

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15133-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 14.12.2021

Date of issue 14.12.2021

Holder of certificate:

Hexagon Metrology GmbH
Hexagon Calibration Services
Siegmund-Hiepe-Straße 2-12, 35578 Wetzlar

Calibration in the fields:

Dimensional quantities

Length

- **Diameter**
- **Length gauges**
- **Lines scales, distance**

Coordinate measuring technology

- **Coordinate measuring machines ^{a)}**
- **Virtual coordinate measuring machines**
- **Step gauges**

^{a)} also on-site-calibration

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>.*

Abbreviations used: see last page

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

Annex to the accreditation certificate D-K-15133-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Coordinate measuring technology Articulated arm coordinate measurement machines using a contacting probing system	Coordinate measuring machines featuring a measuring volume with a diameter of ≤ 4500 mm	Calibration of metrological characteristics according to DKD-R 4-3 part 18.1:2018 guidelines		
		Determination of the length measurement deviation $E_{\text{Uni:0:Tact.AArm}}$ with ball bars/nest bars according to DIN EN ISO 10360-12:2018	Measurement on elements of balls made of ceramics: $2.0 \mu\text{m} + 2.3 \cdot 10^{-6} \cdot l$ Measurement on kinematic seats made of steel: $2.5 \mu\text{m} + 3.7 \cdot 10^{-6} \cdot l$	$l = \text{measured length}$
		Determination of the probing deviation $P_{\text{Form.Sph.1x25:Tact.AArm}}$ according to DIN EN ISO 10360-12:2018	0.05 μm	
		Determination of the probing deviation $P_{\text{Size.Sph.1x25:Tact.AArm}}$ according to DIN EN ISO 10360-12:2018	0.09 μm	
		Determination of the probing deviation $L_{\text{Dia.5x5:Art:Tact.AArm}}$ according to DIN EN ISO 10360-12:2018	0.07 μm	

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 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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Lasertracker	to 35 m	Determination of the length measurement deviation $E_{Vol:0:LT}$ with retro-reflector according to ISO 10360-10:2021	6 μ m	
	to 35 m	Determination of the length measurement deviation with tactile probe according to KAL_LT_02:2021-08 Measurement on calibrated scalebar with two self-centerings	7 μ m	
	to 35 m	Determination of the length measurement deviation with optical scanning probe according to KAL_LT_02:2021-08 Measurement on calibrated scalebar with two spheres	8 μ m	
	to 6 m	Determination of the distance-offset according to KAL_LT_03:2021-08 Linear combination of distance measurements	7 μ m	

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Prismatic workpieces	Coordinate measuring machine with a corresponding calibration procedure for the complete measuring volume: X = 2400 mm Y = 1200 mm Z = 1000 mm (X, Y, Z refer to the convention for coordinate axes defined by the manufacturer) Calibrations are performed with probing elements with a diameter in range 0.3 mm to 30 mm.	Tactile measurement using a calibrated coordinate measuring machine and determination of geometric parameters defined through control geometries (single points, straight lines, planes, circles, balls, cylinders, tapers, toroids) using the evaluation software of the coordinate measuring machine. The measuring points can be captured by single points or scanning. Single-point measuring can be carried out either with fixed, predefined measuring force or with extrapolation to force zero. Excluded are evaluations of gear parameters and free form surfaces and the use of rotary tables in the measuring process. The calibration values can be determined in a substitution and multilayer method by averaging in order to reduce the measurement uncertainty.	The uncertainty of measurement is determined according to ISO/TS 15530-4:2008 „Evaluating task-specific measurement uncertainty using simulation“ using the „Virtual coordinate measuring machine“ method. The measurement uncertainty for bidirectional length measurements on steel artefacts in locations according to DIN EN ISO 10360-2:2010 and in the specified measurement volume is for a central stylus (zero distance between center of the probing ball and the spindle axis) maximum: $U_{E0} = 0.5 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot L$ and for measurements with lateral stylus (150 mm distance between center of the probing ball and the spindle axis) maximum: $U_{E150} = 1.1 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot L$ The smallest applicable measurement uncertainty for bidirectional length measurements on test pieces made of steel and of length L in the specified measuring volume is: $L = 10 \text{ mm} \quad U = 0.2 \mu\text{m}$ $L = 1000 \text{ mm} \quad U = 0.4 \mu\text{m}$ $L = 1540 \text{ mm} \quad U = 0.4 \mu\text{m}$	L = measured length The measurement uncertainty is task-specific. Therefore, no smallest applicable measurement uncertainty can be specified for any measuring tasks. The here specified measurement uncertainties are exemplary for the described measuring tasks. For general measuring tasks referred to the accredited scope, the measuring uncertainty can be significant different. The specified uncertainty in the calibration certificate only refers to the measurement and evaluation strategy. This includes measuring point distribution, filtering of the measured values and outlier elimination. The measurement and evaluation strategy is explicitly documented in the calibration certificate. The dimension of a task-specific measurement uncertainty can be estimated based on the information of a inspection plan. The laboratory can do this before the real measurement starts.

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Prismatic workpieces	Coordinate measuring machines with a calibrated measuring volume of: X = 2400 mm Y = 1200 mm Z = 1000 mm		The measurement uncertainty for diameter and form measurements on a ball made of ceramic with nominal diameter 25 mm, measured in scanning mode and with a measuring strategy according to DIN EN ISO 10360-5:2020, is in the specified measuring volume: for the determination of the form deviation (evaluation to Tschebyschew) $U = 0.2 \mu\text{m}$ for the determination of the diameter (evaluation to Gauß) $U = 0.2 \mu\text{m}$	The stated measurement uncertainties for the scanning mode have been determined in consideration of an wave filter according to DIN EN ISO 16610-21:2013 with a cut-off wavelength of 150 W/U.
Balls Large diameter	1 mm to 50 mm	AA-T5.1-12 010:2020-08 Substitution measurement on a calibrated coordinate measuring machine with tactile single-point measurement	Calculation of the measurement uncertainty using the „Virtual coordinate measuring machine“ method taking account of the substitution effect 0.3 μm	
Balls Diameter	5 mm to 50 mm	AA-T5.1-12 010:2020-08 Substitution measurement on a calibrated coordinate measuring machine with tactile single-point measurement	Calculation of the measurement uncertainty using the „Virtual coordinate measuring machine“ method taking account of the substitution effect 0.3 μm	No circular measurement of the sphere surface (usually measurement of the hemisphere)
Cylindrical setting gauges Diameter	1 mm to 50 mm	AA-T5.1-12 010:2020-08	Calculation of the measurement uncertainty using the „Virtual coordinate measuring machine“ method taking account of the substitution effect 0.3 μm	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Length standards for optical measurement technology	0 mm to 2700 mm	VA-T5.3-01 011:2020-12 Distance measurement with optical sensor on a calibrated coordinate measuring machine. The distance is between symmetrical 2D-structure elements (center of a circle, straight line, reticle). For bars with a length over 2050 mm the measuring range will be extended by a connecting measurement with two overlapping marks on the calibration object. In case of straight lines the distance measurement is carried out from the middle of the line or via a dashed side as a unidirectional distance.	Calculation of the measurement uncertainty with „Virtual coordinate measuring machine“ method	
	0 mm to 995 mm	Axially parallel	$0.85 \mu\text{m} + 1.6 \cdot 10^{-6} \cdot L$	
	> 995 mm to 1800 mm	Axially parallel	$0.90 \mu\text{m} + 2.0 \cdot 10^{-6} \cdot L$	
	> 1800 mm to 2700 mm	Diagonally / Connection measurement	$1.00 \mu\text{m} + 2.4 \cdot 10^{-6} \cdot L$	
Ball plate / Hole plate	to 700 mm	AA-T5.1-13 008:2020-08	Calculation of the measurement uncertainty using the „Virtual coordinate measuring machine“ method taking account of the substitution effect $0.13 \mu\text{m} + 0.72 \cdot 10^{-6} \cdot L$	Distance between two hole and ball center points
Ball bar / Hole bar	to 1100 mm	AA-T5.1-13 008:2020-08	Calculation of the measurement uncertainty using the „Virtual coordinate measuring machine“ method taking account of the substitution effect $0.13 \mu\text{m} + 0.72 \cdot 10^{-6} \cdot L$	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Gauge block made of steel and ceramics according to DIN EN ISO 3650:1999	10 mm to 1000 mm	AA-T5.1-15 007:2020-12 Measurement of the mean size in substitution measurement in comparison with gauge blocks	$0.07 \mu\text{m} + 0.25 \cdot 10^{-6} \cdot L$	L = measured length
Step gauge	to 1020 mm	AA-T5.1-16 007:2021-01 Measurement of the mean size in substitution measurement in comparison with gauge blocks	$0.07 \mu\text{m} + 0.25 \cdot 10^{-6} \cdot L$	

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Coordinate measuring technology Coordinate measuring machines using an optical probing system and control software PC-DMIS of Hexagon Metrology AB	Coordinate measuring machines featuring a measuring volume with a spacial diagonal of $\leq 909 \text{ mm}$	DKD-R 4-3 part 18.1:2018, Calibration of the metrological characteristics of coordinate measuring machines (CMM)		L = measured length
		Determination of the length measurement deviation E_{UX} , E_{UY} and E_{UXY} using line scale according to DIN EN ISO 10360-7:2011.	$0.08 \mu\text{m} + 0.22 \cdot 10^{-6} \cdot L$	
		Determination of the probing deviation P_{F2D} using standard made of glass with circle structure according to DIN EN ISO 10360-7:2011	0.2 μm	
		Determination of the probing deviation P_{FV2D} using standard made of glass with circle structure according to DIN EN ISO 10360-7:2011	0.2 μm	
		Determination of the repeatability range R_U using line scale according to DIN EN ISO 10360-7:2011	0.05 μm	

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On-site Calibration

Calibration and Measurement Capabilities (CMC)				
Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Coordinate measuring machines using a contacting probing system and control software PC-DMIS, Quindos of Hexagon AB	Coordinate measuring machines featuring a measuring volume with a spacial diagonal of ≤ 1500 mm	DKD-R 4-3 part 18.1:2018, Calibration of the metrological characteristics of coordinate measuring machines (CMM)		<i>l</i> = measured length
		Determination of the length measurement deviation E_0 and E_{150} using gauge blocks according to DIN EN ISO 10360-2:2010	$0.05 \mu\text{m} + 0.1 \cdot 10^{-6} \cdot l$	
		Determination of the probing deviation P_{FTU} according to DIN EN ISO 10360-5:2011	$0.05 \mu\text{m}$	
		Determination of the repeatability range R_0 according to DIN EN ISO 10360-2:2010	$0.03 \mu\text{m}$	
Coordinate measuring machines featuring a measuring volume with a spacial diagonal of ≤ 4410 mm	Determination of the length measurement deviation E_0 and E_{150} using step gauges DIN EN ISO 10360-2:2010 and VDI/VDE 2617 part 2.1:2014 (maximum one connection measurement)		for $l \leq$ to 1540 mm $0.06 \mu\text{m} + 0.26 \cdot 10^{-6} \cdot l$	<i>l</i> = measured length
			for $l >$ 1540 mm $0.12 \mu\text{m} + 0.26 \cdot 10^{-6} \cdot l$	
		Determination of the probing deviation P_{FTU} according to DIN EN ISO 10360-5:2011	$0.05 \mu\text{m}$	
		Determination of the repeatability range R_0 according to DIN EN ISO 10360-2:2010	$0.03 \mu\text{m}$	
		Determination of scanning probing deviation THP according to DIN EN ISO 10360-4:2003	$0.1 \mu\text{m}$	

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Abbreviations used:

AA-T	Work instruction of Hexagon Metrology GmbH
CMC	Calibration and measurement capabilities
DIN	Deutsches Institut für Normung e.V.
DKD-R	Guideline of Deutscher Kalibrierdienst (DKD), published by Physikalisch-Technischen Bundesanstalt
VA-T	Handling instruction of Hexagon Metrology GmbH
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.

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