



# National Institute of Metrology (Thailand)

3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani, 12120, Thailand

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## Price List

Item No.	Description	Range	Accuracy / Uncertainty	Price (THB)	Remark	Code
<b>Calibration Fee</b>						
<b>Photometry Metrology</b>						
1	Luminous intensity of an incandescent lamp	$10 \text{ cd} \leq I_v \leq 3\,000 \text{ cd}$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	0.79%	18,750 for the first lamp + 8,500 for any additional lamp of the same type	Substitution method against two national reference standard lamps	13015-11011
			0.93%	12,500 for the first lamp + 6,250 for any additional lamp of the same type	Substitution method against two working standard lamps	13016-11011
2	Illuminance responsivity of a photo- detector head	$12 \text{ lx} \leq E_v \leq 300 \text{ lx}$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	0.70%	6,250	Source-based measurements using national reference standard lamps applying the inverse-square law.	13015-11021
			0.80%	3,130	Source-based measurements using working standard lamps applying the inverse-square law.	13016-11021
3	Illuminance responsivity of an illuminance meter or a lux meter	$2 \text{ lx} \leq E_v \leq 10\,000 \text{ lx}$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	Greater than or equal to 0.91% varied with illuminance level and UUC	2,500 for the first range + 630 for any additional range	Detector-based comparison against reference photometers	13011-11021
4	Total luminous flux of an incandescent lamp	$5 \text{ lm} \leq \Phi_v \leq 9\,000 \text{ lm}$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	0.66%	7,500	Detector-based method by using a gonio- photometer with a standard photometer	13010-11031



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5	Total luminous flux of an incandescent lamp	$5 \text{ lm} \leq \Phi_v \leq 9\,000 \text{ lm}$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	0.80%	17,750 for the first lamp + 7,880 for any additional lamp of the same type	Substitution method inside a 2-meter integrating sphere against two national reference standard lamps	13015-11031
			0.98%	12,500 for the first lamp + 6,250 for any additional lamp of the same type	Substitution method inside a 2-meter integrating sphere against two working standard lamps	13016-11031
6	Total luminous flux of a non-directional LED lamp	$20 \text{ lm} \leq \Phi_v \leq 4\,000 \text{ lm}$ Full (non-directional), white	0.79%	17,750 for the first lamp + 7,880 for any additional lamp of the same type	Substitution method inside a 2-meter integrating sphere against two national reference standard lamps	13015-11032
			1.0%	13,750 for the first lamp + 6,880 for any additional lamp of the same type	Substitution method inside a 2-meter integrating sphere against two working standard lamps	13016-11032
7	Total luminous flux of a linear fluorescent lamp	$800 \text{ lm} \leq \Phi_v \leq 4\,000 \text{ lm}$ $2\,600 \text{ K} \leq \text{CCT} \leq 6\,200 \text{ K}$	0.88%	18,750 for the first lamp + 8,750 for any additional lamp of the same type	Substitution method inside a 2-meter integrating sphere against two national reference standard lamps	13015-11033
			1.2%	12,500 for the first lamp + 6,250 for any additional lamp of the same type	Substitution method inside a 2-meter integrating sphere against two working standard lamps	13016-11033
8	Luminance of a tungsten-based source	$1 \text{ cd/m}^2 \leq L_v \leq 10\,000 \text{ cd/m}^2$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	1.4%	10,000 for the first calibration point + 5,000 for any additional point	Detector-based method against a reference luminance meter	13012-11051



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9	Luminance responsivity of a luminance meter	$10 \text{ cd/m}^2 \leq L_v \leq 10\,000 \text{ cd/m}^2$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	0.85%	10,000 for the first point + 5,000 for any additional point	Detector-based comparison against reference photometers	13011-11060
		$1 \text{ cd/m}^2 \leq L_v < 10 \text{ cd/m}^2$ $2\,000 \text{ K} \leq \text{CCT} \leq 3\,400 \text{ K}$	1.2%		Detector-based comparison against reference photometers and a monitor detector	
10	Total spectral radiant flux of a tungsten lamp	$0.001 \text{ W/nm} \leq \Phi_e \leq 0.05 \text{ W/nm}$ $360 \text{ nm} \leq \lambda \leq 830 \text{ nm}$ at 5 nm interval	2.9% to 4.6%	20,000 (+ 500 for total radiant flux)	Gonio-spectroradiometric method	13010-13051
11	Total radiant flux of a tungsten lamp	$5.5 \text{ W} \leq \Phi_e \leq 15 \text{ W}$	1.1%	20,000	Gonio-spectroradiometric method	13010-15080
12	Regular spectral transmittance of a transmitting filter or film. <i>Measured transmittance values will be reported at 5 nm interval from 200 nm to 900 nm and 50 nm interval from 900 nm to 2 500 nm.</i>	$31.6\% < \%T \leq 97.7\%$ ( $0.01 \leq \text{OD} < 0.5$ )	200 nm to 2000 nm: Greater than or equal to 0.48%	6,250 for the first piece + 3,750 for any additional piece Fee will be scaled down for selected partial wavelength range.	By comparison against a reference ND filters using the reference spectrophotometer. <i>Measurement uncertainties shown are percent relative of transmittance values and they are varied by wavelengths and dependent of UCC.</i>	13025-14011
		$10.0\% < \%T \leq 31.6\%$ ( $0.5 \leq \text{OD} < 1.0$ )	200 nm to 2000: Greater than or equal to 0.57%			
		$1.00\% < \%T \leq 10.00\%$ ( $1.0 \leq \text{OD} < 2.0$ )	200 nm to 2000: Greater than or equal to 0.61%			
		$0.01\% < \%T \leq 1.00\%$ ( $2.0 \leq \text{OD} < 4.0$ )	200 nm to 1800: Greater than or equal to 0.81%			
13	Diffuse spectral transmittance of a diffusely transmitting material	380 nm to 780 nm	For 20% haze plate, typical uncertainties in diffuse spectral transmittance are 0.13% to 0.18% throughout the spectrum	4,000/sample	Direct measurement by single-beam primary reference spectrophotometer	13025-14021



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Item No.	Description	Range	Accuracy / Uncertainty	Price (THB)	Remark	Code
14	Specular excluded spectral diffuse reflectance of a glossy color sample (8°:de) <i>Measured diffused reflectance values will be reported at 5 nm interval from 380 nm to 780 nm.</i>	75% < %R ≤ 100%	380 nm to 400 nm: 1.7%	6,250 for the first piece + 3,750 for any additional piece Fee will be scaled down for selected partial wavelength range.	By comparison against a reference glossy ceramic color standard using the reference spectrophotometer with integrating sphere accessory. <i>Measurement uncertainties shown are percent relative of reflectance values and they are varied by wavelengths and dependent of UCC.</i>	13025-14051
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.86%			
		40% < %R ≤ 75%	380 nm to 400 nm: 1.7%			
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.84%			
		20% < %R ≤ 40%	380 nm to 400 nm: 1.8%			
			405 nm to 460 nm: 1.3%			
			465 nm to 780 nm: 0.90%			
		10% < %R ≤ 20%	380 nm to 400 nm: 1.9%			
			405 nm to 460 nm: 1.5%			
			465 nm to 780 nm: 1.1%			
		5% ≤ %R ≤ 10%	380 nm to 400 nm: 2.1%			
			405 nm to 460 nm: 1.6%			
			465 nm to 780 nm: 1.5%			
15	Specular excluded spectral diffuse reflectance of a matte color sample (8°:de) <i>Measured diffused reflectance values will be reported at 5 nm interval from 380 nm to 780 nm.</i>	75% < %R ≤ 100%	380 nm to 400 nm: 1.7%	6,250 for the first piece + 3,750 for any additional piece Fee will be scaled down for selected partial wavelength range.	By comparison against a reference matte ceramic color standard using the reference spectrophotometer with integrating sphere accessory. <i>Measurement uncertainties shown are percent relative of reflectance values and they are varied by wavelengths and dependent of UCC.</i>	13026-14051
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.86%			
		40% < %R ≤ 75%	380 nm to 400 nm: 1.7%			
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.84%			
		20% < %R ≤ 40%	380 nm to 400 nm: 1.8%			
			405 nm to 460 nm: 1.3%			
			465 nm to 780 nm: 0.90%			
		10% < %R ≤ 20%	380 nm to 400 nm: 1.9%			
			405 nm to 460 nm: 1.5%			
			465 nm to 780 nm: 1.1%			
		5% ≤ %R ≤ 10%	380 nm to 400 nm: 2.1%			
			405 nm to 460 nm: 1.6%			
			465 nm to 780 nm: 1.5%			



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16	Regular spectral reflectance	$5 \leq \%R \leq 100\%$ $200 \text{ nm} \leq \lambda \leq 2\,500 \text{ nm}$ at 5 nm interval	0.32% to 0.42% for the wavelength range from 200 nm to 885 nm 1.0% to 1.4% for the wavelength range from 890 nm to 2 500 nm *Typical values for a high reflective aluminum mirror. Uncertainties for other materials are likely higher.	11,250 for full-range. Price for partial-range will be scaled down accordingly.	Absolute method by a double-subtractive double-beam spectrophotometer (Perkin-Elmer Lambda 1050) equipped with a variable-angle reflectance accessory (URA)	13025-14061
17	Specular included spectral diffuse reflectance of a glossy color sample (8°:di) <i>Measured diffused reflectance values will be reported at 5 nm interval from 380 nm to 780 nm.</i>	$75\% < \%R \leq 100\%$	380 nm to 400 nm: 1.7%	6,250 for the first piece + 3,750 for any additional piece Fee will be scaled down for selected partial wavelength range.	By comparison against a reference glossy ceramic color standard using the reference spectrophotometer with integrating sphere accessory. <i>Measurement uncertainties shown are percent relative of reflectance values and they are varied by wavelengths and dependent of UCC.</i>	13025-14071
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.86%			
		$40\% < \%R \leq 75\%$	380 nm to 400 nm: 1.7%			
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.84%			
		$20\% < \%R \leq 40\%$	380 nm to 400 nm: 1.8%			
			405 nm to 460 nm: 1.3%			
			465 nm to 780 nm: 0.90%			
		$7.5\% < \%R \leq 20\%$	380 nm to 400 nm: 1.9%			
			405 nm to 460 nm: 1.5%			
			465 nm to 780 nm: 1.1%			
		$2.5\% \leq \%R \leq 7.5\%$	380 nm to 400 nm: 2.1%			
			405 nm to 460 nm: 1.6%			
			465 nm to 780 nm: 1.5%			



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Item No.	Description	Range	Accuracy / Uncertainty	Price (THB)	Remark	Code
18	Specular included spectral diffuse reflectance of a matte color sample (8°:di) <i>Measured diffused reflectance values will be reported at 5 nm interval from 380 nm to 780 nm.</i>	75% < %R ≤ 100%	380 nm to 400 nm: 1.7%	6,250 for the first piece + 3,750 for any additional piece Fee will be scaled down for selected partial wavelength range.	By comparison against a reference matte ceramic color standard using the reference spectrophotometer with integrating sphere accessory. <i>Measurement uncertainties shown are percent relative of reflectance values and they are varied by wavelengths and dependent of UCC.</i>	13026-14071
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.86%			
		40% < %R ≤ 75%	380 nm to 400 nm: 1.7%			
			405 nm to 460 nm: 1.2%			
			465 nm to 780 nm: 0.84%			
		20% < %R ≤ 40%	380 nm to 400 nm: 1.8%			
			405 nm to 460 nm: 1.3%			
			465 nm to 780 nm: 0.90%			
		7.5% < %R ≤ 20%	380 nm to 400 nm: 1.9%			
			405 nm to 460 nm: 1.5%			
			465 nm to 780 nm: 1.1%			
		2.5% ≤ %R ≤ 7.5%	380 nm to 400 nm: 2.1%			
			405 nm to 460 nm: 1.6%			
			465 nm to 780 nm: 1.5%			
19	Wavelength calibration of a transmitted wavelength standard (holmium oxide solution, holmium oxide filter, dysprosium oxide filter etc.)	200 nm to 2 000 nm	200 nm to 830 nm: 0.08 nm	2,500 for first peak identification + 1,250 for any additional peak	Measurement by reference spectrometer	13025-14150
			830 nm to 2 000 nm: 0.50 nm			
20	Wavelength calibration of a reflectance wavelength standard (holmium oxide doped ceramic tile etc.)	200 nm to 2 000 nm	200 nm to 830 nm: 0.15 nm	3,750 for first peak identification + 1,250 for any additional peak	Measurement by reference spectrometer with integrating sphere accessory	13025-14151
			830 nm to 2 000 nm: 0.70 nm			



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21	Surface color of general reflecting material, x, y, Y, u', v', L*, a*, b*	Varied be parameter of interest, please contact a laboratory staff for full details.	Varied by parameter of interest and color of UUC, please contact a laboratory staff for full details.	For general material: 7,500 THB for the first piece and 4,000 THB for an additional piece. For a set of color standards: 7,500 THB for the first piece and 2,000 THB for an additional piece.	Spectral diffuse reflectance measurement by single-beam substitution method against a reference color standard	13025-16010
22	Transmitted color of a transmitting material	360 nm to 860 nm	Values and uncertainties vary depending on sample's color. Contact the Colorimetry Laboratory for details	3,500/sample	Direct measurement by single-beam primary reference spectrophotometer	13025-16030
23	Gloss of a gloss sample	20°, 60° and 85°	At 20° $U_{rel} = 0.77\%$ At 60° $U_{rel} = 0.49\%$ At 85° $U_{rel} = 0.20\%$	3,750/sample	Reflectance measurement by spectrophotometer and applying Fresnel Equation	13025-16060
24	Haze and luminous transmittance of a diffusely transmitting material	380 nm to 780 nm	For 20% haze plate, typical uncertainty in transmission haze is 0.16%.	5,000/sample	Based on ASTM D1003 standard method	13025-16070
25	Whiteness and Tint	380 nm to 780 nm W greater than 40 and less than 5Y-280	1.5	6,500/sample	Spectral diffuse reflectance measurement by single-beam substitution method against a reference white diffuse reflectance standard	13025-16120
26	Absolute spectral irradiance responsivity of a scanning spectroradiometer with irradiance probe	250 nm to 2 500 nm	Greater than or equal to 2.5%	11,250	Direct measurement against a set of two FEL working standard lamps	13038-12023

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Item No.	Description	Range	Accuracy / Uncertainty	Price (THB)	Remark	Code
27	Absolute spectral irradiance responsivity of a diode array spectroradiometer with irradiance probe	250 nm to 2 500 nm	Greater than or equal to 2.4%	6,250	Direct measurement against a set of two FEL working standard lamps	13039-12023
28	Relative spectral radiance responsivity of a scanning spectroradiometer with radiance probe	250 nm to 2 500 nm	Greater than or equal to 2.5%	11,250	Direct measurement against a set of two FEL working standard lamps	13038-12030
29	Relative spectral radiance responsivity of a diode array spectroradiometer with radiance probe	250 nm to 2 500 nm	Greater than or equal to 2.4%	6,250	Direct measurement against a set of two FEL working standard lamps	13039-12030
30	Power responsivity of a trap detector	356.4 nm, 406.7 nm, 413.1 nm, 476.2 nm, 530.9 nm, 562.2 nm, 647.1 nm, 799.3 nm	0.018%	20,000 per wavelength point	Absolute calibration based on electrical substitution responsivity at the cryogenic temperature	13030-12040
31	Solar irradiance responsivity of a solar power meter	400 nm to 1 100 nm depending on UUC	4.2%	6,250	Comparison against a working standard spectroradiometer applying 300 W Xe arc lamp with air mass 1.5 Global filter	13034-12071
32	Solar irradiance responsivity of a thermopile-detector pyranometer	400 nm to 1 100 nm (160 W.m <sup>2</sup> to 520 W.m <sup>2</sup> )	2.1%	9,000	Source based calibration against a working standard spectroradiometer applying a solar simulator system	13034-12717





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33	Integrated irradiance responsivity of broadband radiometer	315 nm to 400 nm (UVA )	4.4%	6,250 per probe for the first irradiance level point + 3,130 for any additional irradiance level point	Source based calibration against a reference spectroradiometer using filtered 500 W Hg(Xe) as light source	13034-12090
		280 nm to 315 nm (UVB)	6.3%			13034-12091
		280 nm to 400 nm (UVA+UVB)	6.0%			13034-12092
		Arbitrary range within 280 nm to 1 020 nm	Varied by selected range			13034-12099
34	Integrated irradiance responsivity of narrowband radiometer	365 nm $\pm$ 10 nm	4.4%	6,250 per probe for the first irradiance level point + 3,130 for any additional irradiance level point	Source based calibration against a reference spectroradiometer using filtered 500 W Hg(Xe) as light source	13034-12110
		254 nm $\pm$ 10 nm	10%			13034-12113
		Arbitrary range within 280 nm to 1 020 nm	Varied by selected range			13034-12119
35	Responsivity of PAR radiometer	400 nm to 700 nm	2.0%	6,250	Direct measurement against a set of two FEL working standard lamps	13038-12120
36	Spectral irradiance of a tungsten-halogen lamp (FEL and Ushio type)	250 nm $\leq \lambda \leq$ 320 nm, BW = 5 nm	4.3% to 7.6%	11,250 for the first range of the first lamp + 5,630 for the first range of any additional lamp of the same type + 3,750 for any additional range	By scanning measurements against a set of two spectral irradiance standard lamps using a double subtractive monochromator	13037-13011
		320 nm $< \lambda \leq$ 400 nm, BW = 5 nm	2.5% to 3.8%			
		400 nm $< \lambda \leq$ 1 100 nm, BW = 5 nm	2.2% to 2.3%			
		1 100 nm $< \lambda \leq$ 1 800 nm, BW = 5 nm	2.7% to 2.9%			
		1 800 nm $< \lambda \leq$ 2 300 nm, BW = 10 nm	3.6% to 4.5%			
			4.9% to 10%			



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37	Spectral irradiance of a deuterium lamp	240 nm to 400 nm	3.8% to 10%	13,750 for the first lamp + 5,630 for any additional lamp	By scanning measurements against a spectral irradiance reference national standard lamp using a double subtractive monochromator	13037-13012
38	Measurement of absolute / relative spectral irradiance of a light source	250 nm to 1 020 nm	Greater than or equal to 2.4%	6,250 for the first lamp + 3,130 for any additional lamp of the same type	Measurement by a working standard diode array spectroradiometer	13034-13013
39	Measurement of integrated absolute irradiance of a light source	320 nm to 400 nm (UVA)	4.2%	6,250 for the first lamp (per range) + 3,130 for any additional lamp of the same type (per range)	Measurement by a working standard radiometer	13035-15090
		260 nm to 320 nm (UVB)	6.4%			13035-15091
		400 nm to 500 nm	3.6%			13035-15098
40	Measurement of linearity response of a photo-detector	At discrete wavelengths from 200 nm to 2 500 nm Beam size ranges from 25 micron to 5 mm	200 nm to 400 nm: $\pm 0.1\%$ 400 nm to 2 500 nm: $\pm 0.05\%$	4,375 for one combination of wavelength and beam size of one photo-detector	Flux superposition method	13032-12900
41	Measurement of uniformity of response of a photo-detector	At discrete wavelengths from 200 nm to 2 500 nm Beam size ranges from 25 micron to 5 mm	201 nm to 400 nm: $\pm 0.2\%$ 400 nm to 2 500 nm: $\pm 0.1\%$	6,250 for one combination of wavelength and beam size of one photo-detector	x-y linear scan	13032-12910
42	Luminous intensity of a single packaged LED	0.1 cd to 100 cd	2.3% to 3.4% varied with LED color	15,000 for the first LED (CIE condition A and B) + 7,500 for any additional LED of the same type	Spectroradiometric method against two spectral irradiance standard lamps for CIE condition A and B	13045-11012
43	Luminous flux of a single-packaged LED	0.1 lm to 200 lm	1.8% to 2.3% varied with LED color	12,500 for the first LED + 6,250 for any additional LED of the same type	Absolute integrating sphere method against two spectral irradiance standard lamps	13045-11032



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44	Distribution temperature of tungsten lamp	2 600 K to 3 200 K	20 K* varied by UUC	6,500 (+ 500 for chromaticity coordinate)	Measurement by a working standard spectroradiometer	13041-15010
45	Correlated colour temperature of general light source	2 600 K to 6 600 K	21 K* varied by UUC	6,500 (+ 500 for chromaticity coordinate)	Measurement by a working standard spectroradiometer	13041-15021
46	Chromaticity coordinate of general light source	0 to 0.9 at approximately 1 nm bandwidth	$U(x)=0.001\ 7^*$ $U(y)=0.000\ 6^*$ $U(u)=0.001\ 0^*$ $U(v)=0.000\ 3^*$ $U(u')=0.001\ 0^*$ $U(v')=0.000\ 5^*$ varied by UUC	6,500 (+ 500 for correlated color temperature)	Measurement by a working standard spectroradiometer	13041-15040
47	Correlated color temperature response of a color temperature meter	2 600 K to 10 000 K	45 K to 140 K	6,500 for the first calibration point + 1,000 for any additional point	Spectroradiometric method	13041-15030
48	Chromaticity response of a colorimeter	x : 0.122 3 to 0.696 2 y : 0.089 3 to 0.693 5 u' : 0.051 7 to 0.530 4 v' : 0.210 1 to 0.565 5	0.002 in (x,y) and (u',v')	6,500 for the first calibration point + 1,000 for any additional point	Spectroradiometric method	13041-15050



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<b>On-site Calibration</b>						
49	Measurement of absolute / relative spectral irradiance of a light source	250 nm to 1020 nm	3.4% to 9.8%	6,250	Measurement by a working standard diode array spectroradiometer	13034-33013
50	Measurement of integrated absolute irradiance of a light source	320 nm to 400 nm (UVA)	4.2%	6,130 (per range)	Measurement by a working standard radiometer	13035-35090
		260 nm to 320 nm (UVB)	6.4%			13035-35091
		400 nm to 500 nm	3.6%			13035-35098
51	Solar simulator performance testing according to IEC 60904-9	400 nm to 1,100 nm for spectral match evaluation	0.006* to 0.02*	6,250/irradiance level/DUT	Measurements based on IEC 60904-9	13034-33014
		≥ 6,606 cm <sup>2</sup> for designated test area of non-uniformity evaluation	0.10%	10,000 for 64 test positions + 500/additional test position		
		Data sampling time of DUT ≥ 2 ms for instability evaluation	0.05%	6,250/DUT		

- Note: 1. If the lamp aging is required, the fee is 500 Baht per hour per lamp.  
 2. If the customer requests an adjustment for the unit under calibration, there will be an additional charge to cover for the adjustment fee.  
 3. The uncertainties in the above table are expanded relative measurement uncertainties unless marked with \*.  
 4. For any measurand related to the spectral property or spectrally integrated property, the measurement uncertainty varies by wavelength range of interest and depends on the UUC.