Deutsche Akkreditierungsstelle

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

Valid from: **27.06.2023**

Date of issue: 27.06.2023

Holder of accreditation certificate:

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

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 confirm generally with the principles of DIN EN ISO 9001.

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

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.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [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 error $E_{\mathrm{Uni:0:Tact.AArm}}$ with ball bars/nest bars according to DIN EN ISO 10360-12:2018	Measurement on elements of balls made of ceramics: $2.0\ \mu m + 2.3 \cdot 10^{-6} \cdot l$ Measurement on kinematic seats made of steel: $2.5\ \mu m + 3.7 \cdot 10^{-6} \cdot l$	l = measured length
		Determination of the probing form error $P_{\mathrm{Form.Sph.1x25::Tact.AArm}}$ according to DIN EN ISO 10360-12:2018	0.05 µm	
		Determination of the probing size error $P_{\mathrm{Size.Sph.1x25::Tact.AArm}}$ according to DIN EN ISO 10360-12:2018	0.09 µm	
		Determination of the location error $L_{\mathrm{Dia.5x5:Art:Tact.AArm}}$ according to DIN EN ISO 10360-12:2018	0.07 µm	

[1] Unless otherwise specified, the unit of a variable corresponds to the unit of the measuring range.

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [1]	Remarks
Lasertracker	to 35 m	Determination of the length measurement error $E_{Vol:0:LT}$ with retro-reflector according to ISO 10360-10:2021	6 µm	
	to 35 m	Determination of the length measurement error with tactile probe according to KAL_LT_02:2021-08 Measurement on calibrated scalebar with two self-centerings	7 µm	
	to 35 m	Determination of the length measurement error with optical scanning probe according to KAL_LT_02:2021-08 Measurement on calibrated scalebar with two spheres	8 µm	
	to 6 m	Determination of the distance-offset according to KAL_LT_03:2021-08 Linear combination of distance measurements	7 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [1]	Remarks
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: $U_{E0} = 0.5\ \mu m + 2.5 \cdot 10^{-6} \cdot L$ and for measurements with lateral stylus (150 mm distance between center of the probing ball and the spindle axis) maximum: $U_{E150} = 1.1\ \mu m + 2.5 \cdot 10^{-6} \cdot L$ 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 mm U = 0.2 µm L = 1000 mm U = 0.4 µm L = 1540 mm U = 0.4 µm	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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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [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 µm for the determination of the diameter (evaluation to Gauß) U = 0.2 µm	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 measurement of uncertainty [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 µm + 1.6 · 10^{-6} · L	L = measured length
	> 995 mm to 1800 mm	Axially parallel	0.90 µm + 2.0 · 10^{-6} · L	
	> 1800 mm to 2700 mm	Diagonally / Connection measurement	1.00 µm + 2.4 · 10^{-6} · 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 µm + 0.72 · 10^{-6} · 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 µm + 0.72 · 10^{-6} · L	

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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 µm + 0.25 · 10^{-6} · 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 µm + 0.25 · 10^{-6} · L	

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [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 ≤ 909 mm	DKD-R 4-3 part 18.1:2018, Calibration of the metrological characteristics of coordinate measuring machines (CMM)		
		Determination of the length measurement error E_{UX}, E_{UY} and E_{UXY} using line scale according to DIN EN ISO 10360-7:2011.	0.08 µm + 0.22 · 10^{-6} · L	L = measured length
		Determination of the probing deviation P_{F2D} using standard made of glass with circle structure according to DIN EN ISO 10360-7:2011	0.24 µm	
		Determination of the probing deviation P_{FV2D} using standard made of glass with circle structure according to DIN EN ISO 10360-7:2011	0.24 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

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [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)		
		Determination of the length measurement error E_0 and E_{150} using gauge blocks according to DIN EN ISO 10360-2:2010	0.05 µm + 0.1 · 10^{-6} · l	l = measured length
		Determination of the repeatability range R_0 according to DIN EN ISO 10360-2:2010	0.03 µm	
	Coordinate measuring machines featuring a measuring volume with a spacial diagonal of ≤ 4410 mm	Determination of the length measurement error 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 ≤ to 1540 mm 0.06 µm + 0.26 · 10^{-6} · l for l > 1540 mm 0.12 µm + 0.26 · 10^{-6} · l	
		Determination of the repeatability range R_0 according to DIN EN ISO 10360-2:2010	0.03 µm	
		Determination of single-stylus form error $P_{\text{Form.Sph.1x25:SS:Tact}}$ according to DIN EN ISO 10360-5:2020	0.05 µm	
		Determination of single-stylus size error $P_{\text{Size.Sph.1x25:SS:Tact}}$ according to DIN EN ISO 10360-5:2020	0.09 µm	
		Determination of scanning mode form error $P_{\text{Form.Sph.Scan:PP:Tact}}$ according to DIN EN ISO 10360-5:2020	0.09 µm	
		Determination of scanning mode size error $P_{\text{Size.Sph.Scan:PP:Tact}}$ according to DIN EN ISO 10360-5:2020	0.09 µm	

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On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded measurement of uncertainty [1]	Remarks
		Determination of scanning mode time $\tau_{Sph.Scan:PP:Tact}$ according to DIN EN ISO 10360-5:2020	20 ms	

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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