CERTIFICATE OF ACCREDITATION

In terms of section 22(2) (b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

NATIONAL METROLOGY INSTITUTE OF SOUTH AFRICA
PHOTOMETRY AND RADIOMETRY CALIBRATION LABORATORY

Accreditation Number: **1611**

is a South African National Accreditation System accredited Calibration Laboratory provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying scope of accreditation Annexure "A", bearing the above accreditation number for

PHOTOMETRY AND RADIOMETRY METROLOGY

The facility is accredited in accordance with the recognised International Standard

ISO/IEC 17025:2017

The accreditation demonstrates technical competency for a defined scope and the operation of a laboratory quality management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the relevant SANAS accreditation symbol to issue facility reports and/or certificates

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Mr T Baleni
Acting Chief Executive Officer

Effective Date: 21 April 2021
Certificate Expires: 29 September 2025

ANNEXURE A

SCOPE OF ACCREDITATION

PHOTOMETRY AND RADIOMETRY METROLOGY

Accreditation Number: 1611

Permanent Address of Laboratory:
National Metrology Institute of SA
Photometry and Radiometry Calibration Laboratory
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Technical Signatories:

Mr RH Sieberhagen	(Items 2.1.1, 2.4, 3.1.1, 3.2.1, 3.3.1, & 5.2.1)
Mrs I Rabe	(Items 1.1.1, 1.2.1, 1.3.1.1, 1.3.1.2, 1.4.1, 1.5.1, 1.6, 2.1.1, 2.3.0, 3.2.1, 5.2.1, 5.3.0, 5.4.0.1, 5.5 & 6.9)
Mr EK Mofokeng	(Items 1.1.1, 1.2.1, 1.3.2, 1.3.2.1, 1.4.1, 1.5.1, 1.6, 1.7.1, 2.2.3, 2.9.0, 4.1.1, 4.2.1, 4.3.1, 4.5.1, 4.15, 5.2.1, 5.2.2, 5.4, 5.6.0, & 6.6.0)
Mr PJW du Toit	(Items 1.1.1,1.2.1, 1.3.1.2, 1.3.2, 1.3.2.1, 1.4.1, 1.5.1, 1.6, 1.7.1, 2.1.1, 2.2.3, 2.3.0, 2.4.0, 2.9.0, 3.1.1, 3.1.2, 3.2.1, 5.2.1, 5.2.2, 5.4.0, 5.5.0 & 5.6.0)
Dr L Burger	(Items 1.3.1.1, 4.1.1, 4.2.1, 4.3.1, 4.15 & 6.6.0)
Mr M Mkabela	(Items 1.2.1, 1.6, 2.9.0 & 3.1.2)

Nominated Representative: Ms LN Ntatamala

Issue No.: 16
Date of Issue: 21 April 2021
Expiry Date: 29 September 2025

ITEM	MEASURED QUANTITY OR TYPE OF GAUGE OR INSTRUMENT	MEASUREMENT CONDITIONS	RANGE OF MEASURED QUANTITY	CALIBRATION AND MEASUREMENT CAPABILITY EXPRESSED AS AN UNCERTAINTY (±)	METHOD / PROCEDURE
1	**PHOTOMETRY**				
1.1	**Luminous Intensity**				
1.1.1	Tungsten lamp	Correlated colour temperature 2 856 K	80 cd to < 1 000 cd 1 000 cd	2,5 % 2,4 %	Measurement using a reference photometer and inverse square law.
1.2	**Illuminance responsivity**				
1.2.1	Tungsten source, illuminance meter	Correlated colour temperature 2 856 K	Illuminance levels 40 lx to 200 lx 200 lx to 2 000 lx	2,7 % 2,8 %	Comparison against reference luminous intensity lamp using inverse square law.

The CMC, expressed as an expanded uncertainty of measurement, is stated as the standard uncertainty of measurement multiplied by a coverage factor $k = 2$, corresponding to a confidence level of approximately 95%

Executive Accreditation

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1	**PHOTOMETRY**				
1.3	**Luminous flux**				
1.3.1.1	Tungsten lamp	Correlated colour temperature 2 700 K to 2 856 K	Luminous flux level: 1 000 lm to 4 500 lm	1,5 %	Measured with reference goniophotometer.
1.3.1.2	Tungsten lamp	Correlated colour temperature 2 700 K to 2 856 K	Luminous flux level: 1 000 lm to 4 500 lm	2,6 %	Comparison against reference luminous flux lamp using integrating sphere and photometer.
1.3.2	LED	Geometric measurement conditions: Full Colour: White	Luminous flux level: 0,5 lm to 30 lm 30 lm to 1 000 lm	4,4 % 3,1 %	Measured with reference sphere-spectrometer system.
1.3.2.1	Lamp efficacy, LED	Geometric measurement conditions: Full White LED	8 lm/W to 300 lm/W	4,3 %	Measured with reference sphere-spectrometer system and reference power analyser.
1.4	**Illuminance**				
1.4.1	Tungsten lamp	Correlated colour temperature 2 856 K	17 lx to 1 000 lx 1 000 lx to 3 700 lx	2,4 % 2,3 %	Measured with reference photometer.
1.5	**Luminance**				
1.5.1	Tungsten-based source	Correlated colour temperature 2 856 K	5 to 700 cd/m^2	2,8 %	Measured with reference spectroradiometer.
1.6	**Luminance responsivity**				
1.6.0.1	Tungsten lamp - luminance meter	Correlated colour temperature 2 856 K	Luminance level 5 to 700 cd/m^2	3,1 %	Comparison against reference luminous intensity lamp using inverse square law and reflectance of reference diffuser at 0/45° geometry.
1.6.0.2	Tungsten lamp, luminance meter			3,3 %	Comparison against reference spectroradiometer
1.7	**Averaged luminous intensity**				
1.7.1	LED	CIE Condition A or B, White LED	Luminous intensity range: 0,01 cd to 1 000 cd	2,6 %	Measured with reference spectrometer

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2	**PROPERTIES OF DETECTORS**				
2.1	**Responsivity, Spectral, Power**				
2.1.1	Broad band detector: Photodiode	Wavelength range: 260 nm to 270 nm 270 nm to 390 nm 390 nm to 400 nm 600 nm to 1 050 nm Bandwidth: 1 nm to 10 nm	Power Level: 1 µW to 100 µW A W^{-1} nm^{-1} or V W^{-1} nm^{-1} or Reading W^{-1} nm^{-1}	4,3 % 3,4 % 2,7 % 2,7 %	Comparison against reference detector using monochromator or bandpass filters
2.2	**Responsivity, Spectral, Irradiance**				
2.2.3	Spectroradiometer	Wavelength range: 350 nm to < 450 nm 450 nm to 1 020 nm Bandwidth: 1,85 nm	Spectral irradiance level 8 x 10^{-3} $W/m^2/nm$ to 2 x 10^{-1} $W/m^2/nm$	2,5 % 1,5 %	Comparison against reference spectral irradiance lamp
2.3	**Responsivity, Spectral, Radiance**				
2.3.0	Spectroradiometer	Wavelength range: 380 nm to 390 nm 390 nm to 830 nm 830 nm to 1 000 nm 1 000 nm to 1 080 nm Bandwidth: 14 nm	Spectral radiance level < 100 $W/sr/m^2/nm$	1,9 % 1,5 % 1,6 % 1,7 %	Comparison against reference spectral irradiance lamp and reflectance of reference diffuser at 0/45° geometry
2.4	**Responsivity, Laser, Power**				
2.4.0	General detector, photodiode	Wavelength range 250 nm to 1 050 nm	Power level 0,1 mW to 1 mW	1,2 %	Comparison against reference detector using laser source or broadband source with monochromator or bandpass filters
	General detector Black thermal detector		Power level 0,3 mW to 3 mW	2,0 %	
2.9	**Responsivity, UV, Broadband irradiance**				
2.9.0	Broadband radiometer: UV-A radiometer	Wavelength range: 315 nm to 400 nm	Irradiance level: 140 µW/cm^2 to 2 000 µW/cm^2	5,7 %	Comparison against reference UV-A radiometer using UV-A (Hg) lamp (Calibration can be performed against other sources with different uncertainty)
	UV-B radiometer	Wavelength range: 280 nm to 315 nm	Irradiance level: 120 µW/cm^2 to 1 800 µW/cm^2	6,0 %	Comparison against reference UV-B radiometer using UV-B (Hg) lamp

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2.9.0 Cont.	UV-C (UVGI) radiometer	Wavelength range: 245 nm to 280 nm	Irradiance level: 80 µW/cm^2 to 1 600 µW/cm^2	6,5 %	Comparison against reference UV-C radiometer using UV-C (Hg) lamp
	Bilirubin (Blue light) radiometer	Wavelength range: 390 nm to 550 nm	Irradiance level: 25 µW/cm^2 to 375 µW/cm^2	4,7 %	Comparison against reference Bilirubin radiometer using Bilirubin (Hg) lamp
3	**SPECTRAL EMMISSION PROPERTIES OF SOURCES**				
3.1	**Irradiance, Spectral**				
3.1.1	Tungsten lamp (Other sources e.g. Hg lamps and LEDs can be measured with different uncertainty)	Wavelength range 280 nm to < 300 nm 300 nm to < 315 nm 315 nm to < 365 nm 365 nm to < 415 nm 415 nm to 550 nm Bandwidth 2 nm	Spectral Irradiance level 0,00007 W/m^2/nm to 0,09 W/m^2/nm	12 % 9,1 % 5,4 % 3,0 % 2,0 %	Comparison against reference spectral irradiance lamp using spectroradiometer.
3.1.2	Deuterium lamp	Wavelength range: 230 nm to < 250 nm 250 nm to < 280 nm 280 nm to < 315 nm 315 nm to < 340 nm 340 nm to < 360 nm 360 nm to 375 nm Bandwidth: 8 nm	Spectral Irradiance level 0,00001 W/m^2/nm to 0,1 W/m^2/nm	8,3 % 5,9 % 5,9 % 6,4 % 7,5 % 9,2 %	Comparison against reference spectral irradiance lamp using spectroradiometer
3.2	**Radiance Spectral**				
3.2.1	Tungsten lamp	Wavelength range: 380 nm to 1 080 nm Bandwidth: 2 nm, 8 nm or 14 nm	Spectral radiance level 0,0001 W/sr/m^2/nm to 100 W/sr/m^2/nm	5,0 %	Measured with reference spectroradiometer.
3.3	**Power, Spectral Total Radiant**				
3.3.1	Laser, CW	Wavelength Range 250 nm to 1 050 nm (photodiode detector)	Power level 0,1 mW to 1 mW	1,2 %	Measured with reference detector.

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4	**SPECTRAL PROPERTIES OF MATERIALS**				
4.1	**Transmittance, Regular, Spectral**				
4.1.1	Spectrally-neutral material	Wavelength range: 200 nm to 2 600 nm Bandwidth: 2 nm	Ratio: 0,0001 to 1,0000	0,0001 + 4,0E-3X X = transmittance	Measured with reference spectrophotometer.
4.2	**Transmittance, Diffuse, Spectral**				
4.2.1	Spectrally-neutral material	Bandwidth 0,5 to 4,0 nm Integrating Sphere, 8º/diffuse Wavelength range: 380 to 800 nm Integrating Sphere, 0º/total Wavelength range: 350 to 1 500 nm	Ratio: 0,0005 to 1,0000 0,0005 to 1,0000	0,0005 + 8,0E-3X X = transmittance 0,0005 + 2,0E-2X X = transmittance	Measured with reference spectrophotometer.
4.3 Absorbance, Regular, Spectral					
4.3.1	Spectrally-neutral material	Wavelength range: 200 to 800 nm Bandwidth: 0,5 to 2,0 nm Normal Incidence	0,0005 A to 1,0000 A 1,0000 A to 2,0000 A 2,0000 A to 3,0000 A	0,012 A 0,010 A 0,029 A	Measured with reference spectrophotometer.
4.5 Reflectance, Diffuse, Spectral					
4.5.1	Spectrally-neutral material	Wavelength range: 350 nm to 380 nm 380 nm to 800 nm 800 nm to 1 500 nm Bandwidth: 2,0 nm 8º/total, 8º/diffuse, normal/diffuse	Ratio: 0,0005 to 1,0000	0,78 % R 0,43 % R 0,80 % R	Measured with reference spectrophotometer.
4	**SPECTRAL PROPERTIES OF MATERIALS**				
4.15	**Wavelength**				
4.15.0	Spectrally-selective transmitting material	Bandwidth: 2 nm	200 nm to 380 nm 380 nm to 800 nm 800 nm to 1 400 nm 1 400 nm to 2 500 nm	0,45 nm 0,38 nm 0,73 nm 0,58 nm	Measured with reference spectrophotometer.

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5	**SPECTRALLY - INTEGRATED MEASUREMENTS FOR SOURCES AND DETECTORS**				
5.2	**Correlated colour temperature**				
5.2.1	Tungsten lamp		2 856 K	29 K	Measured with reference spectroradiometer and reflectance of reference diffuser at 0/45° geometry.
5.2.2	LED		3 000 K 6 000 K	35 K 240 K	Measured with reference sphere-spectrometer system.
5.3	**Correlated colour temperature response**				
5.3.0	Tungsten lamp		2 856 K	30 K	Comparison against reference correlated colour temperature lamp using reflectance of reference diffuser at 0/45° geometry
5.4	**Colour, Emitted**				
5.4.0.1	General source, colour space: x, y	Bandwidth: 14 nm Type of source: Tungsten lamp, Xenon lamp, etc	0 to 0,9	0,004	Measured with reference spectroradiometer.
5.4.0.2	General source, colour space: x, y	Bandwidth: 1,85 nm Type of source: LED source	0 to 0,9	Colour: (x, y) White: (0,0046; 0,0068)	Measured with reference sphere-spectrometer system.
5.5	**Chromaticity response**				
5.5.0	Colorimeter	Bandwidth: 14 nm Type of source: LCD display	x, y: 0 to 0,9 Y: 0 % to 100 %	0,005 2,8 %	Comparison against reference spectroradiometer.
5.6	**Colour Rendering, Ra**				
5.6.0	General source	Type of source: White Light Source	< 100	1,8	Measured with reference spectrometer.

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ANNEXURE A

Accreditation No: 1611
Date of Issue: 21 April 2021
Expiry Date: 29 September 2025

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6	**COLOUR AND OTHER SPECTRALLY INTEGRATED MEASUREMENT OF MATERIALS**				
6.6	**Gloss**				
6.6.0	General material	Measurement geometry: 20° 60° 85°	0,1 GU to 99 GU	1,0 GU 1,1 GU 1,1 GU	Measured with reference glossmeter.
6.9	**Luminance factor**				
6.9.0	General material, white diffuser	Type of Source: Tungsten lamp Geometry: 0°/ 45° Bandwidth: 14 nm	0 to 1	1,5 %	Comparison against reference reflectance diffuser using Spectro-radiometer and defined quantities
	General material			Blue : 1,3 % Green : 0,52 % Orange : 0,63 % Yellow : 0,54 % Red : 0,78 %	Comparison against reference ceramic tiles using spectroradiometer and defined quantities.

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ISSUED BY THE SOUTH AFRICAN NATIONAL ACCREDITATION SYSTEM

Executive Accreditation