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Calibration Laboratory CL-233

has met the requirements of AC204, *IAS Accreditation Criteria for Calibration Laboratories*, and has demonstrated compliance with the ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories*. This organization is accredited to provide the services specified in the scope of accreditation maintained on the following page(s).

This certificate is valid up to September 1, 2021.

(See laboratory's scope of accreditation for fields of calibration and accredited calibration.)

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President

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IAS Accreditation Number	CL-233
Accredited Entity	TRANSCAL
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Effective Date of Scope	August 4, 2020
Accreditation Standard	ISO/IEC 17025:2017

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Dimensional			
Height Gauge (Vernier/Dial/ Digital)	0 mm to 600 mm 0 mm to 1000 mm	2.2 µm 2.4 µm	Using Gauge Blocks/Caliper Checker
V- Block (Parallelism, Symmetricity)	300x125x200 mm	4.4 µm	Using Lever Dial Gauge & Mandrel
Caliper (Vernier/Dial/ Digital)	0 mm to 600 mm 0 mm to 1000 mm 0 mm to 2000 mm	7.8 µm 10 µm 12 µm	Using Gauge Block Set, Caliper Checker
External Micrometer (Mechanical / Electronic / Digital)	0 mm to 25 mm	0.4 µm	Using Gauge Blocks
	0 mm to 150 mm 0 mm to 1000 mm 0 mm to 2000 mm	0.6 µm 1.7 µm 11 µm	Using Gauge Blocks
Electronic Probe	0 to 25mm 0 to 50 mm	0.5 um 0.9 µm	Using Gauge Blocks
Wire Gauge	0.19 mm to 7.62 mm	8 µm	Using Vision System
Hegman Gauge	up to 1 mm	2.3 µm	Using Plunger Dial Gauge
Wet Film Thickness Gauge	0.025 mm to 5 mm	5.9 µm	Vision System
Depth Micrometer	0 mm to 300 mm 0 mm to 600 mm	6 µm 11 µm	Using Gauge Block Set
Depth Caliper	0 mm to 300 mm 0 mm to 600 mm	6.4 µm 13 µm	Using Gauge Block Set
Micrometer Setting Rod	25 mm to 1000 mm 1000 mm to 1950 mm	4.7 µm 7.9 µm	Using Gauge Block Set
Angle Graticule	0 deg to 360°°	1.8’	Using Vision System, Comparison method
Laser Distance Meter	0 mm to 2000 mm	350 µm	Using Slip Gauge, Comparison Method
Inclinometer	0° to 90°	1.7’	Using Angle Gauge Blocks, Comparison Method

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

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Bench Center (Co-axiality)	0 mm to 500 mm	8.9 µm	Using Straight & Taper Mandrels, Dial Gauge. IS 5980
Angle Plate	450 mm x 300 mm x 200 mm	11 µm	Using Liver Dial Gauge, IS 2554, IS 6973
Flakiness Gauge	0 mm to 100 mm	5.9 um	Using Vision System & 2D Height Gauge, Comparison Method
Elongation Gauge	0 mm to 100 mm	5.9 um	Using 2D Height Gauge, Comparison Method
Dial Gauge (Plunger /Digital/ Dial Thickness Gauge)	0 mm to 100 mm	0.7 µm	Using Length Measuring Machine
Dial Gauge (Lever Type)	0 mm to 2 mm	0.5 µm	Using Length Measuring Machine
Bore Dial Gauge for Transmission Accuracy check	0 mm to 2 mm	1.8 µm	Using Length Measuring Machine
Surface Plate	5 m X 3 m	1.3 √((L+W)/100) L = Length in mm W = Width in mm	Using Electronic Level
Plain Plug Gauge	0 mm to 100 mm 100 mm to 400 mm	1 µm 1.6 µm	Using Length Measuring Machine, Master Disc, FCDM
Feeler Gauge	Up to 1 mm	1.4 µm	Using Digital Micrometer
Cylindrical Measuring Pin	0.1 mm to 26 mm	0.9 µm	Using Length Measuring Machine, Master Disc, FCDM
Thread Plug Gauge (Major Diameter & Effective Diameter)	3 mm to 100 mm 100 mm to 400 mm	1.2 µm 1.7 µm	Using Length Measuring Machine, Master Disc, FCDM
Snap Gauge	3 mm to 500 mm	2.7 µm	Using Gauge Block Set
Bevel Protractor / Combination Set	0° to 360°	2.9'	Using Angle Block Set
Thread Ring Gauge (For Effective Diameter & Minor Diameter only)	3 mm to 325 mm	1.9 µm	Using Length Measuring Machine, Master Ring
Spirit Level (Type 1, 2 & 3)	Up to 4 mm/m	7.1 µm	Using Electronic Level
Plain Ring Gauge	3 mm to 325 mm	1.9 µm	Using Length Measuring Machine, Master Ring
Measuring Scales	Up to 3000 mm	114 √(L) µm where L is length in m	Using Length Measuring Machine
Measuring Tape/ Pi Tape	Up to 50 m	114 √(L) µm where L is length in m	Using Length Measuring Machine

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Thread Pitch Gauge Pitch	0.25 mm to 6.35 mm	4.8 µm	Using Vision System
Thread Pitch Gauge Angle	55° 60°	1.2' 1.2'	Using Vision System
Radius Gauge	0.4 mm to 50 mm	5.6 µm	Using Vision System
Internal / Stick Micrometer (2 Point)	50 mm to 5000 mm	(1.25 + 3.27L) µm where L is length in m	Using Gauge Block Set
Engineering Square (Squareness)	Up to 400 mm	6.2 µm	Using Granite Square & Slip Gauge
Test Sieves	0.03 mm to 125 mm	4.8 µm	Using Vision System
Comparator Stand (Flatness of worktable)	200 mm x 200 mm	2.4 µm	Using Lever Dial Gauge
Straight Edge/Parallels	Up to 2000 mm	2.8 µm	Using Electronic Level
Inside/ Outside Dial Caliper	0 mm to 150 mm	0.7 µm	Using Gauge Block Set
Pistol Caliper	0 mm to 100 mm	60 µm	Using Gauge Block Set
Thickness Plate/Foils	Up to 2.5 mm	1.6 µm	Using Digital Micrometer
Limit Gauge /Test probes (Length, Radius / Diameter, Angle)	0 mm to 400 mm 360°	4.6 µm 2.4'	Using Vision System
Coating Thickness Gauge with Foils	0 mm to 2000 µm	1.8 µm	Using Standard Thickness Foils
Taper Thread Plug Gauge (Up to 150 mm diameter)	Taper angle and Flank angle Diameter at ends	3.2" 1.4 µm	Using Length Measuring Machine, Master Disc, FCDM; Vision system
3-Point Micrometer	2.5 mm to 100 mm	2.0 µm	Using set of Setting Ring Gauges
Taper Scale	1 mm to 15 mm	4.8 µm	Using Vision System
Ultrasonic Thickness Gauge	0 mm to 300 mm	38 µm	Using Gauge Block Set
Length Bars	50 mm to 500 mm	2.9 µm	Using Length Measuring Machine
Micrometer Head	0 mm to 50 mm	0.8 µm	Using Length Measuring Machine
Fillet Gauge/ Form Gauge	0 mm to 150 mm 0° to 90°	5.8 µm 5.4'	Using Vision System
Taper Plain Plug Gauge	Taper Half Angle Up to 100 mm	0.6" 0.9 µm	Using Length Measuring Machine
Taper Thread Ring Gauge	Up to 100 mm	0.9 µm	Using Length Measuring Machine

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Taper Plain Ring Gauge	Taper Half Angle Up to 100 mm	5.5” 0.9 µm	Using Length Measuring machine
Sine Bar/ Sine Centre / Sine Table	0° to 45°	2.8”	Using Gauge Blocks, Angle Blocks, Lever Dial Gauge
Profile Projector / Video Measuring machine /Microscope	10 X to 50 X	0.06 %	Using Gauge Blocks/Glass Scale
	0° to 360°	2.8”	Using Angle Gauge Blocks/Glass Scale
	400 mm	2.9 µm	Using Gauge Blocks/Glass Scale
Floating Carriage Micrometer	0 mm to 100 mm	1.5 µm	Using Mandrels & Master Cylinders, MOY/SCMI/9
Thread Measuring Wire	0.170 mm to 6.350 mm	0.5 µm	Using Electronic Probe with DRO, Comparison Method
Cylindrical Master (Diameter & Concentricity)	3 mm to 100 mm	1.1 µm (diameter) 1.3 µm (concentricity)	Electronic Probe with DRO, IS 6311
Slip Gauges (Gauge Blocks)	0.5 mm to 25 mm 25 mm to 50 mm 50 mm to 75 mm 75 mm to 100 mm	0.07 µm 0.10 µm 0.12 µm 0.15 µm	Slip Gauge Calibrator & k Grade Slip Gauges, IS 2984, ISO 3650
Dial Calibration Tester	0 mm to 25 mm	0.7 µm	Using Electronic Probe with DRO, by Comparison Method
Gauge Block Comparators	0 mm to 100 mm	0.03 µm	Using K grade Gauge Blocks by Direct Method
Surface Roughness Master specimen	Ra up to 10 µm Rz up to 25 µm	8 % 8 %	Using Surface Roughness Tester
Surface Roughness Tester	1 µm to 800 µm	8.1 %	Using Depth Master and roughness master
Caliper Checker	20 mm to 600 mm	2.1 µm	Electronic Comparator and gauge block (0 grade)
Length Measuring Machine	0 mm to 100 mm	0.3 µm	Using Gauge Block Set (0 Grade)
	0 mm to 1000 mm (Tape & Scale Calibration)	3.7 µm	Using Gauge Block Set and Long Gauge Block (0 Grade)
Long Gauge Blocks	100 mm to 200 mm 200 mm to 300 mm 300 mm to 500 mm	0.7 µm 0.9 µm 1.5 µm	Electronic Comparator and gauge blocks (0 Grade)
Glass Scale	0 mm to 300 mm	6.6 µm	Using Vision Measuring System
Mechanical			
Sound Level Meter (at 1 kHz)	94 dB and 114 dB	0.2 dB	Using Sound Level Calibrator

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Vibration Machine/Vibration Measurement (10 Hz to 6.8 kHz)	1 g to 40 g (where g is acceleration due to gravity)	3.2 %	Using Accelerometer
One Mark Pipette, Graduated Pipette, Graduated Burette, Volumetric Flask, Measuring Jar (Volumetric Glassware)	1 mL to 10 mL 10 mL to 100 mL 100 mL to 1000 mL 1000 mL to 5000 mL	0.00018 mL 0.0004 mL 0.005 mL 0.017 mL	Calibration based on Gravimetric method as per ISO 4787 using weighing balance of d = 0.1 mg, 1 mg, 10 mg and Distilled Water
Micro Pipette	1 µL to 10 µL 10 µL to 100 µL 100 µL to 1000 µL 1000 µL to 10000 µL	0.02 µL 0.04 µL 0.11 µL 1.9 µL	Calibration based on Gravimetric method as per ISO 8655 using weighing balance of d = 0.001 mg, 0.01 mg and Distilled Water
Digital / Analogue Pressure Gauges, Differential Pressure Gauge, Transducers, Transmitters, Switches	0.1 mbar to 10 mbar 10 mbar to 100 mbar 100 mbar to 2 bar 2 bar to 20 bar 20 bar to 40 bar 40 bar to 700 bar 700 bar to 1000 bar	0.93 % 0.06 % 0.045 % 0.043 % 0.016 % 0.023 % 0.02 %	Digital Pressure Gauge using Hydraulic Comparator Pump based on DKD – R 6 - 1
	1 bar to 35 bar 35 bar to 1200 bar	0.026 % 0.02 %	Using Hydraulic (Oil operated) Dead Weight Tester based on DKD – R6 - 1
Pirani gauges	0.006 mbar to 1013 mbar	1.7 %	Using Standard Pirani Gauge
Digital/Analogue Vacuum Gauges, Transducers/ Transmitters	-0.01 bar to -0.9 bar	0.22 %	Digital Pressure Gauge using Pneumatic Vacuum Comparator Pump based on DKD – R6 - 1
Absolute Pressure Gauges	200 mbar to 915 mbar (abs)	0.26 %	Standard absolute Gauge using desiccator and vacuum pump
Altimeter Chamber	30 mbar to 915 mbar	3 mbar	Using Barometer

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Calibration of E1 Class Weights and coarser	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg	0.0010 mg 0.0010 mg 0.0010 mg 0.0010 mg 0.0010 mg 0.0010 mg 0.0013 mg 0.0014 mg 0.0016 mg	Using E1 class Standard weights and Mass comparator of d = 0.1 µg, per OIML R – 111 by subdivision through ABBA cycles
	1 g 2 g 5 g 10 g 20 g	0.003 mg 0.004 mg 0.005 mg 0.006 mg 0.007 mg	Using Mass Comparator of d = 0.001 mg, per OIML R 111 by Substitution Method
	50 g 100 g 200 g 500 g 1 kg	0.01 mg 0.02 mg 0.03 mg 0.10 mg 0.20 mg	Using Mass Comparator of d = 0.01 mg, per OIML R 111 by Substitution Method
Calibration of E2 Class Weights and coarser	2 kg 5 kg 10 kg 20 kg	1 mg 2 mg 3 mg 7 mg	Using Mass Comparator of d = 1 mg, by Substitution Methods through ABBA Cycles as per OIML R - 111
	50 kg	100 mg	Using Mass Comparator of d = 100 mg, by Substitution Methods through ABBA Cycles as per OIML R - 111
Calibration of Class 1 Weighing Balances and coarser	1mg to 2 g 1 mg to 5 g 1 mg to 20 g 1mg to 50 g 1mg to 200 g 1mg to 500 g 1mg to 1 kg 500 mg to 5 kg 500 mg to 20 kg	0.0035 mg 0.005 mg 0.007 mg 0.02 mg 0.03 mg 0.10 mg 0.20 mg 1 mg 7 mg	E1 Class Standard Weights 1 mg to 20 kg, as per OIML R - 76
Calibration of Class 2 Weighing Balances and coarser	500 mg to 50 kg 500 mg to150 kg 1 kg to 300 kg 1 kg to 1000 kg 2 kg to 3000 kg	100 mg 1 g 20 g 100 g 500 g	F1 and M1 class Standard weights Up to 3000 kg, as per OIML R - 76
Spring Balance	10 g to 1500 g 1500 g to 100 kg	0.28 % 0.1 %	Using F1 class weights

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Torque Wrench, Torque Driver, Type I - Class B, C, D, E Type II - Class A, B, D, E	0.1 N·m to 10 N·m 10 N·m to 20 N·m 20 N·m to 200 N·m 200 N·m to 1000 N·m	0.89 % 0.38 % 0.43 % 0.62 %	Torque sensors of various capacities using Torque Calibration Rig Based on ISO 6789
Torque Measuring Devices	0.1 N·m to 1 N·m 1 N·m to 10 N·m 10 N·m to 500 N·m	0.15 % 0.3 % 0.3 %	Using Dead Weight Torque Calibration System as per BS 7882
Load Cells / Force Proving Instruments	0.1 N to 100 N 100 N to 2000 N	0.07 % 0.15 %	Using Newton weights as per ISO 373
Universal Testing Machine (UTM)	Compression: 20 N to 10 kN 20 kN to 1000 kN	 0.52 % 0.52 %	Using Force Proving Instruments as per IS 1828
	Tension: 20 N to 10 kN 20 kN to 100 kN	 0.29 % 0.29 %	
Displacement Measuring System and Devices used in Material Testing Machine	0 mm to 600 mm	0.27 mm	Using Gauge Blocks as per ASTM E2309
Extensometer used in Material Testing Machine - Gauge Length up to 200 mm	0 mm to 12.7 mm	0.16 mm	Using Digital Micrometer as per ISO 9513 and ASTM E83
Speed of Material Testing Machine	0 mm/min to 500 mm/min	0.6 mm/min	As per ASTM E2658
Push Pull Gauge	1 N to 2000 N	0.21 %	Newtonian Weights And Frame Fixture VDI/VDE 2624 – Part 2.1
Hydrometer	SG =0.6 to 1.0 SG =1.0 to 2.0	0.00014 0.00014	Calibration of Hydrometers by Cuckows method
Viscosity Cups, Zahn Cups	30 cSt to 240 cSt	0.33 %	Calibration as per IS 3944, ASTM D4212 using liquids of known kinematic viscosity
Liquid Flow Meter	1 m^3/h to 350 m^3/h	0.62 %	Using Clamp-On Ultra Sonic Flow Meter by Comparison Method
Flow Meters (Air)	0.1 L/min to 5 L/min 5 L/min to 500 L/min	0.77 % 1.0 %	Using Mass Flow Meter by Comparison Method
Velocity (Medium Air)	0.3 m/s to 30 m/s	1.3 %	Using Digital Anemometer
Liquid Flow Measuring Devices	0.001 t/h to 0.2 t/h 0.2 t/h to 4.5 t/h	0.03 % 0.16 %	Using Weighing System by Gravimetric Method

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CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Rubber Hardness Tester	Shore A, B, E, O Shore C, D, DO	0.1 % 0.1 %	Using Load Cell with Indicator
Rockwell Hardness Testing Machines	HRA HRBW HRC	0.62 HRA 0.65 HRBW 0.63 HRC	Using Standard Hardness Blocks as per IS 1586 (Part II) / ISO 6508 - 2 by Indirect Method
Brinell Hardness Testing Machines	HBW 2.5 / 187.5 HBW 5 / 750 HBW 10 / 3000	1.5 % 1.5 % 1.5 %	Using Standard Hardness Blocks as per IS 1500 (Part II) / ISO 6506 - 2 by Indirect Method
Vickers Hardness Testing Machines	HV 10 HV 20 HV 30 HV 50	1.1 % 1.1 % 1.1 % 1.1 %	Using Standard Hardness Blocks as per IS 1501 (Part II) / ISO 6507 - 2 by Indirect Method
Thermal			
Humidity Meters (Dial / Digital)	0.5 %RH 5 %RH 95 %RH	0.33 %RH 0.33 %RH 0.85 %RH	Using Humidity standard solution by direct method
Dial /Digital Humidity Meters	10 %RH to 95 %RH (at 10 °C to 60 °C)	0.80 %RH	Using Temperature & Humidity Meter with Humidity Chamber by Comparison Method
Humidity Transmitters (for temperature scale)	0 °C to 60 °C	0.18 °C	Using Class 'A' RTD Sensor /PRT sensor with Digital Indicator by comparison
RTD, Thermocouples, Indicator with sensor	-196 °C	0.08 °C	Using LN_2 and cryo bath by comparison method
	-100 °C to -45 °C -45 °C to 140 °C 140 °C to 650 °C	0.09 °C 0.02 °C 0.08 °C	Using Dry Temperature Bath, SPRT with Digital Indicator by comparison Method
	650 °C to 1000 °C 1000 °C to 1200 °C	0.43 °C 1.5 °C	Using Dry Temperature Bath, S- Type Thermo couple with Digital Indicator by Comparison Method
Glass Thermometer	-40 °C to 200 °C	0.18 °C	Using Liquid Bath, SPRT with Digital Indicator by Comparison Method

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Oil Bath, Low & High Temperature Bath, Dry Bath, Incubators & Autoclave, Thermal Chambers / Ovens, Water Bath, Furnace	-100 °C to 140 °C 140 °C to 650 °C	0.072 °C 0.08 °C	Using SPRT with Digital Indicator by Direct Method
	650 °C to 1200 °C	1.5 °C	Using S- Type Thermo couple with Digital Indicator by Direct Method
Humidity Chambers, Climatic Chambers, Dry cabinet, De-humidifier	10 %RH to 95 %RH (at 10 °C to 60 °C)	0.98 %RH	Using Temperature & Humidity Meter by Direct Method
	5 %RH to 10 %RH @ ambient temperature	1.3 %RH	
IR Thermometer	0 °C 50 °C to 650 °C 650 °C to 1200 °C	1.0 °C 1.0 °C 1.7 °C	By Comparison Method
Electrical / DC / Low Frequency			
AC Voltage Generate[4]	50 µV to 2 mV (50 Hz to 1 kHz) 2 mV to 20 mV (10 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 500 kHz) (500 kHz to 1 MHz) 20 mV to 200 mV (10 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 300 kHz) (300 kHz to 1 MHz) 200 mV to 2 V (10 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 300 kHz) (300 kHz to 1 MHz) 2 V to 20 V (10 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 300 kHz)	1 % 700 µV/V + 5 µV 190 µV/V + 5 µV 460 µV/V + 5.6 µV 850 µV/V + 7 µV 0.12 %+ 16 µV 0.17 % + 25 µV 0.45 % + 5 µV 320 µV/V + 8 µV 140 µV/V + 9 µV 380 µV/V + 9 µV 0.13 %+ 30 µV 0.41 % + 100 µV 175 µV/V + 35 µV 95 µV/V + 10 µV 145 µV/V + 20 µV 0.04 %+ 70 µV 0.3 % + 1 mV 175 µV/V + 350 µV 95 µV/V + 100 µV 145 µV/V + 200 µV 0.04 %+ 700 µV	Using Calibrator Fluke 5700A/5522A by Direct Method

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CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
AC Voltage Generate[4] continued	2 V to 20 V (300 kHz to 1 MHz) 20 V to 30 V (300 kHz to 500 kHz) 20 V to 220 V (10 Hz to 40 Hz) (40 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) 200 V to 1000 V (50 Hz to 1 kHz)	 0.3 % + 12 mV 0.9 % + 15 mV 175 µV/V + 3.5 mV 100 µV/V + 1.1 mV 240 µV/V + 3.5 mV 0.06 %+ 10 mV 150 µV/V + 4 mV	Using Calibrator Fluke 5700A/5522A by Direct Method
AC Current Generate[4]	10 µA to 200 µA (40 Hz to 1 kHz) 200 µA to 2 mA (10 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz) 2 mA to 20 mA (10 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz) 20 mA to 200 mA (10 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz) 200 mA to 2 A (40 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz) 2 A to 10 A (45 Hz to 100 Hz) (100 Hz to 1 kHz) (1 kHz to 5 kHz) 10 A to 20 A (45 Hz to 100 Hz) (100 Hz to 1 kHz)	 190 µA/A + 16 nA 650 µA/A + 35 nA 190 µA/A + 35 nA 700 µA/A + 0.4 µA 0.16 % + 0.8 µA 650 µA/A + 350 nA 190 µA/A + 350 nA 700 µA/A + 4 µA 0.16 % + 8 µA 650 µA/A + 3.5 µA 190 µA/A + 3.5 µA 700 µA/A + 40 µA 0.16 % + 80 µA 650 µA/A + 35 µA 900 µA/A + 80 µA 0.85 % + 160 µA 0.08 % + 2 mA 0.08 % + 2 mA 3.4 % + 2 mA 0.15 % + 5 mA 0.18 % + 5 mA	Using Calibrator Fluke 5700A/5522A by Direct Method

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CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
AC Current Generate[4] continued	10 A to 20 A (1 kHz to 5 kHz)	3.4 % +5 mA	Using Calibrator Fluke 5700A/5522A by Direct Method
	20 A to 120 A (50 Hz to 1 kHz)	0.1 %	Using current source Omicron, Direct Method
	120 A to 1000 A (50 Hz to 400 Hz) 1000 A to 3000 A (50 Hz)	0.4 % 1.2%	Using current source current coil
AC Power Generate[4] Single Phase, 50 Hz, UPF 120 V to 1000 V 0.01 A to 20 A	0.01 W to 4.8 kW 4.8 kW to 1 MW	0.12 % 0.8 %	Using Calibrator Fluke 5522A Direct Method
AC Power Generate[4] Single Phase, 50 Hz, 0.2 PF lead/lag, 120 V to 1000 V 0.1 A to 20 A	2.4 W to 200 kW	1 %	
AC Power Generate[4] Single Phase, 50Hz, 0.5 PF lead/lag, 120 V to 1000 V 0.1 A to 20 A	6 W to 500 kW	0.50 %	
AC Power Generate[4] Single Phase, 50Hz, 0.8 PF lead/lag, 120V to 1000 V, 0.1 A to 20 A	9.6 W to 800 kW	0.23 %	
AC Energy Generate[4] Active /Reactive Single & Three Phase, 40 V to 300 V, 0.05 A to 20 A, 40 Hz to70 Hz	0.5 Wh to 6 kWh (0.25 pF to 1 pF)	0.25 %	Using Three Phase Energy Source Direct Method
Power Factor, Three phase	0.25 PF Lag to Unity 0.25 PF Lead to Unity	0.006 PF	Using Edutech Energy source by direct method

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Power Factor, Single phase	0.2 PF Lead to unity 0.2 PF Lag to Unity	0.002 PF	Using Calibrator Fluke 5522A by Direct Method
DC Voltage Generate[4]	1.018 V, 10 V	3 µV/V	Using 732B Reference Standard by Direct Method
	50 µV to 0.5 mV 0.5 mV to 220 mV 220 mV to 2.2 V 2.2 V to 11 V 11 V to 22 V 22V to 220 V 220 V to 1000 V	0.2 % 7 µV/V + 1 µV 8 µV/V + 1 µV 8 µV/V + 3.5 µV 8 µV/V + 6.5 µV 9 µV/V + 80 µV 11 µV/V + 500 µV	Using Calibrator Fluke 5700A by Direct Method
DC Current Generate[4]/ Measure[5]	10 nA to 10 µA	0.15 %	Using Reference 732B, Decade Megohm box, DMM by VI method
DC Current Generate[4]	10 µA to 200 µA 200 µA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A 2 A to 10 A 10 A to 20 A	70 µA/A + 8 nA 62 µA/A + 8 nA 72 µA/A + 80 nA 82 µA/A + 0.8 µA 100 µA/A + 25 µA 0.06 % + 500 µA 0.12 % +750 µA	Using Fluke 5700A/5522A
	20 A to 1000 A 1000 A to 3000 A	0.4 % 1.2 %	Using Current Source with current coil
DC Power Generate[4] (1V to 1000 V, 1mA to 1000 A)	1 mW to 1 kW 1 kW to 1 MW	0.08 % 0.65 %	Using Calibrator Fluke 5522A with 50 turns current coil, Direct Method
DC Resistance Generate[4]	75 µΩ 0.001 Ω to 0.1 Ω 0.1 Ω to 1 Ω	1 % 0.6 % 0.1 %	Using Standard Resistors & Shunts by V-I Method
	1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ 1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 300 MΩ 300 MΩ to 1 GΩ	35 uΩ/Ω + 1 mΩ 35 uΩ/Ω + 1.4 mΩ 35 uΩ/Ω + 2 mΩ 35 uΩ/Ω + 0.02 Ω 35 uΩ/Ω + 0.2 Ω 40 uΩ/Ω + 2 Ω 150 uΩ/Ω + 50 Ω 600 uΩ/Ω + 3 kΩ 0.36 % + 100 kΩ 1.7 % + 500 kΩ	Using Calibrator Fluke 5522 A by Direct Method
	1 GΩ to 1 TΩ	1 %	Using Decade MegOhm Box
Discrete DC Resistance Generate[4]	1 Ohm 1.9 Ohm 10 Ohm 19 Ohm 100 Ohm 190 Ohm	110 µΩ/Ω 59 µΩ/Ω 28 µΩ/Ω 32 µΩ/Ω 20 µΩ/Ω 29 µΩ/Ω	Using Calibrator Fluke 5700 with DMM 3458A by Direct Method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Discrete DC Resistance Generate[4] continued	1 kOhm 1.9 kOhm 10 kOhm 19 kOhm 100 kOhm 190 kOhm 1 MOhm 1.9 MOhm 10 MOhm 19 Mohm 100 MOhm	15 µΩ/Ω 16 µΩ/Ω 14 µΩ/Ω 14 µΩ/Ω 16 µΩ/Ω 16 µΩ/Ω 23 µΩ/Ω 24 µΩ/Ω 47 µΩ/Ω 55 µΩ/Ω 140 µΩ/Ω	Using Calibrator Fluke 5700 with DMM 3458A by Direct Method
Temperature Simulation – Generate[4] (temperature indicator / controller / recorder)	B Type: 600 °C to 1800 °C K Type: -200 °C to 1372 °C E Type: -200 °C to 1000 °C U Type: -200 °C to 400 °C L Type: -200 °C to 900 °C J Type: -200 °C to 1200 °C T Type: -200 °C to 400 °C N Type: -200 °C to 1300 °C R Type: 0 °C to 1750 °C S Type: 0 °C to 1750 °C	0.5 °C 0.06 °C 0.08 °C 0.07 °C 0.08 °C 0.06 °C 0.1 °C 0.07 °C 0.07 °C 0.07 °C	Using 5700A Calibrator DC mV measurement method
	RTD: -200 °C to 800 °C	0.07 °C	Using Resistance Method
Capacitance Generate[4]	(1 kHz) 220 pF to 1 µF 1 µF to 10 µF (100 Hz) 10 µF to 100 µF 100 µF to 1 mF 1 mF to 10 mF 10 mF to 110 mF	 0.05 % + 10 pF 0.25 % + 15 nF 0.25 % +150 nF 0.45 % + 1 µF 0.45 % + 10 µF 1.3 %	Using Calibrator Fluke 5520A, Decade Capacitance Box by Direct Method
Harmonics Generate[4] (45 Hz to 5 kHz)	2nd order to 39th order (33 mV to 1000 V and 3.3 mA to 20 A)	0.5 %	FLUKE 5522A Source, Direct Method
AC Voltage Measure[5]	1 mV to 200 mV (50 Hz to 2 kHz) 100 mV to 2 V (20 Hz to 50 Hz) (2 kHz to 100 kHz) 200 mV to 2 V (50 Hz to 2 kHz) 1 V to 20 V (100 kHz to 1 MHz) 2 V to 20 V (20 Hz to 50 Hz)	130 uV/V + 4 uV 130 uV/V + 20 uV 600 uV/V + 0.2 mV 95 uV/V + 20 uV 1 % + 0.2 V 130 uV/V + 0.2 mV	Using 8½ DMM 8508A/HP 3458 A, by Direct Method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
AC Voltage Measure[5] continued	2 V to 20 V (50 Hz to 2 kHz) (2 kHz to 100 kHz) 20 V to 200 V (20 Hz to 50 Hz) (50 Hz to 2 kHz) (2 kHz to 100 kHz) 100 V to 1000 V (50 Hz to 10 kHz) (10 kHz to 20 kHz)	 95 uV/V + 0.2 mV 600 uV/V + 2 mV 130 uV/V + 2 mV 95 uV/V + 2 mV 600 uV/V + 20 mV 130 uV/V + 20 mV 270 uV/V + 40 mV	Using 8½ DMM 8508A/HP 3458 A, by Direct Method
	1 kV to 5 kV (50 Hz) 5 kV to 28 kV (50 Hz) 28 kV to 100 kV (50 Hz)	0.23 % 2 % 2.3 %	Using High Voltage Divider with DMM's, Sources and HV Probe with DMM by Direct Method/Comparison Method
AC Current Measure[5]	20 µA to 200 µA (50 Hz to 1 kHz) 200 µA to 20 mA (50 Hz to 1 kHz) 20 mA to 200 mA (50 Hz to 10 kHz) 200 mA to 2 A (50 Hz to 10 kHz) 2 A to 20 A (50 Hz to 2 kHz) (2 kHz to 10 kHz)	250 µA/A + 0.02 µA 280 µA/A + 2 µA 250 µA/A + 0.02 mA 600 µA/A + 0.2 mA 800 µA/A + 2 mA 0.25 % + 2 mA	Using 8½ DMM 8508A Fluke, Direct Method
	1 A to 30 A (50 Hz to 5 kHz)	0.5 %	Using Shunt with DMM by V-I Method
	30 A to 1000 A (50 Hz) 1000 A to 3000 A (50 Hz)	0.6 % 2.5 %	Using Shunt with DMM by direct method Current coil & Clamp Meter
AC Power Measure[5] 1 Phase, 50 Hz @ UPF 120V to 240 V, 0.01 A to 20 A	1.2 W to 4.8 kW	0.25 %	Using Digital Power Meter WT 210 by Direct Method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
AC Power Measure[5] 1 Phase, 50 Hz, 0.8 PF Lead/Lag 120V to 240 V, 0.1 A to 20 A	9.6 W to 3.8 kW	0.23 %	Using Digital Power Meter WT 210 by Direct Method
AC Power Measure[5] 1 Phase, 50 Hz, 0.5 PF Lead/Lag, 120 to 240V, 0.1 A to 20 A	6 W to 2.4 kW	0.5 %	Using Digital Power Meter WT 210 by Direct Method
AC Power Measure[5] 1 Phase, 50 Hz, 0.2 PF Lead/Lag, 120V to 240 V, 0.1A to 20 A	2.4 W to 960 W	0.5 %	Using Digital Power Meter WT 210 by Direct Method
High Frequency Power Measure[5] (400 kHz)	100 mW to 400 W	4 %	Using Differential probe in combination with Oscilloscope by comparison method
DC Voltage Measure[5]	50 µV to 0.5 mV	0.8 %	Direct / Comparison Method using 8½ DMM HP 3458A/Fluke 8508A
	0.5 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V	7.2 µV/V + 0.1 µV 4.6 µV/V + 0.4 µV 4.6 µV/V + 4 µV 6.7 µV/V + 0.04 mV 6.8 µV/V + 0.5 mV	
	1 kV to 5 kV	0.20 %	Using HV Divider with DMM by Direct Comparison Method
	5 kV to 40 kV 40 kV to 100 kV	2 % 1.7 %	Using Source & HV Probe with DMM by Direct Comparison Method
DC Current Measure[5]	10 nA to 100 nA	0.05 %	Using Shunt with DMM V-I / Comparison Method
	100 nA to 10 µA 10 µA to 200 µA 200 µA to 20 mA 20 mA to 200 mA 200 mA to 2 A 2 A to 20 A 20 A to 75 A 75 A to 100 A 100 A to 1000 A	0.08 % 13 µA/A + 0.4 µA 14 µA/A + 0.4 µA 55 µA/A + 0.8 µA 0.02 % + 16 µA 0.04 % + 0.4 mA 0.08 % 0.60 % 1.0 %	Using 8½ DMM HP 3458A FLUKE8508A, by Direct /Comparison Method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
DC Power Measure[5] (1V to 600V, 1 mA to 20 A)	1 mW to 10 W 10 W to 1 kW 1 kW to 12 kW	0.09 % 0.50 % 0.65 %	Using Digital Power Meter WT 210 by Direct Method
Pulse Energy Measure[5] (1 ms to 10 ms pulse length)	1 J to 360 J	2.8 %	Using oscilloscope DP07254, Differential Probe, DP-100 and P 6015 for measurements. Defibrillator used as source
Capacitance Measure[5]	(1 kHz) 1 pF to 1 µF 1 µF to 100 µF 100 µF to 100 mF	 0.06 % 0.13 % 0.11 %	Using LCR Meter by Direct / Comparison Method
Inductance Measure[5]	(1 kHz) 100 µH to 1 mH 1 mH to 10 H	 0.09 % 0.07 %	Using LCR Meter by Direct / Comparison Method
AC Resistance Measure[5]	(1 kHz) 1 Ω to 10 kΩ	 0.06 %	Using LCR Meter
	(1 kHz to 100 kHz) 100 Ω to 1 kΩ	0.16 %	Using LCR Meter & calibrator
DC Resistance Measure[5]	75 µΩ to 1 mΩ 1 mΩ to 10 mΩ 10 mΩ to 1 Ω 0.1 Ω to 1 Ω	0.60 % 0.60 % 0.035 % + 4 µΩ 0.035 % + 40 µΩ	Using micro-ohmmeter and Fluke 8508A DMM, standard resistors and shunts by VI method
	1 Ω to 2 Ω 2 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 kΩ 2 kΩ to 20 kΩ 20 kΩ to 200 kΩ 200 kΩ to 2 MΩ 2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 2 GΩ 2 GΩ to 20 GΩ	12 µΩ/Ω + 4 µΩ 7 µΩ/Ω + 30 µΩ 9 µΩ/Ω + 50 µΩ 9 µΩ/Ω + 0.5 mΩ 7.5 µΩ/Ω+ 22 mΩ 9 µΩ/Ω + 100 mΩ 6.5 µΩ/Ω + 7 Ω 7 µΩ/Ω + 160 Ω 4 µΩ/Ω + 7 kΩ 30 µΩ/Ω + 0.28 MΩ 0.05 % + 20 MΩ	Using DMM 81/2 8508A by Direct Comparison method
	20 GΩ to 1 TΩ	1 %	Using Fluke Calibrator & 8½ DMM by VI Method/Comparison
Temperature Simulation - Measure[5]	B Type: 600 °C to 1800 °C K Type: -200 °C to 1372 °C E Type: -200 °C to 1000 °C U Type: -200 °C to 400 °C L Type: -200 °C to 900 °C J Type: -200 °C to 1200 °C T Type: -200 °C to 400 °C N Type: -200 °C to 1300 °C R Type: 0 °C to 1750 °C S Type: 0 °C to 1750 °C	0.5 °C 0.05 °C 0.08 °C 0.07 °C 0.08 °C 0.06 °C 0.1 °C 0.07 °C 0.07 °C 0.07 °C	Using 8½-digit DMM 3458A/8508A DC mV measurement method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Temperature Simulation - Measure[5] continued	RTD: -200 °C to 800 °C	0.02 °C	Using 8½-digit DMM 3458A/8508A DC mV measurement method
Oscilloscope – DC Signal	1 mV to 130 V	0.08 %	Using Fluke Calibrator 5520A/5522A with 1.1 GHz option by Direct Method
Oscilloscope - Band Width @ 50 kHz Reference	50 kHz to 1 GHz	0.07 %	
Oscilloscope - Scope Amplitude, Square Wave Signal (10 Hz to 10 kHz)	1 mV to 55 Vp-p	0.12 %	
Oscilloscope, Time Marker	1 ns to 1000 s	0.00005 %	Using Rubidium standard, Fluke Calibrator 5520A/5522A with 1.1 GHz option by Direct Method
RF / Microwave			
3 dB Bandwidth Measure[5] (Filter, Power Meter, Power Sensor)	Up to 40 GHz	1 %	Using RF Reference Source - 9640ALPNX, Signal Generator and Power Meter by Direct Method
RF Power Measure[5] / Generate[4]	(1 kHz to 18 GHz) -60 dBm to -100 dBm -60 dBm to 15 dBm	 0.65 dB 0.24 dB	Using RF Reference source 9640A LPNX, Signal Generator, Attenuator, Multimeter, Power Meter, Spectrum Analyzer Method
	(18 GHz to 40 GHz) 15 dBm to -60 dBm	11 %	Using Signal Generator SMB 100A & USB Power Sensor U2054XA
	(18 GHz to 29.99 GHz) 15 dBm to -100 dBm	12 %	Using Signal Generator SMB 100A & Spectrum analyzer FSV30
RF Attenuation Measure[5] / Generate[4]	(1 kHz) 1 dB to 60 dB (1 kHz to 18 GHz) 1 dB to 60 dB (18 GHz to 40 GHz) 1 dB to 60 dB	 0.09 dB 0.14 dB 7.4 %	Using RF Reference Source 9640A, Signal Generator-Multimeter & Power Meter Method
	(10 MHz to 18 GHz) 60 dB to 110 dB (18 GHz to 29.99 GHz) 1 dB to 110 dB	 0.50 dB 7.4 %	Using Signal Generator, attenuator & Spectrum Analyzer Method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Spectral Purity (THD) Measure[5]	0.17 % to 3.19 % (No. of harmonics n=2 to n=10, 10 Hz to 2.9 GHz)	0.2 %	Using Spectrum Analyzer FSV-30 Up to 30 GHz by Direct Method
Reflection Coefficient Measure[5]/ Generate[4] - 10 MHz to 18 GHz (Maury Microwave Mismatch Test Set/Network Analyzer)	rho = 0.024 to 0.33	0.032	Using Network Analyzer (R&S ZVB20) by direct method, with Cal kit Z270. Maury Microwave Mismatch Test Set used for verification of Network Analyzer performance as check/transfer standard.
Amplitude Modulation (AM) Measure[5]/ Generate[4] CW: 100 kHz to 3.9 GHz Modulation Rate: 50 Hz to 10 kHz AM Depth	1 % to 98 %	0.25 %	Using Rhode & Schwarz Signal generator, reference source, Spectrum Analyzer FSV 30, Modulation analyzer HP 8901B as transfer by Relative Sideband Amplitude Method
Frequency Modulation (FM) Measure[5]/ Generate[4] CW: 100 kHz to 25 GHz Modulation Rate: 50 Hz to 267 kHz FM Deviation	50 Hz to 4 MHz	0.15 %	Using Rhode & Schwarz Signal generator, reference source, Spectrum Analyzer FSV 30, by Bessel Function Method
Time/Frequency			
Frequency Generate[4]	1 mHz to 40 GHz	0.2 nHz/Hz + 10 µHz	Using Rubidium Frequency Standard, Signal Generator, RF Reference Source by Direct Method
Frequency Measure[5]	1 mHz to 29.999 GHz	0.2 nHz/Hz + 10 µHz	Using Rubidium Frequency Standard locked to other Equipment, Frequency Counter 5350B, Spectrum Analyzer -- by Direct Method
Time Interval	100 ms to 86400 s	12 µs/s + 10 µs	Using Timer/counter and oscilloscope by Direct method

SCOPE OF ACCREDITATION

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)[1,2]

CALIBRATION AREA	RANGE	EXPANDED UNCERTAINTY[3] (±)	TECHNIQUE, REFERENCE STANDARD, EQUIPMENT
Rotational Speed - Non-Contact	6 rpm 7 rpm to 1000 rpm 1001 rpm to 5000 rpm 5001 rpm to 20000 rpm 20001 rpm to 90000 rpm	2.2 % 0.33 % 0.09 % 0.07 % 0.06 %	Using Digital Tachometer
Rotational Speed - Contact	6 rpm 7 rpm to 100 rpm 101 rpm to 3000 rpm	2.2 % 0.33 % 0.09 %	
Rotational Speed - Centrifuge	6 rpm 7 rpm to 1000 rpm 1001 rpm to 5000 rpm 5001 rpm to 20000 rpm	2.2 % 0.33 % 0.09 % 0.07 %	Using Digital Tachometer
Optical Radiation			
Illuminance meter	1 lux to 20,000 lux	3.4 %	Using Standard Illuminance Meter
OT Lights (Light Intensity Measurement)	1 lux to 200,000 lux	3.3 %	Using Illuminance Meter

[1]The uncertainty covered by the Calibration and Measurement Capability (CMC) is expressed as the expanded uncertainty having a specific coverage probability of approximately 95 %. It is the smallest measurement uncertainty that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than that provided in the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[2]If information in this CMC is presented in non-SI units, the conversion factors stated in NIST Special Publication 811 "Guide for the Use of the International System of Units (SI)" apply.

[3]When uncertainty is stated in relative terms (such as percent, a multiplier expressed as a decimal fraction or in scientific notation), it is in relation to instrument reading or instrument output, as appropriate, unless otherwise indicated.

[4]Capability is suitable for the calibration of measuring devices in the stated ranges.

[5]Capability is suitable for the calibration of devices intended to generate the measurand in the stated ranges.

SG = specific gravity
PF = power factor
THD = total harmonic distortion
CW = continuous wave