

Length, Thailand, NIMT (National Institute of Metrology (Thailand))

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		Expanded Uncertainty						
Class	Instrument or artifact	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 Service Identifier	Comments
Laser radiations	Frequency stabilized laser	Optical beat frequency	633	633	nm			24	kHz	2	95 %	No	08010-10101	Approved on 28 April 2010
Laser radiations	Frequency stabilized laser	Optical beat frequency	633	633	nm			1.0E-09		2	95 %	Yes	08010-10201	Approved on 28 April 2010
End standards	Gauge block: central length L	Interferometry exact fractions	0.5	125	mm	Material	steel	Q[26, 0.35L], L in mm, values range from 26.0 nm to 50.9 nm	nm	2	95 %	No	08020-10101	Approved on 10 April 2018
End standards	Gauge block: central length L	Interferometry exact fractions	0.5	125	mm	Material	ceramic	Q[26, 0.29L], L in mm, values range from 26.0 nm to 44.6 nm	nm	2	95 %	No	08020-10101	Approved on 10 April 2018
End standards	Gauge block: central length L	Interferometry exact fractions	0.5	125	mm	Material	tungsten carbide	Q[26, 0.18L], L in mm, values range from 26.0 nm to 34.4 nm	nm	2	95 %	No	08020-10101	Approved on 10 April 2018
End standards	Gauge block: central length L	Interferometry exact fractions	0.5	125	mm	Material	chromium carbide	Q[26, 0.27L], L in mm, values range from 26.0 nm to 42.6 nm	nm	2	95 %	No	08020-10101	Approved on 10 April 2018
End standards	Gauge block: central length L	Mechanical comparison	0.5	125	mm	Material	steel, tungsten carbide and chromium carbide	Q[50, 0.50L], L in mm, values range from 50 nm to 1.2E+02 nm	nm	2	95 %	No	08020-10301	Approved on 28 April 2010
End standards	Gauge block: central length L	Mechanical comparison	0.5	125	mm	Material	ceramic	Q[70, 0.50L], L in mm, values range from 70 nm to 1.4E+02 nm	nm	2	95 %	No	08020-10301	Approved on 28 April 2010

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End standards	Gauge block: central length L	Mechanical comparison	150	1000	mm	Material	steel	$Q[50, 0.80L]$, L in mm, values range from $1.3E+02$ nm to $8.5E+02$ nm	nm	2	95 %	No	08020-10501, 08020-10502, 08020-10503	Approved on 28 April 2010
End standards	Step gauge: face spacing	CMM with laser interferometer	0	1020	mm	Step gauge size	< 1020 mm	$Q[0.26, 1.4E-03L]$, L in mm	μm	2	95 %	No		Approved on 26 January 2012
End standards	Caliper checker: face spacing	CMM with laser interferometer	0	1020	mm	Caliper checker size	< 1020 mm	$Q[0.30, 2.7E-03L]$, L in mm	μm	2	95 %	No		Approved on 26 January 2012
Line standard	Precision line scale: line spacing	Line scale interferometer	0	500	mm	Glass scale	low coefficient of thermal expansion ($8E-08 \text{ K}^{-1}$)	$Q[41, 0.1L]$, L in mm	nm	2	95 %	No		Approved on 10 April 2018
Line standard	Precision line scale: line spacing	Line scale interferometer	0	1000	mm	Glass scale	working standard	$Q[0.11, 2.9E-03L]$, L in mm	μm	2	95 %	No		Approved on 26 January 2012
Diameter standards	External cylinder (plain plug gauge): diameter	1-d comparator and 2 contacting probes	0.1	1	mm			0.24	μm	2	95 %	No	08040-10501	Approved on 28 April 2010
Diameter standards	External cylinder (plain plug gauge): diameter D	1-d comparator and 2 contacting probes	1	100	mm			$Q[0.23, 1.4E-03D]$, D in mm, values range from $0.23 \mu\text{m}$ to $0.27 \mu\text{m}$	μm	2	95 %	No	08040-10502	Approved on 28 April 2010
Diameter standards	External cylinder (plain plug gauge): diameter D	1-d comparator and 2 contacting probes	100	300	mm			$Q[0.25, 1.4E-03D]$, D in mm, values range from $0.29 \mu\text{m}$ to $0.49 \mu\text{m}$	μm	2	95 %	No	08040-10503	Approved on 28 April 2010

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Diameter standards	Internal cylinder (plain ring gauge): diameter D	1-d comparator and focusing microscope	0.1	100	mm			Q[0.37, 1.3E-03D], D in mm, values range from 0.37 μm to 0.39 μm	μm	2	95 %	No	08040-10101	Approved on 28 April 2010
Angle by circle divider	Optical polygon: face angle	Indexing table and one autocollimator, error separation	3	72	faces			0.2	"	2	95 %	No	08030-10201, 08030-10202, 08030-10203, 08030-10204	Approved on 28 April 2010
Angle by circle divider	Indexing table: index angle	Cross calibration versus polygon and autocollimator	0	360	$^{\circ}$	Measured angle: $360/n$ $^{\circ}$, number of division n	Measurement interval, $n = 3, 4, 6, 8$ and 12	0.2	"	2	95 %	No	08030-10501	Approved on 28 April 2010
Angle instrument	Autocollimator: error of indicated angle	Sine arm and autocollimator	-1000	1000	"			0.2	"	2	95 %	No	08030-10101	Approved on 28 April 2010
Flatness standard	Optical flat: flatness deviation over whole diameter	Fizeau interferometer, three flat test, automatic assessment	0	0.3	μm	Maximum diameter	60 mm	4	nm	2	95 %	No	08060-10201	Approved on 28 April 2010
Flatness standard	Optical flat, optical parallel: flatness	Fizeau interferometer, automatic assessment	0	0.3	μm	Maximum diameter	60 mm	20	nm	2	95 %	No	08060-10101, 08060-10102	Approved on 28 April 2010
Flatness standard	Optical parallel: parallelism	Gauge block comparator	0	20	μm	Maximum diameter	60 mm	40	nm	2	95 %	No	08060-10101	Approved on 28 April 2010

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Roundness standards	Glass hemisphere: roundness <i>R</i>	Multi-step, stylus-on-spindle roundness instrument	0	20	µm	Diameter	1 mm to 355 mm	Q[7.7, 7.6 <i>R</i>], <i>R</i> in µm, values range from 7.7 nm to 1.6E+02 nm	nm	2	95 %	No	08060-10301	Approved on 28 April 2010
Roundness standards	Internal and external cylinder, magnification standard: roundness <i>R</i>	Stylus-on-spindle roundness instrument	0	20	µm	Diameter	1 mm to 355 mm	Q[12, 12 <i>R</i>], <i>R</i> in µm, values range from 12 nm to 2.2E+02 nm	nm	2	95 %	No	08060-10401	Approved on 28 April 2010
Surface texture standards	Depth standard, (ISO 5436-1, type A), depth <i>d</i>	Stylus instrument	0.025	32	µm	Groove depth, <i>d</i>	ISO 5436-1	Q[6.6, 12 <i>d</i>], <i>d</i> in µm, values range from 6.6 nm to 3.8E+02 nm	nm	2	95 %	No	08060-10501	Approved on 28 April 2010
Surface texture standards	Depth standard, (ISO 5436-1, type A), depth <i>d</i>	Interference microscope and stylus instrument (for pre-measurement)	0.01	10	µm	Groove depth	ISO 5436-1	Q[2.4, 5.4 <i>d</i>], <i>d</i> in µm	nm	2	95 %	No		Approved on 26 January 2012
Surface texture standards	Depth standard, (ISO 5436-1, type A), depth <i>d</i>	Non-contact optical profiler	0.3	50	µm	Groove depth	ISO 5436-1	Q[75, 7.3 <i>d</i>], <i>d</i> in µm	nm	2	95 %	No		Approved on 26 January 2012
Surface texture standards	Roughness standard, ISO 5436-1 type C, D: <i>Ra</i> (ISO 4287)	Stylus instrument	0.025	32	µm	<i>Ra</i> (ISO 4287)	ISO 4287, ISO 4288, ISO 11562	Q[10, 12 <i>Ra</i>], <i>Ra</i> in µm, values range from 10 nm to 3.8E+02 nm	nm	2	95 %	No	08060-10601	Approved on 28 April 2010

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Surface texture standards	Roughness standard, ISO 5436-1 type C, D: Rz (ISO 4287)	Stylus instrument	0.025	32	µm	Rz (ISO 4287)	ISO 4287, ISO 4288, ISO 11562	Q[18, 17Rz], Rz in µm, values range from 18 nm to 5.4E+02 nm	nm	2	95 %	No	08060-10601	Approved on 28 April 2010
CMM artefacts	Ball plate: 2D center coordinates	CMM with laser interferometer using swing round method	0	620	mm	Ball plate size	< 620 mm x 620 mm	Q[0.27, 1.9E-03L], L in mm	µm	2	95 %	No		Approved on 26 January 2012
2-D, 3-D instruments	CMM: error of indicated [size; location; shape]	Comparison with gauge blocks	0	1200	mm	CMM size	< 1200 mm x 1000 mm x 700 mm	Q[0.52, 1.4E-03L], L in mm	µm	2	95 %	No		Approved on 26 January 2012
2-D, 3-D instruments	CMM: error of indicated [size; location; shape]	Comparison with step gauges	0	1200	mm	CMM size	< 1200 mm x 1000 mm x 700 mm	Q[0.52, 2.0E-03L], L in mm	µm	2	95 %	No		Approved on 26 January 2012
Surface texture standards	Spacing standard, ISO 5436-1 type C: wavelength parameters: D: Rsm (ISO 4287)	Stylus instrument	0.1	1000	µm	Rsm, Sm	ISO 4287, ISO 4288, ISO 11562	Q[0.58, 0.02Sm], Sm in µm, values range from 0.58 µm to 20.0 µm	µm	2	95 %	No	08061-10501	Approved on 10 April 2018
Diameter standards	External cylinder (Plug, Pin, Wire) : External Diameter	1-D measuring machine (direct method)	0.1	300	µm			Q[0.23, 1.0E-03D], D in mm, range from 0.23 µm to 0.38 µm	µm	2	95 %	No	0.0841-10501-10703	Approved on 10 April 2018