Length, Czech Republic, CMI (Czech Metrology Institute)

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Class	Instrument or Artifact: Measurand	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	NMI Internal Service Identifier
Laser radiations	Stabilized laser of the mise en pratique: vacuum wavelength	Optical beat frequency	633	633	nm			0.03	fm	2	95%	No	1
Laser radiations	Stabilized laser of the mise en pratique: absolute frequency	Optical beat frequency	474	474	THz			20	kHz	2	95%	No	1
Laser radiations	Stabilized laser of the mise en pratique: vacuum wavelength	Optical beat frequency	612	612	nm			0.36	fm	2	95%	No	2
Laser radiations	Stabilized laser of the mise en pratique: absolute frequency	Optical beat frequency	490	490	THz			0.30	MHz	2	95%	No	2
Laser radiations	Stabilized laser of the mise en pratique: vacuum wavelength	Optical beat frequency	543	543	nm			0.28	fm	2	95%	No	3
Laser radiations	Stabilized laser of the mise en pratique: absolute frequency	Optical beat frequency	551	551	THz			0.28	MHz	2	95%	No	3
Laser radiations	Other stabilized laser: vacuum wavelength, λ_0	Optical beat frequency	633	633	nm			1E-09λ_0	nm	2	95%	No	4
Laser radiations	Other stabilized laser: vacuum wavelength, λ_0	Optical beat frequency	612	612	nm			1E-09λ_0	nm	2	95%	No	5
Laser radiations	Other stabilized laser: vacuum wavelength, λ_0	Optical beat frequency	543.5	543.5	nm			1E-09λ_0	nm	2	95%	No	6
Laser radiations	Other stabilized laser: vacuum wavelength, λ_0	Wavemeter (continuous)	400	1650	nm			2E-06λ_0	nm	2	95%	No	7
Laser radiations	Other stabilized laser: vacuum wavelength, λ_0	Wavemeter (pulsed)	400	1000	nm			1E-05λ_0	nm	2	95%	No	8

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Length instruments	Laser interferometer system: error of indicated displacement *L*	Comparison to master length interferometer	0	2	m			Q[0.001, 0.1*L*], *L* in m	µm	2	95%	No	9
Length instruments	Laser interferometers: wavelength compensation *n*	Calibration of pressure and temperature transducers, Edlen formula				Pressure	800 hPa to 1060 hPa	1E-07*n*		2	95%	No	10
						Temperature	15 °C to 30 °C						
						Relative humidity	20% to 80%						
Length instruments	1-D measuring machines: error of indicated size and displacement *L*	Laser interferometer and gauge block	0	6	m			Q[0.05, 1.5*L*], *L* in m	µm	2	95%	No	14
Length instruments	Height measuring instruments, error of indicated [vertical size, displacement] *L*	CMM	0	0.72	m			Q[0.5, 0.8*L*], *L* in m	µm	2	95%	No	15
Length instruments	Displacement transducers: error of indicated displacement *L*	1-D measuring machine SIP 1002M	0	1	m			Q[0.4, 2.6*L*], *L* in m	µm	2	95%	No	16
Length instruments	Displacement actuators: error of prescribed displacement *L*	1-D measuring machine SIP 1002M and laser interferometer	0	1	m			Q[0.02, 1.1*L*], *L* in m	µm	2	95%	No	17
Length instruments	Gauge block comparators	Set of end gauges	-10	10	µm	Maximum gauge block length	100 mm	0.1	µm	2	95%	No	18
End standards	Gauge block, central length *L*	Interferometry, exact fraction	0.3	300	mm			Q[20, 0.2*L*], *L* in mm	nm	2	95%	No	19
End standards	Gauge blocks: central length *L*	Mechanical comparison	0.3	100	mm			Q[50, 0.5*L*], *L* in mm	nm	2	95%	No	20

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End standards	Long gauge blocks: central length *L*	Mechanical comparison	100	1000	mm			Q[100, 1*L*], *L* in mm	nm	2	95%	No	21
End standards	Step gauges: face spacing *L*	CMM	10	720	mm			Q[500, 0.8*L*], *L* in mm	nm	2	95%	No	22
Line standards	Precision line scales: line spacing	Laser interferometer, CCD microscope	0.01	120	mm			0.2	µm	2	95%	No	23
Line standards	Precision line scales: line spacing *L*	Laser interferometer, microscope	1E-02	2000	mm			Q[0.21, 1.22*L*], *L* in m	µm	2	95%	No	24
Line standards	Surveyor invar tapes and wires: line spacing *L*	25 m bench and laser interferometer	0.001	25	m			Q[10, 2*L*], *L* in m	µm	2	95%	No	27
Line standards	Surveyor tapes and wires: line spacing *L*	25 m bench and laser interferometer	0.001	1000	m			Q[10, 10*L*], *L* in m	µm	2	95%	No	28
Line standards	Surveyor levelling rods: line spacing *L*	Bench and laser interferometer	0.01	3	m			Q[10, 10*L*], *L* in m	µm	2	95%	No	29
Diameter standards	External cylinders (plugs, pistons): diameter	CMM	3	100	mm			0.5	µm	2	95%	No	30
Diameter standards	External cylinders (plugs, pistons): diameter *D*	CMM	0.003	0.5	m			Q[0.8, 1.3*D*], *D* in m	µm	2	95%	No	31
Diameter standards	External cylinders (plugs, pistons): diameter *D*	1-D measuring machine SIP 1002M	1E-04	0.5	m			Q[0.4, 2.6*D*], *D* in m	µm	2	95%	No	32
Diameter standards	Internal cylinders (rings) : diameter	CMM	3	150	mm			0.5	µm	2	95%	No	33
Diameter standards	Internal cylinders (rings): diameter *D*	CMM	3E-04	0.5	m			Q[0.8, 1.3*D*], *D* in m	µm	2	95%	No	34
Diameter standards	Internal cylinders (rings): diameter *D*	1-D measuring machine SIP 1002M	2E-03	0.3	m			Q[0.4, 2.6*D*], *D* in m	µm	2	95%	No	35
Diameter standards	Spheres (balls): diameter *D*	CMM	1E-03	0.5	m			Q[0.8, 1.3*D*], *D* in m	µm	2	95%	No	36

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Diameter standards	Spheres (balls): diameter *D*	1-D measuring machine SIP 1002M	1E-03	0.135	m			Q[0.4, 2.6*D*], *D* in m	µm	2	95%	No	37
Angle by circle-dividers	Optical polygons: face angle	Comparison with polygon	0	360	°	Number of faces	subdivisions of 36: 3, 4, 6, 9, 12, 18, 36	0.6	"	2	95%	No	38
Angle by circle-dividers	Indexing tables: index angle	Comparison with polygon	0	360	°			1	"	2	95%	No	39
Angle by circle-dividers	Rotary tables, rotary encoder scales: position angle	Comparison with polygon	0	360	°			1.6	"	2	95%	No	40
Angle instruments	Autocollimators: error of indicated angle	Small angle generator	-100	100	'			0.5	"	2	95%	No	41
Angle instruments	Electronic levels: error of indicated inclination angle	Small angle generator	-100	100	'			1	"	2	95%	No	42
Angle artefacts	Angle blocks: included angle	Goniometer	0	360	°			2	"	2	95%	No	44
Angle artefacts	90° steel or granite squares: squareness	CMM	90	90	°	Size	500 mm	0.5	"	2	95%	No	45
Angle artefacts	90° cylinders: squareness	CMM	90	90	°	Size	500 mm	0.5	"	2	95%	No	46
Roundness standards	Plug: external cylinder roundness	CMM	0	0.5	mm	Cylinder diameter *D*	up to 0.5 m	Q[0.8, 1.3*D*], *D* in m	µm	2	95%	No	48
Roundness standards	Ring: internal cylinder roundness	CMM	0	0.5	mm	Cylinder diameter *D*	up to 0.5 m	Q[0.8, 1.3*D*], *D* in m	µm	2	95%	No	49
Roundness standards	Spheres (balls): roundness	CMM	0	0.5	mm	Sphere diameter *D*	up to 0.5 m	Q[0.8, 1.3*D*], *D* in m	µm	2	95%	No	50
Straightness standards	Straight edge: straightness deviation *S*	Laser interferometer	0	1.5	mm	Length *L*	up to 15 m	Q[0.7, 1*L*, 11*S*], *L* in m, *S* in mm	µm	2	95%	No	51
Surface texture	Depth standard: step height, groove depth *Pt* (eg., ISO 5436-1 Type A)	Stylus instrument	0.01	100	µm			Q[5, 20*Pt*], *Pt* in µm	nm	2	95%	No	52

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
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Surface texture	Spacing standards type C: ISO 5436-1 parameters	Stylus instrument	0.01	100	µm	Parameters	*Ra* , *Rq*	Q[10, 30*Ra*], *Ra* in µm	nm	2	95%	No	53
						Parameters	*Rp* , *Rv* , *Rz* , *Rt*	Q[20, 40*Rp*], *Rp* in µm	nm	2	95%	No	53
Surface texture	Roughness standard type D: ISO 5436-1 parameters	Stylus instrument	0.01	100	µm	Parameters	*Ra* , *Rq*	Q[10, 40*Ra*], *Ra* in µm	nm	2	95%	No	54
						Parameters	*Rp* , *Rv* , *Rz* , *Rt*	Q[20, 50*Rp*], *Rp* in µm	nm	2	95%	No	54
CMM artefacts	Ball/hole plates: centre coordinates	CMM, reversal method	(100x100)	(700x700)	mm^2			Q[0.8, 1.1*L*], *L* centre distance in m	µm	2	95%	No	59
CMM artefacts	Ball bar: centre coordinates	CMM	100	700	mm			Q[0.5, 0.8*L*], *L* centre distance in m	µm	2	95%	No	60
2-D, 3-D instruments	CMM: error of indicated location	Laser interferometer, ball plate, holeplate, step gauge				Measured distance *L*	up to 30 m	Q[0.5, 0.8*L*], *L* in m	µm	2	95%	No	61
Pressure artifacts	Piston/cylinder assembly: 3-D size, shape	CMM	3	100	mm			0.25	µm	2	95%	No	62