

Annex to declaration of accreditation (scope of accreditation)  
 Normative document: EN ISO/IEC 17025:2017  
 Registration number: **K 018**

of **TRESCAL Hengelo B.V.**  
**Calibration Laboratory**

This annex is valid from: **02-10-2024** to **01-12-2024**

Replaces annex dated: **12-06-2024**

**Location(s) where activities are performed under accreditation**

**Head Office**

Joseph Schumpeterstraat 10  
 7559 SG  
 Hengelo  
 The Netherlands

Location	Abbreviation/ location code
Joseph Schumpeterstraat 10 7559 SG Hengelo The Netherlands	HLO
On site	OS

HCS code	Measured quantity, Instrument, Measure	Range	CMC <sup>1</sup>	Remarks	Location
DM 0 0	DIMENSIONAL QUANTITIES				
DM 1 0	Gauge blocks				HLO
	Gauge blocks, steel	0.5 mm – 100 mm 0.02 inch – 4 inch	0.06 μm + 1.2·10 <sup>-6</sup> /	Central length, fixed sizes	
	Gauge blocks, tungsten carbide	0.5 mm – 100 mm 0.02 inch – 4 inch	0.06 μm + 0.7·10 <sup>-6</sup> /	Central length, fixed sizes	
	Gauge blocks, ceramic	0.5 mm – 100 mm 0.02 inch – 4 inch	0.06 μm + 1.0·10 <sup>-6</sup> /	Central length, fixed sizes	

This annex has been approved by the Board of the Dutch Accreditation Council, on its behalf,

J.A.W.M. de Haas

<sup>1</sup> Calibration and Measurement Capability (CMC): Demonstrated measurement uncertainty, with coverage probability of 95%, in a given measurement point or measurement range. Measurement uncertainty, *U*, is calculated according to EA-4/02 "Expression of the Uncertainty of Measurement in Calibration".

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	Gauge blocks, steel / tungsten carbide / ceramic		$0.05 \mu\text{m} + 0.1 \cdot 10^{-6} \cdot l$	Length variation	
	Step gauge	up to 1000 mm	$1.2 \mu\text{m} + 6.0 \cdot 10^{-6} \cdot l$		
DM 1 0	Length gauges			Comparative measure	HLO
	Steel	125 mm – 500 mm	$0.2 \mu\text{m} + 3 \cdot 10^{-6} \cdot l$		
DM 2 0	Line scales, distances				HLO
	Rulers (all models)	up to 300 mm	$0.8 \mu\text{m} + 4 \cdot 10^{-6} \cdot l$		
		up to 600 mm	$1.1 \mu\text{m} + 4 \cdot 10^{-6} \cdot l$		
		up to 3000 mm	$6 \mu\text{m} + 5 \cdot 10^{-6} \cdot l$		
		up to 100 m	$6 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
DM 3 0	Length measuring instruments				HLO, OS
	1D-measuring machines <sup>(i)</sup>			Laser interferometer; machine equipped with	
		up to 20 m	$0.15 \mu\text{m} + 0.7 \cdot r + 1.0 \cdot 10^{-6} \cdot l$	Zerodur scales	
		up to 20 m	$0.15 \mu\text{m} + 0.7 \cdot r + 1.3 \cdot 10^{-6} \cdot l$	Glass scales	
		up to 20 m	$0.15 \mu\text{m} + 0.7 \cdot r + 1.6 \cdot 10^{-6} \cdot l$	Steel scales	
		up to 400 mm	$0.3 \mu\text{m} + 0.7 \cdot r + 3 \cdot 10^{-6} \cdot l$	Optical systems	
		up to 700 mm	$0.05 \mu\text{m} + 0.5 \cdot 10^{-6} \cdot l + S$	Using special gauge blocks	

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	Handheld tools for external measurements	0 mm – 200 mm	$0.45 \mu\text{m} + 0.5 \cdot r + 25 \cdot 10^{-6} \cdot l$	e.g. vernier, micrometer	
		200 mm – 2000 mm	$4 \mu\text{m} + 0.5 \cdot r + 5 \cdot 10^{-6} \cdot l$		
	Handheld tools for internal measurements (2-point)	0 mm – 200 mm	$0.7 \mu\text{m} + 0.5 \cdot r + 25 \cdot 10^{-6} \cdot l$	e.g. vernier, internal micrometer	
		200 mm – 400 mm	$5 \mu\text{m} + 0.5 \cdot r + 4 \cdot 10^{-6} \cdot l$		
	Handheld tools for internal measurements (2- and 3-point)	1 mm – 250 mm	$1.5 \mu\text{m} + 0.5 \cdot r + 25 \cdot 10^{-6} \cdot l$	e.g. internal micrometers	
	Handheld tools for height- and depth measurements	0 mm – 200 mm	$0.7 \mu\text{m} + 0.5 \cdot r + 25 \cdot 10^{-6} \cdot l$	e.g. (depth) vernier	
		200 mm – 500 mm	$4 \mu\text{m} + 0.5 \cdot r + 5 \cdot 10^{-6} \cdot l$		
	Linear displacement sensor	up to 200 mm	$0.05 \mu\text{m} + 0.7 \cdot r + 2.5 \cdot 10^{-6} \cdot l + S$	e.g. dial gauge	
		200 mm – 300 mm	$0.7 \mu\text{m} + 0.7 \cdot r + 3.5 \cdot 10^{-6} \cdot l$	e.g. dial gauge	HLO
	Height gauge	up to 1500 mm	$0.8 \mu\text{m} + 0.7 \cdot r + 2.5 \cdot 10^{-6} \cdot l$		HLO, OS
	Inside micrometer	up to 300 mm	$0.7 \mu\text{m} + 0.7 \cdot r + 2.5 \cdot 10^{-6} \cdot l$		
		300 mm – 1000 mm	$0.4 \mu\text{m} + 0.7 \cdot r + 2 \cdot 10^{-6} \cdot l$		
		1000 mm – 3000 mm	$0.4 \mu\text{m} + 0.7 \cdot r + 2 \cdot 10^{-6} \cdot l$		HLO
	Film thickness gauge	up to 25 mm	$0.6 \mu\text{m} + 0.7 \cdot r + 22 \cdot 10^{-6} \cdot l$		
	Laser distance meter	up to 25 m	$0.5 \text{ mm} + 40 \cdot 10^{-6} \cdot l + 0.6 \cdot r$		

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DM 4 0	Diameter, length				HLO
	Setting rings and ring gauges	Ø 1 mm – 4 mm	$1.2 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
		Ø 4 mm – 200 mm	$1.0 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		
		Ø 200 mm – 500 mm	$1.2 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
	Pin gauge	up to Ø 300 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		
	Plug gauge	up to Ø 300 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		
	Thread wires	up to Ø 20 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		
	Other external diameters	up to Ø 100 mm	$0.5 \mu\text{m} + (1+6 \cdot \Delta T) \cdot 10^{-6} \cdot l$		HLO, OS
		up to Ø 300 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		HLO
	Other internal diameters	Ø 1 mm – 4 mm	$1.2 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
		Ø 4 mm – 200 mm	$1.0 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		
		Ø 200 mm – 500 mm	$1.2 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
	Feeler gauges	up to 5 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		
	Setting gauges for micrometers	up to 300 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		HLO, OS
		300 mm – 1000 mm	$0.4 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		HLO, OS
		1000 mm – 3000 mm	$0.4 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		HLO
	Other distances for parallel faces	up to 300 mm	$0.8 \mu\text{m} + 2.5 \cdot 10^{-6} \cdot l$		HLO, OS
		300 mm – 1000 mm	$0.4 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		HLO, OS
		1000 mm – 3000 mm	$0.4 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		HLO
	Conical (taper) ring and pin	Ø 1 mm – 500 mm	$1.8 \mu\text{m} + 0.4 \cdot 10^{-6} \cdot l$	$h \leq 390 \text{ mm}$	HLO

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DM 5 0	Form error				
	Roundness in- and externally	Ø 1 mm – 500 mm	$0.05 \mu\text{m} + 0.01 \cdot A$	A=roundness deviation	HLO
	Roundness testers and other instruments for measuring roundness		$0.04 \mu\text{m} + 0.5 \cdot r$	<sup>(i)</sup>	HLO, OS
	Knife edge straight edge	up to 100 mm	0.25 $\mu\text{m}$		
		100 mm – 300 mm	0.6 $\mu\text{m}$		
		300 mm – 500 mm	0.7 $\mu\text{m}$		
	Straight edge	up to 10 m	$0.4 \mu\text{m} + 0.25 \cdot 10^{-6} \cdot l$		
	Surface plate	Up to 6 x 10 m <sup>2</sup>	$0.2 \mu\text{m} + 1.5 \cdot 10^{-6} \cdot l$	l = longest side of the surface plate	
	Flick standard (roundness standard)		0.15 $\mu\text{m}$		HLO
DM 6 0	Roughness <sup>(i)</sup>				
	Surface texture measuring instruments	Ra up to 5 $\mu\text{m}$	$0.01 \mu\text{m} + 0.02 \cdot A + 0.5 \cdot r + S$	A = Ra-value of reference	HLO, OS
		Rz up to 10 $\mu\text{m}$	$0.01 \mu\text{m} + 0.05 \cdot A + 0.5 \cdot r + S$	A = Rz-value of reference	
		Rt Rmax up to 10 $\mu\text{m}$	$0.01 \mu\text{m} + 0.05 \cdot A + 0.5 \cdot r + S$	A = Rt Rmax-value of reference	
	Roughness standards	Ra up to 10 $\mu\text{m}$	$0.015 \mu\text{m} + 0.045 \cdot A$	A = measured Ra-value	HLO
		Rz up to 15 $\mu\text{m}$	$0.025 \mu\text{m} + 0.07 \cdot A$	A = measured Rz-value	
		Rt (Rmax) up to 15 $\mu\text{m}$	$0.025 \mu\text{m} + 0.07 \cdot A$	A = measured Rt (Rmax)-value	
	Groove depth (-standaard)	up to 6 mm	$0.05 \mu\text{m} + 0.007 \cdot A$	A = measured profile height	HLO

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DM 7 0	Thread quantities external			e.g. screw plug gauge	HLO
	Pitch	up to 10 mm	2 µm		
	Profile angle	up to 180°	(0.2 + 9/L) arcmin		
	Simple pitch diameter	Ø 1 mm – 300 mm	α = 30°: (6.0 – 7.5) µm	According to Euramet/CG-10/V.02, method 1a or 1b	
		Ø 1 mm – 300 mm	α = 55° 60°: (3.2 – 4.1) µm		
		Ø 1 mm – 300 mm	α = 90°: (2.6 – 3.4) µm		
	Pitch diameter	Ø 1 mm – 300 mm	α = 30°: (6.0 – 7.5) µm	According to Euramet/CG-10/V.02, method 2a, 2b or 3	
		Ø 1 mm – 300 mm	α = 55° 60°: (3.2 – 4.1) µm		
		Ø 1 mm – 300 mm	α = 90°: (2.6 – 3.4) µm		
DM 7 0	Thread quantities				HLO
	Thread quantities measured with master scanner ( <i>Thread trapezium excluded</i> )			Method 4 according to TCGM – 04.05 d = nominal diameter α = flank angle P = pitch Cylindrical & Conical thread	
	Thread plug gauges (external thread) outside, core diameter pitch diameter	Ø 2 mm – 90 mm Ø 2 mm – 90 mm	1.5 µm + 5·10 <sup>-6</sup> ·/ 2.5 µm + 10·10 <sup>-6</sup> ·/ 4.5 µm + 10·10 <sup>-6</sup> ·/	α ≥ 27° α < 27°	
	Thread ring gauges (internal thread) outside, core diameter pitch diameter	Ø 3 mm – 100 mm Ø 3 mm – 100 mm	1.5 µm + 10·10 <sup>-6</sup> ·/ 2.5 µm + 10·10 <sup>-6</sup> ·/ 4.5 µm + 10·10 <sup>-6</sup> ·/	α ≥ 27° α < 27°	

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DM 7 0	Thread quantities internal			e.g. screw ring gauge	HLO
	Pitch	up to 10 mm	2 µm		
	Profile angle	up to 180°	(0.2 + 9/L) arcmin	Measurement on cast	
	Simple pitch diameter	∅ 4 mm – 200 mm	α = 30°: (9 – 14) µm	According to Euramet/CG-10/V.02, method 1a or 1b	
		∅ 4 mm – 200 mm	α = 55° 60°: (3.6 – 7) µm		
		∅ 4 mm – 200 mm	α = 90°: (3.1 – 6.2) µm		
	Pitch diameter	∅ 4 mm – 200 mm	α = 30°: (9 – 14) µm	According to RvA-I-4.05, Euramet/CG-10/V.02, method 2a, 2b or 3	
		∅ 4 mm – 200 mm	α = 55° 60°: (3.6 – 7) µm		
		∅ 4 mm – 200 mm	α = 90°: (3.1 – 6.2) µm		
DM 8 0	Combined instruments <sup>(i)</sup>				HLO, OS
	1D-, 2D- en 3D-measuring machines	up to 20 m	0.15 µm + 0.7·r + 1.0·10 <sup>-6</sup> ·l	Laser interferometer, Zerodur scales	
		up to 20 m	0.15 µm + 0.7·r + 1.3·10 <sup>-6</sup> ·l	Laser interferometer, glass scales	
		up to 20 m	0.15 µm + 0.7·r + 1.6·10 <sup>-6</sup> ·l	Laser interferometer, steel scales	
		up to 400 mm	0.3 µm + 0.7·r + 2.3·10 <sup>-6</sup> ·l	Optical systems	
		up to 700 mm	0.05 µm + 0.5·10 <sup>-6</sup> ·l + S	Using special gauge blocks	
	Deviation of nominal displacement	up to 20 m	0.15 µm + 0.7·r + 1.0·10 <sup>-6</sup> ·l	Laser interferometer, Zerodur scales	
		up to 20 m	0.15 µm + 0.7·r + 1.3·10 <sup>-6</sup> ·l	Laser interferometer, glass scales	

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		up to 20 m	$0.15 \mu\text{m} + 0.7 \cdot r + 1.6 \cdot 10^{-6} \cdot l$	Laser interferometer, steel scales	
		up to 400 mm	$0.3 \mu\text{m} + 0.7 \cdot r + 2.3 \cdot 10^{-6} \cdot l$	Optical systems	
		up to 700 mm	$0.05 \mu\text{m} + 0.5 \cdot 10^{-6} \cdot l + S$	Using special gauge blocks	
	Deviations transverse to the translation directions	up to 0.5 mm	$0.1 \mu\text{m} + 3 \cdot 10^{-6} \cdot l + 0.005 \cdot A$	A = measured deviation; measuring length up to 3000 mm	
	Rotational deviations around the translation direction	up to 400 arcsec	$0.5 \text{ arcsec} + 0.0035 \cdot H$	H = measured angle; only horizontal translations	
		up to 2000 $\mu\text{m}/\text{m}$	$2.5 \mu\text{m}/\text{m} + 0.0035 \cdot H$		
		up to 400 arcsec	$1.6 \text{ arcsec} + 0.007 \cdot H$	Up to 2000 mm translation; ceramic straight edge and 2 displacement sensors	
		up to 2000 $\mu\text{m}/\text{m}$	$8 \mu\text{m}/\text{m} + 0.007 \cdot H$		
	Other rotational deviations	up to 7200 arcsec	$0.5 \text{ arcsec} + 0.0016 \cdot H$	H = measured angle, translation up to 20 m	
	Translation deviation along a rotational axis		0.025 $\mu\text{m}$		
	Parallelism of a rotation and a translation	translation up to 500 mm	1 arcsec		
	Squareness of 2 translations	up to 500 x 500 mm <sup>2</sup>	1 arcsec	Ceramic square and displacement sensor	
		up to 500 x 500 mm <sup>3</sup>	0.6 arcsec		Ceramic square and measurement system op measuring machine; reversal method
	Squareness of a rotation and a translation	translation up to 150 mm	0.07 $\mu\text{m}$		
		translation up to 300 mm	0.7 $\mu\text{m}$		



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DM 8 0	Coordinate Measuring Machines X, Y and Z axis			using calibration fixture (steppauge) measuring (reference).	HLO, OS
		max. 1000 mm	$0.95 \mu\text{m} + 0.5 \cdot 10^{-6} \cdot l$	Measurement uncertainty steel reference and glass ruler.	
		max. 2000 mm	$1.0 \mu\text{m} + 0.8 \cdot 10^{-6} \cdot l$	Measurement uncertainty steel reference and glass ruler.	
		max. 100 mm	$0.6 \mu\text{m}$	Measurement uncertainty steel reference and zerodur ruler.	
		max. 500 mm	$1.2 \mu\text{m} + 0.65 \cdot 10^{-6} \cdot l$	Measurement uncertainty steel reference and zerodur ruler.	
DM 8 0	Focus variation measuring machine	0 – 360 mm	$0.5 \mu\text{m} + 0.5 \cdot 10^{-6} \cdot l$		OS
DM 8 1	Tools, products				HLO
	Surface profiles	up to 6 x 120 mm <sup>2</sup>	$0.05 \mu\text{m} + 0.007 \cdot A$	A = measured profile height	
	Roughness	Ra: up to 10 μm	$0.015 \mu\text{m} + 0.045 \cdot A$	A = measured Ra-value	
		Rz: up to 15 μm	$0.025 \mu\text{m} + 0.07 \cdot A$	A = measured Rz-value	
		Rt, Rmax: up to 15 μm	$0.025 \mu\text{m} + 0.07 \cdot A$	A = measured Rt, Rmax-value	
	Straightness	up to 6 x 120 mm <sup>2</sup>	$0.05 \mu\text{m} + 0.007 \cdot A$	A = measured profile height	
		up to 100 mm	$0.25 \mu\text{m}$		
		100 mm – 300 mm	$0.6 \mu\text{m}$		

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		300 mm – 500 mm	0.7 µm		
		up to 1000 mm	1.3 µm + 2·10 <sup>-6</sup> ·l		
		up to 10 m	0.5 µm + 0.5·10 <sup>-6</sup> ·l	-	HLO, OS
	Roundness external	up to Ø 500 mm	0.05 µm + 0.01·A	A = measured roundness	HLO
	Roundness internal	Ø 0.7 mm – 500 mm	0.05 µm + 0.01·A	A = measured roundness	
	Cylindricity	up to Ø 500 and up to height 100 mm	0.5 µm + 1.1·10 <sup>-6</sup> ·H + 0.01·A	A = measured cylindricity H = height cylinder	
		up to Ø 500 and up to height 500 mm	1.1 µm + 2·10 <sup>-6</sup> ·H + 0.01·A		
	Coaxiality and concentricity	up to Ø 500 and up to height 500 mm	0.1 µm + 0.02·A	A = measured coaxiality / concentricity	
	Flatness	up to Ø 60 mm	0.04 µm		
		up to Ø 145 mm	0.06 µm		
		up to Ø 300 mm	0.6 µm		
		up to 6 x 10 m <sup>2</sup>	0.2 µm + 1.5·10 <sup>-6</sup> ·l		HLO, OS
	Angles between sides or planes	up to 180°	(0.2 + 9/A) arcmin	A = leg length; leg length up to 200 mm	HLO
	Diameter external	up to Ø 300 mm	0.8 µm + 2.5·10 <sup>-6</sup> ·l		
		up to Ø 100 mm	0.5 µm + (1 + 6·ΔT)·10 <sup>-6</sup> ·l		HLO, OS
		Ø 300 mm – 500 mm	1.2 µm + 6·10 <sup>-6</sup> ·l		HLO
	Diameter internal	Ø 1 mm – 4 mm	1.2 µm + 6·10 <sup>-6</sup> ·l		
		Ø 4 mm – 200 mm	1.0 µm + 2·10 <sup>-6</sup> ·l		
		Ø 200 mm – 500 mm	1.2 µm + 6·10 <sup>-6</sup> ·l		
DM 8 1	Tools, products	Distance of 2 parallel planes			HLO
	External	up to 300 mm	0.8 µm + 2.5·10 <sup>-6</sup> ·l		

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		up to 100 mm	$0.5 \mu\text{m} + (1 + 6 \cdot \Delta T) \cdot 10^{-6} \cdot l$		HLO, OS
		300 mm – 3000 mm	$0.4 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		HLO
	Internal	Ø 1 mm – 4 mm	$1.2 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
		Ø 4 mm – 200 mm	$1.0 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$		
		Ø 200 mm – 500 mm	$1.2 \mu\text{m} + 6 \cdot 10^{-6} \cdot l$		
DM 8 1	Tools, products	Thread external			HLO
	Pitch	up to 10 mm	2 µm		
	Profile angle	up to 180°	$(0.2 + 9/L)$ arcmin		
	Simple pitch diameter	Ø 1 mm – 300 mm	$\alpha = 30^\circ:$ $(6.0 - 7.5) \mu\text{m}$	According to Euramet/CG-10 V 2.0, method 1a or 1b	
		Ø 1 mm – 300 mm	$\alpha = 55^\circ 60^\circ:$ $(3.2 - 4.1) \mu\text{m}$		
		Ø 1 mm – 300 mm	$\alpha = 90^\circ:$ $(2.6 - 3.4) \mu\text{m}$		
	Pitch diameter	Ø 1 mm – 300 mm	$\alpha = 30^\circ:$ $(6.0 - 7.5) \mu\text{m}$	According to Euramet/CG-10 V 2.0, method 2a, 2b or 3	
		Ø 1 mm – 300 mm	$\alpha = 55^\circ 60^\circ:$ $(3.2 - 4.1) \mu\text{m}$		
		Ø 1 mm – 300 mm	$\alpha = 90^\circ:$ $(2.6 - 3.4) \mu\text{m}$		
	Simple pitch diameter	Ø 4 mm – 100 mm	$\alpha = 30^\circ:$ (9 – 14) µm	According to Euramet/CG-10 V 2.0, method 1a or 1b	
		Ø 4 mm – 100 mm	$\alpha = 55^\circ 60^\circ:$ $(3.6 - 7) \mu\text{m}$		
		Ø 4 mm – 100 mm	$\alpha = 90^\circ:$ (3.1 – 6) µm		
	Pitch diameter	Ø 4 mm – 100 mm	$\alpha = 30^\circ:$ (9 – 14) µm	According to Euramet/CG-10 V 2.0, method 2a, 2b or 3	
		Ø 4 mm – 100 mm	$\alpha = 55^\circ 60^\circ:$ $(3.6 - 7) \mu\text{m}$		
		Ø 4 mm – 100 mm	$\alpha = 90^\circ:$ (3.1 – 6) µm		

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DM 9 0	Angle measurement				HLO
	Angle gauge block	0° – 180°	2 arcsec		
	Cylindrical square	up to Ø 300 mm, up to height 500 mm	$0.9 \mu\text{m} + 2.1 \cdot 10^{-6} \cdot l + 0.02 \cdot A$	A = measured squareness	
	Square	up to 500 mm leg length	$0.7 \mu\text{m} + 2.2 \cdot 10^{-6} \cdot l + 0.02 \cdot A$	A = measured squareness	
	Angle plate	90°	0.5 arcsec		
	Autocollimator	up to 12.5 mm/m	$0.5 \mu\text{m}/\text{m} + 0.001 \cdot H + 0.7 \cdot r$		
		up to 2600 arcsec	$0.1 \text{ arcsec} + 0.001 \cdot H + 0.7 \cdot r$		
	Spirit level	up to 12.5 mm/m	$0.5 \mu\text{m}/\text{m} + 0.001 \cdot H + 0.7 \cdot r$		
		up to 2600 arcsec	$0.1 \text{ arcsec} + 0.001 \cdot H + 0.7 \cdot r$		
DM 9 1	Angle measurement				HLO
	Leveling instruments		0.01 mm/m		
DM 9 2	Angle measurement				HLO
	Polygon	up to 360°	0.5 arcsec		
	Pentagon prism	90°	0.5 arcsec		
DM 9 3	Angle measurement				HLO, OS
	Deviation of the nominal rotation	360°	$0.9 \text{ arcsec} + 0.7 \cdot r$	f.i. rotary heads and rotary table	
DM 9 4	Angle measurement				HLO, OS
	Clinometer	up to 360°	5 arcsec		

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HCS code	Measured quantity, Instrument, Measure	Range	CMC <sup>1</sup>	Remarks	Location
MW 1 0	MASS AND WEIGHT				HLO, OS
MW 1 2	Weighing instruments	1 mg – 33 kg	$2.5 \cdot 10^{-5} \cdot m + \text{last digit} + h/2$	h = Repeatability	
		1 mg – 2500 kg	$6 \cdot 10^{-5} \cdot m + \text{last digit} + h/2$	h = Repeatability	

HCS code	Measured quantity, Instrument, Measure	Frequency	CMC <sup>1</sup>	Remarks	Location
LF 0 0	DC/LF ELECTRICITY				
LF 1 0	Direct voltage				HLO, OS
	0 mV – 200 mV		$1.0 \cdot 10^{-5} \cdot U$ , minimum 0.15 $\mu$ V	Measuring	
	0.2 V – 2 V		$7 \cdot 10^{-6} \cdot U$	Measuring	
	2 V – 20 V		$5 \cdot 10^{-6} \cdot U$	Measuring	
	20 V – 200 V		$7 \cdot 10^{-6} \cdot U$	Measuring	
	200 V – 1000 V		$8 \cdot 10^{-6} \cdot U$	Measuring	
	0 mV – 220 mV		$2.0 \cdot 10^{-5} \cdot U$ , minimum 1.5 $\mu$ V	Generate	
	0.22 V – 2.2 V		$7 \cdot 10^{-6} \cdot U$	Generate	
	2.2 V – 22 V		$1.0 \cdot 10^{-5} \cdot U$	Generate	
	22 V – 220 V		$1.5 \cdot 10^{-5} \cdot U$	Generate	
	220 V – 1100 V		$1.0 \cdot 10^{-5} \cdot U$	Generate	
LF 2 0	Direct current				HLO, OS
	1 $\mu$ A – 200 $\mu$ A		$1 \cdot 10^{-4} \cdot I$ , minimum 0.5 nA	Measuring	
	200 $\mu$ A – 20 mA		$3 \cdot 10^{-5} \cdot I$	Measuring	

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	20 mA – 200 mA		$7 \cdot 10^{-5} \cdot I$	Measuring	
	0.2 A – 2 A		$2.5 \cdot 10^{-4} \cdot I$	Measuring	
	2 A – 20 A		$6 \cdot 10^{-4} \cdot I$	Measuring	
	0 $\mu$ A – 220 mA		$1.0 \cdot 10^{-4} \cdot I$ , minimum 0.5 nA	Generate compliance < 0,5 V	
	0.22 A – 2.2 A		$1 \cdot 10^{-4} \cdot I$	Generate compliance < 0,5 V	
	2.2 A – 20 A		$2.0 \cdot 10^{-4} \cdot I$	Generate compliance < 0,5 V	
	20 A – 1000 A		$5 \cdot 10^{-3} \cdot I$	Generate, with coils	
LF 3 0	Alternating voltage				HLO, OS
	10 mV – 200 mV	20 Hz – 20 kHz	$1.4 \cdot 10^{-3} \cdot U$	Measuring	
	10 mV – 200 mV	20 kHz – 100 kHz	$4 \cdot 10^{-3} \cdot U$	Measuring	
	0.2 V – 2 V	20 Hz – 10 kHz	$2.0 \cdot 10^{-4} \cdot U$	Measuring	
	0.2 V – 2 V	10 kHz – 100 kHz	$1.0 \cdot 10^{-3} \cdot U$	Measuring	
	2 V – 20 V	20 Hz – 10 kHz	$1.6 \cdot 10^{-4} \cdot U$	Measuring	
	2 V – 20 V	10 kHz – 100 kHz	$1 \cdot 10^{-3} \cdot U$	Measuring	
	20 V – 200 V	20 Hz – 10 kHz	$1.6 \cdot 10^{-4} \cdot U$	Measuring	
	20 V – 200 V	10 kHz – 100 kHz	$1 \cdot 10^{-3} \cdot U$	Measuring	
	200 V – 1000 V	55 Hz – 10 kHz	$2.0 \cdot 10^{-4} \cdot U$	Measuring	
	200 V – 1000 V	10 kHz – 30 kHz	$1.0 \cdot 10^{-3} \cdot U$	Measuring	
	1 kV – 100 kV	50 Hz	$1.0 \cdot 10^{-3} \cdot U$	Measuring	
	2.2 mV – 22 mV	40 Hz – 20 kHz	$5 \cdot 10^{-4} \cdot U$	Generate	
	22 mV – 220 V	40 Hz – 20 kHz	$1.0 \cdot 10^{-4} \cdot U$	Generate	
	220 V – 1100 V	40 Hz – 1 kHz	$1.0 \cdot 10^{-4} \cdot U$	Generate	

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HCS code	Measured quantity, Instrument, Measure	Frequency	CMC <sup>1</sup>	Remarks	Location
LF 4 0	Alternating current				HLO, OS
	10 µA – 100 µA	55 Hz – 1 kHz	$4 \cdot 10^{-3} \cdot I$	Measuring	
	100 µA – 200 mA	55 Hz – 1 kHz	$6 \cdot 10^{-4} \cdot I$	Measuring	
	0.2 A – 2 A	55 Hz – 1 kHz	$1.0 \cdot 10^{-3} \cdot I$	Measuring	
	2 A – 20 A	55 Hz – 1 kHz	$1.3 \cdot 10^{-3} \cdot I$	Measuring	
	20 A – 600 A	50 Hz	$6 \cdot 10^{-4} \cdot I$	Measuring	
	100 µA – 220 mA	40 Hz – 1 kHz	$2.0 \cdot 10^{-4} \cdot I$	Generate	
	0.22 A – 2.2 A	40 Hz – 1 kHz	$3 \cdot 10^{-4} \cdot I$	Generate	
	2.2 A – 20 A	40 Hz – 440 Hz	$1.0 \cdot 10^{-3} \cdot I$	Generate	
	20 A – 1000 A	45 – 60 Hz	$5 \cdot 10^{-3} \cdot I$	Generate, with coils Calibration of clamps	HLO
	20 A – 200 A	60 – 440 Hz	$7.5 \cdot 10^{-3} \cdot I$	Generate, with coils Calibration of clamps	HLO
LF 6 1	Resistance				HLO, OS
	100 µΩ – 1 mΩ		$3 \cdot 10^{-4} \cdot R$	Measuring	
	1 mΩ – 100 mΩ		$1.5 \cdot 10^{-4} \cdot R$	Measuring	
	100 mΩ – 1 Ω		$5 \cdot 10^{-5} \cdot R$	Measuring	
	1 Ω – 2 Ω		$3.0 \cdot 10^{-5} \cdot R$	Measuring	
	2 Ω – 2 kΩ		$1.3 \cdot 10^{-5} \cdot R$	Measuring	
	2 kΩ – 20 kΩ		$1.1 \cdot 10^{-5} \cdot R$	Measuring	
	20 kΩ – 2 MΩ		$1.2 \cdot 10^{-5} \cdot R$	Measuring	
	2 MΩ – 20 MΩ		$3.6 \cdot 10^{-5} \cdot R$	Measuring	
	20 MΩ – 200 MΩ		$2.8 \cdot 10^{-4} \cdot R$	Measuring	
	200 MΩ – 2 GΩ		$3.0 \cdot 10^{-3} \cdot R$	Measuring	

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HCS code	Measured quantity, Instrument, Measure	Frequency	CMC <sup>1</sup>	Remarks	Location
LF 6 1	Resistance				HLO, OS
	0 Ω		70 μΩ	Generate	
	100 μΩ, 1 mΩ, 10 mΩ		1·10 <sup>-4</sup> ·R	Generate	
	100 mΩ		4·10 <sup>-5</sup> ·R	Generate	
	1 Ω, 1.9 Ω		8·10 <sup>-5</sup> ·R	Generate	
	10 Ω		2.5·10 <sup>-5</sup> ·R	Generate	
	19 Ω, 100 Ω, 190 Ω, 1 kΩ, 1.9 kΩ, 10 kΩ, 19 kΩ, 100 kΩ, 190 kΩ		2.0·10 <sup>-5</sup> ·R	Generate	
	1 MΩ, 1.9 MΩ		3·10 <sup>-5</sup> ·R	Generate	
	10 MΩ		4·10 <sup>-5</sup> ·R	Generate	
	19 MΩ, 100 MΩ		6·10 <sup>-5</sup> ·R	Generate	
LF 6 5	LF Capacity				HLO, OS
	2 nF, 10 nF, 20 nF, 200 nF	1 kHz	1.0·10 <sup>-3</sup> ·C	Generate only sine-shaped signals	

HCS code	Measured quantity, Instrument, Measure	Range	CMC <sup>1</sup>	Remarks	Location
PV 0 0	PRESSURE AND VACUUM				
PV 1 0	Gas pressure				
PV 1 1	Absolute pressure	(750 – 1150) hPa a	0.3 hPa	By comparison to a reference barometer	HLO
		(0.01 – 1.1) MPa a	0.3 hPa +  25·10 <sup>-5</sup> ·(p - 100 kPa)		
		(1.1 – 60.1) MPa a	1·10 <sup>-3</sup> ·(p - 0.1 MPa)	By comparison with digital pressure indicators	HLO, OS



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HCS code	Measured quantity, Instrument, Measure	Range	CMC <sup>1</sup>	Remarks	Location
PV 1 2	Relative pressure	(-1.5 – -90) kPa g	$25 \cdot 10^{-5} \cdot p_e$		HLO
		(1.5 – 1000) kPa g	$25 \cdot 10^{-5} \cdot p_e$		
		(1 – 60) MPa g	$1 \cdot 10^{-3} \cdot p_e$	By comparison with digital pressure indicators	HLO, OS
PV 2 0	Liquid pressure				
PV 2 1	Absolute pressure	(120 – 300) kPa a	$0.3 \text{ hPa} + 1 \cdot 10^{-3} \cdot (p - 100 \text{ kPa})$	By comparison with digital pressure indicators	HLO, OS
		(0.3 – 70.1) MPa a	$0.3 \text{ hPa} + 25 \cdot 10^{-5} \cdot (p - 0.1 \text{ MPa})$		
PV 2 2	Relative pressure	( 20 – 200) kPa g	$1 \cdot 10^{-3} \cdot p_e$	By comparison with digital pressure indicators	HLO, OS
		(0.2 – 70) MPa g	$25 \cdot 10^{-5} \cdot p_e$		
TE 0 0	TEMPERATURE				
TE 1 0	Resistance thermometer with and without readout	-20 °C up to 250 °C	0.10 °C	By comparison in liquid block baths with external reference probe	HLO, OS
		250 °C up to 650 °C	0.20 °C		
TE 3 0	Thermocouple with and without readout	-20 °C up to 250 °C	0.10 °C	By comparison in liquid block baths with external reference probe	HLO, OS
		250 °C up to 650 °C	0.20 °C		

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HCS code	Measured quantity, Instrument, Measure	Range	CMC <sup>1</sup>	Remarks	Location
TF 0 0	TIME AND FREQUENCY				
TF 2 0	Relative time				HLO
	Electronic chronometers	24 h	0.1 s / 24 h	Direct measurement	
	Mechanical chronometers	24 h	5 s / 24 h	Direct measurement	
TF 2 1	Time and Frequency				HLO
	10 Hz – 225 MHz		$3 \cdot 10^{-6} \cdot f$	Measure	
TF 2 2	Time interval				HLO
	1 $\mu$ s – 1000 s		$3 \cdot 10^{-6} \cdot t$	Measuring; period applicable to repetitive signals	
	6 min <sup>-1</sup> – 100.000 min <sup>-1</sup>		$4 \cdot 10^{-6} \cdot n$	By comparison with frequency references with n = number of revolutions min <sup>-1</sup>	
TQ 0 0	TORQUE				HLO, OS
TQ 1 2	Torque wrenches	0.1 – 1350 Nm	$1.5 \cdot 10^{-2} \cdot M + 0.5 \cdot r$		

Remarks:

R = reading accuracy of the instrument

Temperature conditions for electrical calibrations is nominal 23 °C; temperature conditions for geometrical and torque calibrations is nominal 20 °C, temperature conditions for pressure and temperature calibrations is nominal 21 °C

$p_e = p - p_{amb}$ :  $p_e$  is overpressure,  $p_{amb}$  is ambient pressure

This list of calibrations is, unless otherwise stated, applicable for calibrations performed inside the laboratory.

<sup>1</sup>  $P_e = P - P_{amb}$ :  $P_e$  is overpressure,  $P_{amb}$  is ambient pressure