DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

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

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the calibration laboratory

ZwickRoell GmbH & Co. KG

with the further locations:

August-Nagel-Straße 11, 89079 Ulm

Parc Empresarial Trade Center, Avda Corts Catalanes 5-7 planta 2a Local 1, E-08173 Santa Cugat del Valles (Barcelona), Spain

18 Boon Lay Way, #06-105/106, TradeHub 21, Singapore 609966

Corso Perrone 39 h rosso, I-16152 Genova, Italy

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out calibrations in the following fields:

Mechanical quantities
Material testing machines (MTM)
- **Force (MTM)** [a)]
- **Extension (MTM)** [a)]
- **Mechanical work (MTM)** [a)]
- **Hardness (MTM)** [a)]
- **Torque (MTM)** [a)]
- **Angle of rotation (MTM)** [a)]
- **Velocity (MTM)** [a)]

Thermodynamic quantities
Temperature quantities
- **Climatic chambers (temperature)** [a)]
- **Thermocouples** [a)]

[a)] only on site calibrations

The accreditation certificate shall only apply in connection with the notice of accreditation of 31.03.2021 with the accreditation number D-K-18351-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 11 pages.

Registration number of the certificate: **D-K-18351-01-00**

Braunschweig,	Dr Heike Manke	Translation issued:	
31.03.2021	Head of Division	31.03.2021	Head of Division

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 may be found respectively in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH https://www.dakks.de/en/content/accredited-bodies-dakks.

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

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

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Annex to the Accreditation Certificate D-K-18351-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 31.03.2021

Date of issue: 31.03.2021

Holder of certificate:

ZwickRoell GmbH & Co. KG

with the further locations:

August-Nagel-Straße 11, 89079 Ulm

Parc Empresarial Trade Center, Avda Corts Catalanes 5-7 planta 2a Local 1, E-08173 Santa Cugat del Valles (Barcelona), Spain

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Calibrations in the fields:

Mechanical quantities
Material testing machines (MTM)
- **Force (MTM)** a)
- **Extension (MTM)** a)
- **Mechanical work (MTM)** a)
- **Hardness (MTM)** a)
- **Torque (MTM)** a)
- **Angle of rotation (MTM)** a)
- **Velocity (MTM)** a)

Thermodynamic quantities
Temperature quantities
- **Climatic chambers (temperature)** a)
- **Thermocouples** a)

a) only on site calibrations

Abbreviations used: see last page

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.

The management system requirements of DIN EN ISO/IEC 17025 are written in the language relevant to the operations of calibration laboratories. Laboratories that conform to the requirements of this standard, operate generally in accordance with the principles of DIN EN ISO 9001.

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 may be found respectively in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH https://www.dakks.de/en/content/accredited-bodies-dakks.

August-Nagel-Straße 11, 89079 Ulm

On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range			Measurement conditions / procedure	Best measurement capability [1]	Remarks
Force (MTM) *) Force measuring devices of materials testing machines according to DIN 51220	1 N	to	600 kN	DIN EN ISO 7500-1:2018 with supplementary sheet 1 bis 3:1999 supplementary sheet 4:2013 DIN EN ISO 7500-2:2007 DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2: 2018 DIN EN ISO 6508-2:2015 DIN EN ISO 4545-2: 2018 DIN EN ISO 2039-1:2003 DIN EN ISO 14577-2:2015 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017 ASTM E18:2020 ASTM F36:2015 ASTM E4:2020	0.12 %	Force transducer Class 0.5 tensile / compression
	200 N	to	3000 kN		0.12 %	Force transducer Class 0.5 tensile
	200 N	to	5000 kN		0.12 %	Force transducer Class 0.5 compression
	0,02 N	to	200 N		0.10 %	Known masses tensile / tensile and compression
Extension (MTM) *) Extension measuring devices of materials testing machines according to DIN 51220	0 mm	to	60 mm	DIN EN ISO 9513:2013 DIN EN ISO 6508-2:2015 DIN EN ISO 2039-1:2003 DIN EN ISO 14577-2:2015 DIN EN ISO 527-1:2019 ASTM F36:2015 ASTM E83:2016 ASTM E2309:2020	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe (CP60/CT6002)
	0 mm	to	12 mm		$2 \cdot 10^{-3} \cdot l$; but not < 2 µm	Measuring principle: incremental probe (MT 12)
	0 mm	to	12 mm		$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe (MT 1201)
	0 mm	to	205 mm		$2 \cdot 10^{-3} \cdot l$; but not < 5 µm	Measuring principle: probe on basis of magnet technology
	0 mm	to	1500 mm		$2 \cdot 10^{-3} \cdot l$; but not < 4 µm	Measuring principle: Rotary encoder with incremental divide
	1,1 mm	to	100 mm		$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Gauge blocks class 1
Extension (MTM) Extension measuring devices of cross section measuring devices	1,1 mm	to	100 mm	QI-D-010:2019	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Gauge blocks class 1
Extension (MTM) *) Optical indentation measuring devices of Hardness Testers	0 mm	to	6 mm	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 4545-2:2018 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: Object micrometer in incident light
Depth measuring device of Hardness Testers	0 mm	to	0.8 mm	DIN EN ISO 6508-2:2015 ASTM E18:2020	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

August-Nagel-Straße 11, 89079 Ulm

On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Mechanical Work (MTM) *) Pendulum Impact Testers and Impact Testing Devices	0.2 J to 750 J	DIN EN-ISO 148-2:2017 DIN EN ISO 13802:2016 DIN 51222:2017 DIN 53435:2018 DIN 53512:2000 ASTM E23:2018	Force: 0.12 % Pendulum length: 0.17 mm Angle: 0.03° Time: 0.02 s	The measurement uncertainty is calculated for: 1. Position of centre of percussion, 2. Potential energy, 3. Error of the indicated energy.
Hardness (MTM) *) Hardness Testers according to Brinell-, Vickers-, Rockwell-, Knoop- and Martens test procedure	100 HB to 550 HB	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015 DIN EN ISO 4545-2:2018 DIN EN ISO 2039-1:2003 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017 ASTM E18:2020 ASTM F36:2015	2 % HB	The values indicated for the measurement uncertainty are valid for the indirect verification with hardness comparison plates. The measurement uncertainty of the individual parameters of the direct verification is indicated separately. U_{CRM} = calibration uncertainty of the hardness comparison plate
	30 HV to 950 HV (Hardness scales HV5 to HV100) (Hardness scales HV 0.01 to HV3)		1 % HV, but not < 1,5 · U_{CRM} 2 % HV, but not < 1.5 · U_{CRM}	
	100 HK to 950 HK (Hardness scales HK 0.01 to HK 2)		2 % HK, but not < 1.5 · U_{CRM}	
	20 HRA to 65 HRA 66 HRA to 95 HRA		1.0 HRA 0.5 HRA	
	10 HRB to 55 HRB 56 HRB to 100 HRB		1.5 HRB 1.0 HRB	
	20 HRC to 55 HRC 56 HRC to 70 HRC		1.0 HRC 0.5 HRC	
	40 HRD to 69 HRD 70 HRD to 77 HRD		1.5 HRD 1.0 HRD	
	60 HRF to 100 HRF		1.0 HRF	
	20 HRN to 60 HRN 61 HRN to 91 HRN		1.0 HRN 0.5 HRN	
	12 HRT to 93 HRT		2.0 HRT	
Torque (MTM) Torque measuring devices of materials testing machines according to DIN 51220	0.2 N·m to 2000 N·m	QI-D-005: 2018	0.30 %	With torque transducers (clockwise and counterclockwise torque)
	0.02 N·m to 20 N·m		0.30 %	Known masses tensile in combination with lever arm

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Angle of rotation (MTM) Measuring devices for angle of rotation on materials testing machines according to DIN 51220	1° to 360°	QI-D-006: 2018	$3 \cdot 10^{-3} \cdot W$	Measuring principle: incremental *W*: measured angle
Velocity [*)] Traverse speed of materials testing machines according to DIN 51220	0.1 mm/min to 500 mm/min	ASTM E2658:2015	1.0 %	Measuring principle: Start/Stop-Method of distance and time
Temperature [*)] Climate chambers Climate chamber with air circulation in empty or defined loaded usable space	-80 °C to -40 °C	DKD-R 5-7: 2018 Methode C Measurement in air	0.2 K	Comparison with standard thermometers
	> -40 °C to 0 °C		0.15 K	
	> 0 °C to 100 °C		0.10 K	
	> 100 °C to 150 °C		0.15 K	
	> 150 °C to 200 °C		0.25 K	
	> 200 °C to 250 °C		0.35 K	
Climate chamber with air circulation in empty or defined loaded usable space	-80 °C to -40 °C	DKD-R 5-7: 2018 Method A and B Measurement in air	0.5 K	Comparison with standard thermometers
	> -40 °C to 0 °C		0.4 K	
	> 0 °C to 100 °C		0.2 K	
	> 100 °C to 150 °C		0.4 K	
	> 150 °C to 200 °C		0.6 K	
	> 200 °C to 250 °C		1.7 K	
Climate chamber without air circulation in empty or defined loaded usable space	-80 °C to -40 °C	DKD-R 5-7: 2018 Method C Measurement in air	0.5 K	Comparison with standard thermometers
	> -40 °C to 0 °C		0.4 K	
	> 0 °C to 100 °C		0.3 K	
	> 100 °C to 150 °C		0.4 K	
	> 150 °C to 200 °C		0.5 K	
	> 200 °C to 250 °C		0.8 K	

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Temperature [*)] Climate chambers	-80 °C to -40 °C	DKD-R 5-7: 2018 Method A and B Measurement in air	3.0 K	Comparison with standard thermometers
	> -40 °C to 0 °C		2.0 K	
Climate chamber without air circulation in empty or defined loaded usable space	> 0 °C to 100 °C		2.2 K	
	> 100 °C to 150 °C		3.0 K	
	> 150 °C to 200 °C		3.5 K	
	> 200 °C to 250 °C		5.0 K	
Thermocouples with indicator device	150 °C to 300 °C	DKD-R 5-3: 2018 In block calibrator Pegasus	2.8 K	Comparison with standard thermometers
	> 300 °C to 600 °C		3.5 K	
	> 600 °C to 900 °C		4.3 K	
	> 900 °C to 1200 °C		5.5 K	

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1]	Remarks
Force (MTM) *) Force measuring devices of materials testing machines according to DIN 51220	1 N to 600 kN	DIN EN ISO 7500-1:2018 with supplementary sheet 1 bis 3:1999 supplementary 4:2013 DIN EN ISO 7500-2:2007 DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015 DIN EN ISO 4545-2:2018 DIN EN ISO 2039-1:2003 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017 ASTM E18:2020 ASTM F36:2015 ASTM E4:2020	0.12 %	Force transducer Class 0.5 tensile / compression
	200 N to 3000 kN		0.12 %	Force transducer Class 0.5 tensile
	200 N to 5000 kN		0.12 %	Force transducer Class 0.5 compression
	0.02 N to 200 N		0.10 %	Known masses tensile / compression
Extension (MTM) *) Extension measuring devices of materials testing machines according to DIN 51220	0 mm to 60 mm	DIN EN ISO 9513:2013 DIN EN ISO 6508-2:2015 DIN EN ISO 2039-1:2003 DIN EN ISO 527-1:2019 ASTM F36:2015 ASTM E83:2016 ASTM E2309:2020	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe (CP60/CT6002)
	0 mm to 12 mm		$2 \cdot 10^{-3} \cdot l$; but not < 2 µm	Measuring principle: incremental probe (MT 12)
	0 mm to 12 mm		$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe (MT 1201)
	0 mm to 205 mm		$2 \cdot 10^{-3} \cdot l$; but not < 5 µm	Measuring principle: probe on basis of magnet technology
	0 mm to 1500 mm		$2 \cdot 10^{-3} \cdot l$; but not < 4 µm	Measuring principle: Rotary encoder with incremental divide
	1.1 mm to 100 mm		$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Gauge blocks class 1
Extension (MTM) Extension measuring devices of cross section measuring devices	1.1 mm to 100 mm	QI-D-010:2019	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Gauge blocks class 1
Extension (MTM) *) Optical indentation measuring devices of Hardness Testers	0 mm to 6 mm	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 4545-2:2018 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: Object micrometer in incident light

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1]	Remarks
Extension (MTM) *) Depth measuring device of Hardness Testers	0 mm to 0.8 mm	DIN EN ISO 6508-2:2015 ASTM E18:2020	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe
Mechanical Work (MTM) *) Pendulum Impact Testers and Impact Testing Devices	0.2 J to 750 J	DIN EN-ISO 148-2:2017 DIN EN ISO 13802:2016 DIN 51222:2017 DIN 53435:2018 DIN 53512:2000 ASTM E23:2018	Force: 0.12 % Pendulum length: 0.17 mm Angle: 0.03° Time: 0.02 s	The measurement uncertainty is calculated for: 1. Position of centre of percussion, 2. Potential energy, 3. Error of the indicated energy.
Hardness (MTM) *) Hardness Testers according to Brinell-, Vickers-, Knoop-, and Rockwell test procedure	100 HB to 550 HB 30 HV to 950 HV (Hardness scales HV5 to HV100) (Hardness scales HV 0.01 to HV3)	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015 DIN EN ISO 4545-2:2018 DIN EN ISO 2039-1:2003 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017 ASTM E18:2020 ASTM F36:2015	2 % HB 1 % HV, but not < 1,5 · U_{CRM} 2 % HV, but not < 1.5 · U_{CRM}	The values indicated for the measurement uncertainty are valid for the indirect verification with hardness comparison plates. The measurement uncertainty of the individual parameters of the direct verification is indicated separately. U_{CRM} = calibration uncertainty of the hardness comparison plate
	100 HK to 950 HK (Hardness scales HK 0.01 to HK 2)		2 % HK, but not < 1.5 · U_{CRM}	
	20 HRA to 65 HRA 66 HRA to 95 HRA		1.0 HRA 0.5 HRA	
	10 HRB to 55 HRB 56 HRB to 100 HRB		1.5 HRB 1.0 HRB	
	20 HRC to 55 HRC 56 HRC to 70 HRC		1.0 HRC 0.5 HRC	
	40 HRD to 69 HRD 70 HRD to 77 HRD		1.5 HRD 1.0 HRD	
	60 HRF to 100 HRF		1.0 HRF	
	20 HRN to 60 HRN 61 HRN to 91 HRN		1.0 HRN 0.5 HRN	
	12 HRT to 93 HRT		2.0 HRT	

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Force (MTM) [*)] Force measuring devices of materials testing machines according to DIN 51220	1 N to 600 kN	DIN EN ISO 7500-1:2018 with supplementary sheet 1 bis 3:1999 supplementary 4:2013 DIN EN ISO 7500-2:2007 DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015 DIN EN ISO 4545-2:2018 DIN EN ISO 2039-1:2003 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017 ASTM E18:2020 ASTM F36:2015 ASTM E4:2020	0.12 %	Force transducer Class 0.5 tensile / compression
	200 N to 3000 kN		0.12 %	Force transducer Class 0.5 tensile
	200 N to 5000 kN		0.12 %	Force transducer Class 0.5 compression
	0.02 N to 200 N		0.10 %	Known masses tensile / compression
Extension (MTM) [*)] Extension measuring devices of materials testing machines according to DIN 51220	0 mm to 60 mm	DIN EN ISO 9513:2013 DIN EN ISO 6508-2:2015 DIN EN ISO 2039-1:2003 DIN EN ISO 527-1:2019 ASTM E83:2016 ASTM E2309:2020 ASTM F36:2015	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe (CP60/CT6002)
	0 mm to 12 mm		$2 \cdot 10^{-3} \cdot l$; but not < 2 µm	Measuring principle: incremental probe (MT 12)
	0 mm to 12 mm		$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe (MT 1201)
	0 mm to 205 mm		$2 \cdot 10^{-3} \cdot l$; but not < 5 µm	Measuring principle: probe on basis of magnet technology
	0 mm to 1500 mm		$2 \cdot 10^{-3} \cdot l$; but not < 4 µm	Measuring principle: Rotary encoder with incremental divide
	1.1 mm to 100 mm		$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Gauge blocks class 1
Optical indentation measuring devices of Hardness Testers	0 mm to 6 mm	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 4545-2:2018 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: Object micrometer in incident light
Depth measuring device of Hardness Testers	0 mm to 0.8 mm	DIN EN ISO 6508-2:2015 ASTM E18: 2020	$1.5 \cdot 10^{-3} \cdot l$; but not < 0.5 µm	Measuring principle: incremental probe

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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On-site calibration Calibration and measurement capabilities (CMC)

Measured quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1]	Remarks
Mechanical Work (MTM) [*] Pendulum Impact Testers and Impact Testing Devices	0.2 J to 750 J	DIN EN-ISO 148-2:2017 DIN EN ISO 13802: 2016DIN 51222:2017 DIN 53435:2018 DIN 53512:2000 ASTM E23:2018	Force: 0.12 % Pendulum length: 0.17 mm Angle: 0.03° Time: 0.02 s	The measurement uncertainty is calculated for: 1. Position of centre of percussion, 2. Potential energy, 3. Error of the indicated energy.
Hardness (MTM) [*] Hardness Testers according to Brinell-, Vickers-, Knoop-, and Rockwell test procedure	100 HB to 550 HB	DIN EN ISO 6506-2:2019 DIN EN ISO 6507-2:2018 DIN EN ISO 6508-2:2015 DIN EN ISO 4545-2:2018 DIN EN ISO 2039-1:2003 ASTM E10:2018 ASTM E92:2017 ASTM E384:2017 ASTM E18:2020 ASTM F36:2015	2 % HB	The values indicated for the measurement uncertainty are valid for the indirect calibration with hardness comparison plates. The measurement uncertainty of the individual parameters of the direct calibration is indicated separately. (U_{CRM} = calibration uncertainty of the hardness comparison plate)
	30 HV to 950 HV (Hardness scales HV5 to HV100) (Hardness scales HV0.01 to HV3)		1 % HV, but not < 1.5 · U_{CRM} 2 % HV, but not < 1.5 · U_{CRM}	
	100 HK to 950 HK (Hardness scale HK 0.01 to HK 2)		2 % HK, but not < 1.5 · U_{CRM}	
	20 HRA to 65 HRA		1.0 HRA	
	66 HRA to 95 HRA		0.5 HRA	
	10 HRB to 55 HRB		1.5 HRB	
	56 HRB to 100 HRB		1.0 HRB	
	20 HRC to 55 HRC		1.0 HRC	
	56 HRC to 70 HRC		0.5 HRC	
	40 HRD to 69 HRD		1.5 HRD	
	70 HRD to 77 HRD		1.0 HRD	
	60 HRF to 100 HRF		1.0 HRF	
	20 HRN to 60 HRN		1.0 HRN	
	61 HRN to 91 HRN		0.5 HRN	
	12 HRT to 93 HRT		2.0 HRT	

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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	200 N	to	3000 kN		0.12 %	Force transducer Class 0.5 tensile
	200 N	to	5000 kN		0.12 %	Force transducer Class 0.5 compression
	0.02 N	to	200 N		0.10 %	Known masses tensile / compression
Extension (MTM) *) Extension measuring devices of materials testing machines according to DIN 51220	0 mm	to	60 mm	DIN EN ISO 9513:2013 DIN EN ISO 527-1:2019 ASTM E83:2016 ASTM E2309:2020	$1.5 \cdot 10^{-3} \cdot l$; but not <0.5 µm	Measuring principle: incremental probe (CP60/CT6002)
	0 mm	to	12 mm		$2 \cdot 10^{-3} \cdot l$; but not <2 µm	Measuring principle: incremental probe (MT 12)
	0 mm	to	12 mm		$1.5 \cdot 10^{-3} \cdot l$; but not <0.5 µm	Measuring principle: incremental probe (MT 1201)
	0 mm	to	205 mm		$2 \cdot 10^{-3} \cdot l$; but not < 5 µm	Measuring principle: probe on basis of magnet technology
	0 mm	to	1500 mm		$2 \cdot 10^{-3} \cdot l$; but not <4 µm	Measuring principle: Rotary encoder with incremental divide
	1.1 mm	to	100 mm		$1.5 \cdot 10^{-3} \cdot l$; but not <0.5 µm	Gauge blocks class 1
Mechanical Work (MTM) *) Pendulum Impact Testers and Impact Testing Devices	0.2 J	to	750 J	DIN EN-ISO 148-2:2017 DIN EN ISO 13802:2016 DIN 51222:2017 DIN 53435:2018 DIN 53512:2000 ASTM E23:2018	Force: 0.12 % Pendulum length: 0.17 mm Angle: 0.03° Time: 0.02 s	The measurement uncertainty is calculated for: 1. Position of centre of percussion, 2. Potential energy, 3. Error of the indicated energy.

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Abbreviations used:

ASTM	ASTM American Standard for Testing and Materials
CMC	Calibration and measurement capabilities
DIN	Deutsches Institut für Normung e.V. (German Institut for Standardization)
EN	European Standard
ISO	International Organisation for Standardization
QI	Quality Instruction (In house calibration procedure of ZwickRoell GmbH & Co. KG)

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.