 \cdot 10^{-4}$	Compression and tension force, 50 kN- and 250-kN-K-BNME with reference sensors 500 N, 2 kN, 10 kN, 50 kN, 250 kN
Hand force measuring devices	50 N to 1000 N	DKD-R 3-3:2018 Method C	0.5 %	Compression and tension force, 50-kN- and 250-kN-K-BNME with reference force sensors 500 N, 2 kN
Acoustical quantities* Free field effective sensitivity level of ¼'' and ½'' measuring microphones	125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz	DIN EN 61094-8:2013 Substitution method in an anechoic chamber with ½" standard microphone at sound pressure level 74 dB to 94 dB	0.35 dB 0.35 dB 0.45 dB 0.50 dB	
Free field frequence response of sound calibrators	125 Hz to < 250 Hz 250 Hz to 8 kHz > 8 kHz to 10 kHz > 10 kHz to 20 kHz	DIN EN 61672-3:2017 respectively DIN EN 62585:2013 Substitution method in an anechoic chamber with ½" standard microphone at sound pressure level 74 dB to 94 dB	0.50 dB 0.40 dB 0.50 dB 0.60 dB	

Permanent Laboratory - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Pressure sensitivity level of ½'' measuring microphones	31.5 Hz to 5 kHz > 5 kHz to 10 kHz > 10 kHz to 16 kHz	DIN EN 61094-5:2016 Comparative measurement in an electro-acoustical coupler	0.25 dB 0.40 dB 0.50 dB	
Sound pressure level of sound calibrators	250 Hz; 1 kHz	DIN EN IEC 60942:2018 94 dB; 114 dB; 124 dB	0.15 dB	

On-Site Calibration - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Torque * Hand torque assembly tools, triggering / indicating	1 N·m to 1 000 N·m	DIN EN ISO 6789-2:2017	$1 \cdot 10^{-2}$	
Extension (MTM) * Extensiometer systems of material testing machines according to DIN 51220:2022	0 mm to 60 mm	DIN EN ISO 9513:2013 ASTM E 83:2023 ASTM E 399:2023 ASTM E 2309/ E 2309M:2020	0.15 %; but not less than 0.5 µm	Measuring principle: incremental
	0 mm to 1 500 mm		0.3 %; but not less than 3 µm	
Identation measuring devices of hardness testing machines	0 mm to 20 mm	ISO 6506-2:2017 DIN EN ISO 6506-2:2018 ASTM E 10:2023 ISO 6507-2:2018 DIN EN ISO 6507-2:2018 ASTM E 384:2022 ASTM E 92:2017 ISO 6508-02:2023 DIN EN ISO 6508-2:2024 ASTM E 18:2022 DIN EN ISO 2039-1:2003 DIN EN ISO 2039-2:2000 ASTM F 36:2015 ASTM D 785:2023	0.15 %; but not less than 0.5 µm	Measuring principle: Stage micrometer in reflected light
Depth measuring devices of hardness testing machines	0 mm to 1 mm	DIN EN ISO 6508-2:2024 ASTM E 18:2022	0.3 µm	Measuring principle: incremental, DMS

On-Site Calibration - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Force (MTM) * Force measuring devices of material testing machines	10 N to 600 kN	ISO 7500-1:2018 DIN EN ISO 7500-1:2018 DIN EN ISO 7500-1 Supplement 1:2022 Supplement 2:2022 Supplement 3:1999 Supplement 4:2013 ISO 7500-2:2006 DIN EN ISO 7500-2:2007 ASTM E 4:2021 ISO 6506-2:2017 DIN EN ISO 6506-2:2019 ASTM E 10:2023 ISO 6507-2:2018 DIN EN ISO 6507-2:2018 ASTM E 384:2022 ASTM E 92:2017 ISO 6508-2:2023 DIN EN ISO 6508-2:2024 ASTM E 18:2022 DIN EN ISO 2039-1:2003 DIN EN ISO 2039-2:2000 ASTM F 36:2015 ASTM D 785:2023 ASTM E 1012:2019 ASTM E 467:2021 ISO 23788:2012	0.12 %	with force measurement for direction of tension
	1 N to 1 000 kN		0.12 %	with force measurement for direction of compression
	0.1 N to 100 N		0.10 %	with mass stacks in direction of compression and tension
Velocity (MTM) * Traverse speed	0.1 mm/min to 20 mm/min	ASTM E 2658:2015	1.5 %	Measuring principle: Start/stop method of distance and time
Mechanical work (MTM) * pendulum impact testing machines and impact devices	0.2 J to 750 J	DIN EN ISO 148-2:2017 DIN 51222:2017	Force: 0.12 % Pendulum length: 0.3 mm Angle: 0.05° Time: 0.2 s	The uncertainty is calculated for: 1. position of the oscillation center 2. potential energy 3. Deviation of the indicated energy 4. Indirect calibration with reference samples

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On-Site Calibration - Esslingen

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Hardness (MTM) * Hardness testing machines according to Brinell, Vickers and Rockwell methods	60 HBW to 650 HBW	DIN EN ISO 6506-2:2019 ASTM E 10:2023	2 % HBW	The specified values of uncertainty apply to indirect calibration with hardness reference plates. Uncertainty of individual parameters from direct measurement is listed separately. U_{CRM} = Calibration uncertainty of hardness reference plate
	100 HV to 1 000 HV (Hardness scales HV5 to HV100) (Hardness scales HV0,01 to HV3)	ISO 6507-2:2018 DIN EN ISO 6507-2:2018 ASTM E 384:2022 ASTM E 92:2017	1 % HV, but not < 1.5 · U_{CRM} 2 % HV, but not < 1.5 · U_{CRM}	
	20 HRA to 93 HRA	ISO 6508-2:2023 DIN EN ISO 6508-2:2024 ASTM E 18:2022	0.5 HRA	
	20 HRB to 115 HRB		0.8 HRB	
	10 HRC to 70 HRC		0.5 HRC	
	70 HR15N to 94 HR15N		0.6 HR15N	
	42 HR30N to 86 HR30N		0.6 HR30N	
	20 HR45N to 77 HR45N		0.6 HR45N	
	67 HR15T to 93 HR15T		1.2 HR15T	
	29 HR30T to 82 HR30T		1.2 HR30T	
	15 HR45T to 72 HR45T		1.2 HR45T	

Halver

Permanent Laboratory - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Torque * Hand torque assembly tools	2 N·m to 3 kN·m	DIN EN ISO 6789-2:2017	$1 \cdot 10^{-2}$	
Force * Force measuring devices	10 N to 50 kN	DKD-R 3-3:2018	0.45 %	With force measuring devices in direction of compression and tension
Hand force measuring devices	1 N to 600 N	VDI/VDE 2624 part 2.1:2008	0.2 %	with mass stacks in direction of compression and tension
	10 N to 5 kN		0.2 %	With force measuring devices in direction of compression and tension
Temperature quantities direct reading thermometers with resistance sensor *	−35 °C to 150 °C	DKD-R 5-1:2018 in liquid baths	0.6 K	Comparison with reference thermometer
	50 °C to 600 °C	DKD-R 5-1:2018 in dry block calibrator	3.1 K	
direct reading thermometers with thermocouple sensor *	−35 °C to 150 °C	DKD-R 5-3:2018 in liquid baths	1.0 K	Comparison with reference thermometer
	50 °C to 600 °C	DKD-R 5-3:2018 in dry block calibrator	4.5 K	
Temperature indicators for thermocouples *		DKD-R 5-5:2018 without reference junction compensation		Characteristics according to DIN EN 60584-1:2014
Type J	−200 °C to 1200 °C		0.5 K	
Type K	−200 °C to 1200 °C		0.6 K	
Type N	−200 °C to 1200 °C		0.6 K	
Type T	−200 °C to 400 °C		0.6 K	
Type E	−200 °C to 1000 °C		0.6 K	
Type C	0 °C to 1200 °C		0.9 K	
Type R	0 °C to 1200 °C		0.6 K	
Type S	0 °C to 1200 °C		0.6 K	
Type B	0 °C to 1200 °C		0.6 K	

On-Site Calibration - Halver

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Force *				
Hand force measuring devices	1 N to 600 N	VDI/VDE 2624 part 2.1:2008	0.2 %	with mass stacks in direction of compression and tension
Temperature quantities		DKD-R 5-5:2018 without reference junction compensation		Characteristics according to DIN EN 60584-1:2014
Temperature indicators for thermocouples *				
Type J	−200 °C to 1200 °C		0.5 K	
Type K	−200 °C to 1200 °C		0.6 K	
Type N	−200 °C to 1200 °C		0.6 K	
Type T	−200 °C to 400 °C		0.6 K	
Type E	−200 °C to 1000 °C		0.6 K	
Type C	0 °C to 1200 °C		0.9 K	
Type R	0 °C to 1200 °C		0.6 K	
Type S	0 °C to 1200 °C		0.6 K	
Type B	0 °C to 1200 °C		0.6 K	

Braunschweig

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Temperature quantities				
Resistance thermometers, direct reading thermometers and transmitters with resistance sensor	0.01 °C	Trescal BS KA20a 01.1/2021 Triple point of water	15 mK	Calibration at fixed point temperatures
	29.7646 °C	Trescal BS KA20b 01.1/2021 Fixed point of gallium	15 mK	
Resistance thermometers, direct reading thermometers and transmitters with resistance sensor *	−100 °C to −20 °C	DKD-R 5-1:2018 in dry block calibrator	0.25 K	Comparison with reference thermometer
	> −20 °C to 140 °C		0.05 K	
	> 140 °C to 300 °C		0.2 K	
	> 300 °C to 660 °C		0.7 K	
	−40 °C to 150 °C	DKD-R 5-1:2018 in climatic chamber	0.4 K	
Direct reading thermometers with base metal thermocouple sensor *	−100 °C to 140 °C	DKD-R 5-3:2018 in dry block calibrator	0.5 K	Comparison with reference thermometer
	> 140 °C to 300 °C		0.5 K	
	> 300 °C to 660 °C		0.9 K	
	500 °C to 900 °C	DKD-R 5-3:2018 in tube furnace	1.6 K	
	> 900 °C to 1100 °C		2.0 K	
	> 1100 °C to 1200 °C		3.0 K	
	−40 °C to 150 °C	DKD-R 5-3:2018 in climatic chamber	0.5 K	
Base metal thermocouples and transmitters with base metal thermocouple sensor *	−100 °C to 140 °C	DKD-R 5-3:2018 in dry block calibrator	1.0 K	Comparison with reference thermometer
	140 °C to 300 °C		1.0 K	
	> 300 °C to 660 °C		1.4 K	
	500 °C to 700 °C	DKD-R 5-3:2018 in tube furnace	2.3 K	
	> 700 °C to 900 °C		2.4 K	
	> 900 °C to 1100 °C		2.7 K	
	> 1100 °C to 1200 °C		3.5 K	

Permanent Laboratory - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Noble metal thermocouples, direct reading thermometers with noble metal thermocouple sensor and transmitters with thermocouple sensor * Type S and type R	200 °C	to	300 °C	DKD-R 5-3:2018 in dry block calibrator	0.5 K	Comparison with reference thermometer
	> 300 °C	to	660 °C		0.9 K	
	500 °C	to	700 °C	DKD-R 5-3:2018 in tube furnace	1.2 K	
	> 700 °C	to	900 °C		1.3 K	
	> 900 °C	to	1100 °C		1.8 K	
	> 1100 °C	to	1200 °C		2.9 K	
Dry block calibrators *	−100 °C	to	300 °C	DKD-R 5-4:2018	0.35 K	Comparison with reference thermometer
	> 300 °C	to	660 °C		0.65 K	
	> 660 °C	to	800 °C		2.5 K	
	> 800 °C	to	1000 °C		4.0 K	
	> 1000 °C	to	1200 °C		5.0 K	
Thermo-hygrographs	10 °C	to	40 °C	Trescal BS KA24 01.1/2021 in climatic chamber	1.2 K	Comparison with reference thermometer
Humidity quantities						
Relative humidity Hygrometers for direct logging of relative humidity in air *	20 %	to	50 %	DKD-R 5-8:2019 in climatic chamber temperature range: 20 °C to 80 °C	1.5 %	Comparison with dew point hygrometer Measurement uncertainty expressed as an absolute value of relative humidity
	> 50 %	to	80 %		2.0 %	
	> 80 %	to	90 %		2.6 %	
	20 %	to	50 %	DKD-R 5-8:2019 in humidity generator at 23 °C	1.0 %	
	> 50 %	to	90 %		1.5 %	
Thermo-hygrographs *	20 %	to	90 %	DKD-R 5-8:2019 in climatic chamber temperature range: 20 °C to 80 °C	5.0 %	

On-Site Calibration - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Temperature quantities						
Resistance thermometers, direct reading thermometers and transmitters with resistance sensor *	−100 °C	to	−20 °C	DKD-R 5-1:2018 in dry block calibrator	0.5 K	Comparison with reference thermometer
	> −20 °C	to	140 °C		0.1 K	
	> 140 °C	to	300 °C		0.4 K	
	> 300 °C	to	660 °C		1.4 K	

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On-Site Calibration - Braunschweig

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Direct reading thermometers and transmitters with thermocouple sensor *	−100 °C	to	140 °C	DKD-R 5-3:2018 in dry block calibrator	1.0 K	Comparison with reference thermometer
	> 140 °C	to	300 °C		1.0 K	
	> 300 °C	to	660 °C		1.8 K	
Climatic chamber with air circulation *	−90 °C	to	10 °C	DKD-R 5-7:2018 method A or B	1.7 K	Comparison with reference thermometer
	> 10 °C	to	40 °C		1.0 K	
	> 40 °C	to	250 °C		1.7 K	
Climatic chamber without air circulation *	−90 °C	to	10 °C	DKD-R 5-7:2018 method A or B	3.0 K	Comparison with reference thermometer
	> 10 °C	to	40 °C		2.2 K	
	> 40 °C	to	250 °C		5.0 K	
Measuring locations in climatic chambers with air circulation *	−90 °C	to	10 °C	DKD-R 5-7:2018 method C	1.7 K	Comparison with reference thermometer
	> 10 °C	to	40 °C		1.0 K	
	> 40 °C	to	250 °C		1.7 K	
Measuring locations in climatic chambers without air circulation *	−90 °C	to	10 °C	DKD-R 5-7:2018 method C	1.7 K	Comparison with reference thermometer
	> 10 °C	to	40 °C		1.0 K	
	> 40 °C	to	250 °C		1.7 K	
Humidity quantities Climatic chambers with air circulation *	20 %	to	90 %	DKD-R 5-7:2018 method A or B Air temperature: 10 °C to 20 °C	3.5 %	Comparison with capacitive humidity sensor Measurement uncertainty expressed as absolute value of relative humidity
	10 %	to	90 %	DKD-R 5-7:2018 method A or B Air temperature: 20 °C to 90 °C	3.5 %	
Measuring locations in climatic chambers with air circulation *	20 %	to	90 %	DKD-R 5-7:2018 method C Air temperature: 10 °C to 20 °C	3.5 %	
	10 %	to	90 %	DKD-R 5-7:2018 method C Air temperature: 20 °C to 90 °C	3.5 %	

Ruhla

On-Site Calibration - Ruhla

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Hardness (MTM) *				
Calibration of Hardness testing machines according to Brinell, Vickers and Rockwell methods	60 HBW to 650 HBW	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015	2 % HBW	Determination of uncertainty with direct and indirect calibration of hardness testing maschine U_{CRM} = Calibration uncertainty of hardness reference plate
	50 HV To 1500 HV (Hardness scales HV5 to HV100) (Hardness scales HV0,01 to HV3)		1 % HV, but not less than 1.5 · U_{CRM} 2 % HV, but not less than 1.5 · U_{CRM}	
	20 HRA to 95 HRA		0.6 HRA	
	10 HRBW to 100 HRBW		1.0 HRBW	
	10 HRC to 70 HRC		0.6 HRC	
	20 HRN to 94 HRN		1.0 HRN	
	10 HRTW to 93 HRTW		1.6 HRTW	
	60 HRFW to 100 HRFW		1.0 HRFW	
Calibration of depth measuring device of Rockwell hardness testing machines *	0 mm to 0.25 mm	DIN EN ISO 6508-2:2015	0.6 µm	direct calibration with depth measuring device
Calibration of indentation measuring device of hardness testing machines *	0.01 mm to 6 mm	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2013	0.15 µm	Measuring principle: Stage micrometer in reflected light
Calibration of force measuring device of hardness testing machines *	2.5 N to 50 kN	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015	0.24 %	with force sensors (class 1) in compression direction
	0.1 N to 100 N		0.10 %	

Nürnberg

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Torque * Hand torque assembly tools, triggering / indicating	1 N·m to 1000 N·m	DIN EN ISO 6789-2:2017	$1 \cdot 10^{-2}$	
Mass * Mass or conventional mass	1 mg	OIML R 111-1:2004	0.006 mg	for fixed nominal values for weights according to OIML R111-1: 2004 according to class F_1
	2 mg		0.006 mg	
	5 mg		0.006 mg	
	10 mg		0.008 mg	
	20 mg		0.010 mg	
	50 mg		0.012 mg	
	100 mg		0.016 mg	
	200 mg		0.020 mg	
	500 mg		0.025 mg	
	1 g		0.03 mg	
	2 g		0.04 mg	
	5 g		0.05 mg	
	10 g		0.06 mg	
	20 g		0.08 mg	
	50 g		0.10 mg	
	100 g		0.16 mg	
	200 g		0.3 mg	
	500 g		0.8 mg	
	1 kg		1.6 mg	
	2 kg		3.0 mg	
	5 kg		8.0 mg	
Temperature quantities * Resistance thermometers and direct reading thermometers with resistance sensor *	−10 °C to 140 °C	DKD-R 5-1:2018 in liquid baths	0.3 K	Comparison with reference thermometer
Thermocouples and direct reading thermometers with thermocouple sensor *	−10 °C to 140 °C	DKD-R 5-3:2018 in liquid baths	1 K	Comparison with reference thermometer
Temperature indicators for thermocouples *	−200 °C to 1200 °C	DKD-R 5-5:2018	0.6 K	Characteristics according to DIN EN 60584-1:2014

Permanent Laboratory - Nürnberg

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Humidity quantities *				
measuring instruments for relative humidity hygrometers	25 % to 75 %	DKD-R 5-8:2019 in climate chamber air temperature 25 °C	2 %	Comparison with capacitive humidity sensors Measurement uncertainty expressed as an absolute value of relative humidity

Abbreviations used:

ASTM	American Society for Testing and Materials
CMC	Calibration and measurement capabilities
DIN	Deutsches Institut für Normung e.V.
DKD-R	Guideline of Deutscher Kalibrierdienst (DKD), published by Physikalisch-Technische Bundesanstalt
EURAMET	European Association of National Metrology Institutes
OIML R	International Recommendation of International Organization of Legal Metrology
Trescal BS KA	Calibration Guide of Trescal GmbH
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.

Calibration and measurement capabilities (CMC)

> Partial Accreditation Certificate D-K-15015-01-01

The laboratory uses calibration standards or equivalent calibration procedures with different issue dates from the accreditation certificate for the following:

Permanent Laboratory - Neustadt

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Knife straight edges * Straightness deviation	to 1000 mm	VDI/VDE/DGQ/DKD 2618, Part 5.2:2024	$1\ \mu m + 2.8 \cdot 10^{-6} \cdot l$	l = test edge length

Permanent Laboratory – Berlin / Mahlow

Measurement quantity / Calibration item	Range	Measurement conditions / Procedure	Expanded measurement of uncertainty	Remarks
Length				
Straight edges * Flatness and parallelism deviation	to 500 mm	VDI/VDE/DGQ/DKD 2618 Part 5.1:2022	$7\ \mu m + 5 \cdot 10^{-6} \cdot l_z$	l_z = length of form embodiment

Within the measurands/calibration items marked with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates. The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

Calibration and measurement capabilities (CMC*)*

> Partial Accreditation Certificate D-K-15015-01-02

The laboratory uses calibration standards or equivalent calibration procedures with different issue dates from the accreditation certificate for the following:

On-site Calibration – Esslingen

Messgröße / Kalibriergegenstand	Messbereich / Messspanne	Messbedingungen / Verfahren	Erweiterte Messunsicherheit	Bemerkungen
Extension (MTM) *				
Indentation measuring devices of hardness testing machines	0 mm to 20 mm	ISO 6506-2:2017 DIN EN ISO 6506-2:2018 ASTM E 10:2023 ISO 6507-2:2018 DIN EN ISO 6507-2:2018 ASTM E 384:2022 ASTM E 92:2023 ISO 6508-2:2023 DIN EN ISO 6508-2:2024 ASTM E 18:2024 DIN EN ISO 2039-1:2003 DIN EN ISO 2039-2:2000 ASTM F 36:2015 ASTM D 785:2023	0.15 but not less than 0.5 µm	Measuring principle: Stage micrometer in reflected light
Depth measuring devices of hardness testing machines	0 mm to 1 mm	DIN EN ISO 6508-2:2024 ASTM E 18:2024	0.3 µm	Measuring principl: incremental, DMS

Within the measurands/calibration items marked with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates. The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

Messgröße / Kalibriergegenstand	Messbereich / Messspanne	Messbedingungen / Verfahren	Erweiterte Messunsicherheit	Bemerkungen
Force (MTM) * Force measuring devices of material testing machines	10 N to 600 kN	ISO 7500-1:2018 DIN EN ISO 7500-1:2018	0.12 %	with force measurement for direction of tension
	1 N to 1.000 kN	DIN EN ISO 7500-1, Beiblatt 1:2022	0.12 %	with force measurement for direction of compression
	0,1 N to 100 N	DIN EN ISO 7500-1, Beiblatt 2:2022 DIN EN ISO 7500-1, Beiblatt 3:1999 DIN EN ISO 7500-1, Beiblatt 4:2013 ISO 7500-2:2006 DIN EN ISO 7500-2:2007 ASTM E 4:2024 ISO 6506-2:2017 DIN EN ISO 6506-2:2019 ASTM E 10:2023 ISO 6507-2:2018 DIN EN ISO 6507-2:2018 ASTM E 384:2022 ASTM E 92:2023 ISO 6508-2:2023 DIN EN ISO 6508-2:2024 ASTM E 18:2024 DIN EN ISO 2039-1:2003 DIN EN ISO 2039-2:2000 ASTM F 36:2015 ASTM D 785:2023 ASTM E 1012:2019 ASTM E 467:2021 ISO 23788:2012	0.10 %	with mass stacks in direction of compression and tension
Hardness (MTM) * Hardness testing machines according to Brinell, Vickers and Rockwell methods	60 HBW to 650 HBW	DIN EN ISO 6506-2:2019 ASTM E 10:2023	2 % HBW	The specified values of uncertainty apply to indirect calibration with hardness reference plates. Uncertainty of individual parameters from direct measurement is listed separately. U_{CRM} = Calibration uncertainty of hardness reference plate
	100 HV to 1.000 HV (Hardness scales HV5 to HV100) (Hardness scales HV0,01 to HV3)	ISO 6507-2:2018 DIN EN ISO 6507-2:2018 ASTM E 384:2022 ASTM E 92:2023	1 % HV; but not < 1.5 · U_{CRM} 2 % HV; but not < 1.5 · U_{CRM}	
	20 HRA to 93 HRA	ISO 6508-2:2023 DIN EN ISO 6508-2:2024 ASTM E 18:2024	0.5 HRA	
	20 HRB to 115 HRB		0.8 HRB	
	10 HRC to 70 HRC		0.5 HRC	
	70 HR15N to 94 HR15 N		0.6 HR15N	
	42 HR30N to 86 HR30 N		0.6 HR30N	
	20 HR45N to 77 HR45 N		0.6 HR45N	
	67 HR15T to 93 HR15T		1.2 HR15T	
	29 HR30T to 82 HR30T		1.2 HR30T	
	15 HR45T to 72 HR45T		1.2 HR45T	

Within the measurands/calibration items marked with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates. The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.