Length, Italy, INRIM (Istituto Nazionale di Ricerca Metrologica)

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**	**Comments**
Laser radiations	Stabilized laser of the mise en pratique: vacuum wavelength	Optical beat frequency	633	633	nm			0.04	fm	2	95%	No	1	
Laser radiations	Stabilized laser of the mise en pratique: absolute frequency	Optical beat frequency	474	474	THz			24	kHz	2	95%	No	1	
Laser radiations	Stabilized laser of the mise en pratique: vacuum wavelength	Optical beat frequency	532	532	nm			0.08	fm	2	95%	No	2	
Laser radiations	Stabilized laser of the mise en pratique: absolute frequency	Optical beat frequency	563	563	THz			0.08	MHz	2	95%	No	2	
Laser radiations	Other stabilized laser: vacuum wavelength, λ_0	Optical beat frequency	633	633	nm			1E-09 λ_0	nm	2	95%	No	3	
End standards	Gauge block: central length *L*	Interferometry, exact fractions	0.5	100	mm			Q[18, 0.34*L*], *L* in mm	nm	2	95%	No	4	
End standards	Long gauge block: central length *L*	Laser interferometer, fringe fraction	100	1000	mm			Q[60, 0.26*L*], *L* in mm	nm	2	95%	No	6	
End standards	Step gauge: face spacing *L*	1-D comparator and mechanical probe	20	420	mm			Q[0.2, 0.7E-03*L*], *L* in mm	µm	2	95%	No	7	
Line standards	Stage micrometer: line spacing	1-D comparator and video microscope	0.02	20	mm	Minimum pitch	10 µm	0.1	µm	2	95%	No	8	
Line standards	1-D grating: pitch *p* sinusoidal profile	Laser diffractometer	0.3	50	µm	Measurement area	1 mm^2 to 70 mm^2	0.09p^2, *p* in µm	nm	2	95%	No	9	
Line standards	1-D grating: pitch *p* non-sinusoidal profile	Laser diffractometer	0.3	50	µm	Measurement area	1 mm^2 to 70 mm^2	0.05*p*, *p* in µm	nm	2	95%	No	9	
Line standards	2-D grating: pitch *p* sinusoidal profile	Laser diffractometer	0.3	50	µm	Measurement area	1 mm^2 to 70 mm^2	0.09p^2, *p* in µm	nm	2	95%	No	10	
Line standards	2-D grating: pitch *p* non-sinusoidal profile	Laser diffractometer	0.3	50	µm	Measurement area	1 mm^2 to 70 mm^2	0.05*p*, *p* in µm	nm	2	95%	No	10	
Diameter standards	External cylinder (plug): diameter *L*	1-D comparator and mechanical probe	1	150	mm			Q[0.1, 0.5E-03*L*], *L* in mm	µm	2	95%	No	11	
Diameter standards	Internal cylinder (ring): diameter *L*	1-D comparator and mechanical probe	1	150	mm			Q[0.1, 0.5E-03*L*], *L* in mm	µm	2	95%	No	12	
Diameter standards	Sphere: diameter *L*	1-D comparator and mechanical probe	5	150	mm			Q[0.1, 0.5E-03*L*], *L* in mm	µm	2	95%	No	13	

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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**	**Comments**
Angle by circle-dividers	Optical polygon: face angle	Index table and autocollimator, full closure	3	72	faces	Face dimension	minimum 10 x 10 mm^2	0.2	"	2	95%	No	14	Approved on 04 May 2006
Angle by circle-dividers	Index table: index angle	Index table and autocollimator, full closure	0	360	°			0.2	"	2	95%	No	15	Approved on 04 May 2006
Angle instruments	Autocollimator: error of indicated angle	Sine bar (SAG)	0	1000	"	Orientation	vertical	0.2	"	2	95%	No	16	Approved on 04 May 2006
Angle instruments	Electronic level: error of indicated inclination angle	Sine bar (SAG)	0	1000	"	Orientation	vertical	0.2	"	2	95%	No	17	Approved on 04 May 2006
Angle instrument	Clinometers	Index table	0	360	°			1	"	2	95%	No	35	Approved on 01 April 2010
Angle artifacts	Angle block	Comparison to index table, autocollimator	0	90	°			0.2	"	2	95%	No	18	
Angle prisms	Optical square (pentaprism): deflection angle	2-mirror method	90	90	°			0.5	"	2	95%	No	19	
Roundness standards	External cylinder (plug): roundness, *R*	Multi-step	0	20	µm	Diameter	4 mm to 150 mm	Q[7, 10*R*], *R* in µm	nm	2	95%	No	20	Approved on 04 May 2006
Roundness standards	Internal cylinder (ring): roundness	Multi-step	0	20	µm	Diameter	4 mm to 150 mm	Q[7, 10*R*], *R* in µm	nm	2	95%	No	21	Approved on 04 May 2006
Roundness standards	Sphere or hemisphere: roundness	Multi-step	0	20	µm	Diameter	4 mm to 150 mm	Q[7, 10*R*], *R* in µm	nm	2	95%	No	22	Approved on 04 May 2006
Roundness standards	Magnification (flick) standard: roundness	Stylus instrument, 1-profile	0	20	µm	Diameter	4 mm to 150 mm	Q[100, 10*R*], *R* in µm	nm	2	95%	No	23	Approved on 04 May 2006
Surface texture	Depth standard: (ISO 5436-1 type A), depth *d*	Stylus profilometry	0.01	15	µm			Q[1, 4.7*d*], *d* in µm	nm	2	95%	No	24	
CMM artefacts	Ball bar: ball spacing	1-D comparator and mechanical probe	10	330	mm			0.4	µm	2	95%	No	25	
Length instruments	Displacement transducer: displacement *L*	Heterodyne interferometer with high-resolution phase meter	0	50	µm			Q[0.7, 0.5*L*], *L* in µm	nm	2	95%	No	26	Approved on 22 March 2005

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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**	**Comments**
Length instruments	Displacement transducer: displacement *L*	1-D comparator	0	50	mm			Q[0.1, 0.5E-03*L*], *L* in mm	µm	2	95%	No	28	Approved on 22 March 2005
Line standards	1D gratings: pitch *p*	Scanning Probe Microscope with interferometric and capacitance controls of displacements	0.1	5	µm			Q[2, 1*p*], *p* in µm	nm	2	95%	No	29	Approved on 22 March 2005
Line standards	2D gratings: pitch *p*	Scanning Probe Microscope with interferometric and capacitance controls of displacements	0.1	5	µm			Q[2, 1*p*], *p* in µm	nm	2	95%	No	30	Approved on 22 March 2005
Line standards	Precision line scales: line spacing *L*	1-D comparator with laser interferometer, CCD/optical microscope	0.1	280	mm			Q[80, 0.87*L*], *L* in mm	nm	2	95%	No	32	Approved on 04 May 2006
Surface texture	Roughness standard (ISO 5436-1 type C): ISO roughness parameters	Stylus profilometry	0.01	20	µm	Parameters	*Ra* and *Rq*	Q[10, 30 *Ra*], *Ra* in µm	nm	2	95%	No	33	Approved on 19 May 2007
Surface texture	Roughness standard (ISO 5436-1 type C): ISO roughness parameters	Stylus profilometry	0.01	20	µm	Parameters	*Rz* and *Rp, Rv, Rt*	Q[20, 50 *Rz*], *Rz* in µm	nm	2	95%	No	33	Approved on 19 May 2007
Surface texture	Roughness standard (ISO 5436-1 type C): ISO roughness parameters	Stylus profilometry	50	500	µm	Parameter	*RSm*	0.5	µm	2	95%	No	33	Approved on 19 May 2007
Surface texture	Roughness standard (ISO 5436-1 type D): ISO roughness parameters	Stylus profilometry	0.01	20	µm	Parameters	*Ra* and *Rq*	Q[10, 30 *Ra*], *Ra* in µm	nm	2	95%	No	34	Approved on 19 May 2007

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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**	**Comments**
Surface texture	Roughness standard (ISO 5436-1 type D): ISO roughness parameters	Stylus profilometry	0.01	20	µm	Parameters	*Rz* and *Rp, Rv, Rt*	Q[20, 50 *Rz*], *Rz* in µm	nm	2	95%	No	34	Approved on 19 May 2007