Laboratory	**Roots Metrology & Testing Laboratory (A Unit of Roots Industries India Limited), No.37, First Main Road, SIDCO Industrial Estate, Thirumazhisai, Chennai, Tamil Nadu**		
Accreditation Standard	**ISO/IEC 17025: 2005**		
Certificate Number	**CC-2201**	**Page**	**1 of 16**
Validity	**22.07.2019 to 29.02.2020**	**Last Amended on**	**12.09.2019**

Sl.	Measurand or Reference Material/ Type of instrument or material to be calibrated or measured/ Quantity Measured / Instrument	Calibration or Measurement Method or procedure	Measurement range and additional parameters where applicable (Range and Frequency)	Calibration and Measurement Capability (CMC) (±)
	ELECTRO-TECHNICAL CALIBRATION			
I.	**SOURCE**			
1.	DC Voltage#	Using Portable Calibrator (Beamex) By Direct Method	0.1 V to 12 V	0.62 % to 0.01%
2.	DC Current#	Using Portable Calibrator (Beamex) By Direct Method	1 mA to 25 mA	0.24% to 0.11%
3.	Resistance#	Using Portable Calibrator (Beamex) By Direct Method	1Ω to 4KΩ	2.87% to 0.06%
4.	Frequency#	Using Portable Calibrator (Beamex) By Direct Method	5 Hz to 10 kHz	1.23% to 0.54%
5.	Temperature Simulation# (Indicator, Controller and Recorder)			
	RTD PT-100 K-Type Thermocouple J-Type Thermocouple T-Type Thermocouple R-Type Thermocouple S-Type Thermocouple E-Type Thermocouple	Using Portable Calibrator (Beamex) By Direct Method	(-)200°C to 800°C (-)200°C to 1350°C (-)200°C to 1200°C (-)100°C to 400°C	0.27°C 0.34°C 0.24°C 0.33°C

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	N-Type Thermocouple B-Type Thermocouple N-Type Thermocouple B-Type Thermocouple		50°C to 1700°C 50°C to 1700°C (-)200°C to 1000°C (-)200°C to 1300°C 600°C to 1800°C	0.75°C 0.74°C 0.24°C 0.32°C 0.86°C
II.	**MEASURE**			
1.	DC Voltage[#]	Using Portable Calibrator (Beamex) By Direct Method	0.1V to 1 V 1V to 50 V	0.4 % to 0.07% 0.07% to 0.02%
2.	DC Current[#]	Using Portable Calibrator (Beamex) By Direct Method	1mA to 100 mA	0.25% to 0.02%
3.	Resistance[#]	Using Portable Calibrator (Beamex) By Direct Method	2Ω to 4KΩ	0.52% to 0.02%
4.	Frequency[#]	Using Portable Calibrator (Beamex) By Direct Method	5Hz to10kHz	0.17% to 0.02%
5.	Time Interval Meter / Timer / Stop Watch (Analog/ Digital)[#]	Using Digital Time Interval Meter By Comparison Method	1 s to 86400 s	0.1 s to 10.83 s

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6.	Temperature Simulation[#] (Indicator, Controller and Recorder)			
	RTD PT-100 K-Type Thermocouple J-Type Thermocouple T-Type Thermocouple	Using Portable Calibrator (Beamex) By Direct Method	(-)200°C to 800°C (-)200°C to 1350°C (-)200°C to 1150°C (-)100°C to 350°C	0.23°C 0.52°C 0.34°C 0.33°C
	R-Type Thermocouple S-Type Thermocouple E-Type Thermocouple N-Type Thermocouple B-Type Thermocouple		5°C to 1700°C 5°C to 1700°C (-)200°C to 950°C (-)100°C to 1250°C 600°C to 1800°C	1.0°C 0.94°C 0.30°C 0.44°C 1.31°C

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	MECHANICAL CALIBRATION			
I.	**DIMENSION (BASIC MEASURING INSTRUMENT, GAUGE ETC.)**			
1.	Vernier/Dial Caliper[$] (Vernier/Digital/Dial) L.C.: 0.01 mm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 300 mm Upto 600 mm Upto 1000 mm	7.1 µm 7.6 µm 10.3 µm
2.	Depth Gauge[$] (Digital/Vernier) L.C. : 0.01 mm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 300 mm Upto 600 mm	7.3 µm 8.2 µm
3.	Height Gauge[$] (Digital/Dial) L.C.: 0.01 mm	Using Height Measuring System by Comparison Method	Upto 600 mm Upto 1000 mm	9.0 µm 11.1 µm
4.	Dial Caliper Gauge[$] L.C.: 0.01 mm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 300 mm	6.2 µm
5.	Thickness Gauge[$] (Digital/Dial) L.C.: 0.001 mm	Using Gauge Blocks by Comparison Method	Upto 25 mm	0.7 µm

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6.	External Micrometer[$] (Mechanical/Digital) L.C.: 0.001 mm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 100 mm >100 mm to 300 mm >300 mm to 500 mm >500 mm to 1000 mm	1.1 µm 2.4 µm 3.3 µm 7.2 µm
7.	Depth Micrometer[$] L.C.: 0.001 mm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 500 mm	3.3 µm
8.	Micrometer Setting Rod[$]	Using Universal Length Measuring System / Height Measuring System by Comparison Method	25 mm to 100 mm >100 mm to 500 mm >500 mm to 1000 mm	1.2 µm 5.1 µm 8.2 µm
9.	Feeler Gauge[$]	Using Digital Micrometer by Comparison Method	Upto 1 mm	1.3 µm
10.	Inside/Groove Micrometer[$] L.C.: 0.01 mm	Using Gauge Block and Gauge Block accessory by Comparison Method	5 mm to 100 mm	5.9 µm
11.	Internal /Stick Micrometer[$] L.C.: 0.01 mm	Universal Length Measuring / Height Measuring System by Comparison Method	25 mm to 300 mm 300 mm to 1000 mm	5.8 µm 9.6 µm
12.	Snap Micrometer[$] L.C.: 0.001 mm	Using Gauge Block by Comparison Method	Upto 100 mm	2.1 µm

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13.	Dial Bore Gauge[$] L.C.: 0.001 mm	Using Universal Length Measuring System by Comparison Method	20 mm to 500 mm Upto 1.5 mm travel	1.0 µm
14.	Coating Thickness Foil[$]	Using Universal Length Measuring System by Comparison Method	Upto 2.0 mm	0.8 µm
15.	Cylindrical Measuring Pins[$] (Grade "1" and Coarser)	Using Universal Length Measuring System by Comparison Method	Upto 20 mm	0.8 µm
16.	Cylindrical Setting Master[$] (Diameter Only)	Using Universal Length Measuring System by Comparison Method	Upto 100 mm	1.1 µm
17.	Dial Calibration Tester[$] L.C.: 0.001 mm	Using Universal Length Measuring System by Comparison Method	Upto 100 mm	1.1 µm
18.	Depth Gauge - Hook Type[$] L.C.: 0.02 mm	Using Gauge Block by Comparison Method	Upto 300 mm	14.3 µm

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19.	Electronic Probe/ LVDT System[$] L.C.: 0.1 µm	Using Universal Length Measuring System by Comparison Method	0 to 25 mm	0.7 µm
20.	Lever Type Dial Gauge[$] L.C.: 0.001 mm L.C.: 0.01 mm	Using Universal Length Measuring System by Comparison Method	Upto 0.14 mm Upto 1.2 mm	1.0 µm 5.9 µm
21.	Plunger Type Dial/ Digital Gauge[$] L.C.: 0.001 mm L.C.: 0.01 mm	Using Universal Length Measuring System by Comparison Method	Upto 25 mm Upto 100 mm	1.0 µm 5.9 µm
22.	Micrometer Head[$] L.C.: 0.0001 mm	Using Universal Length Measuring System by Comparison Method	Upto 25 mm	1.2 µm
23.	Pistol Caliper[$] L.C.: 0.1 mm	Using Gauge Blocks by Comparison Method	0 to 100 mm	57.9 µm
24.	Thread Ring Gauge[$]	Using Universal Length Measuring System by Comparison Method	3 mm to 90 mm > 90 mm to 200 mm	0.9 µm 4.3 µm

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25.	Plain Plug Gauge[$]	Using Universal Length Measuring System by Comparison Method	Upto100 mm > 100 mm to 400 mm	1.3 µm 4.7 µm
26.	Plain / Setting Ring Gauge[$]	Using Universal Length Measuring System by Comparison Method	3 mm to 100 mm >100 to 300 mm	1.8 µm 4.7 µm
27.	Thread Plug Gauge[$]	Using Universal Length Measuring System by Comparison Method	Upto 100 mm > 100 mm to 400 mm	1.7 µm 4.7 µm
28.	Snap Gauge[$] (Plain/Adjustable)	Using Gauge Block and Gauge Block accessory by Comparison Method	2 mm to 100 mm >100 mm to 300 mm	2.0 µm 2.9 µm
29.	Width/Gap Gauge[$]	Using Universal Length Measuring System by Comparison Method	0 to 100 mm >100 mm to 300 mm	1.0 µm 6.0 µm
30.	Taper Thread Plug Gauge[$]	Using Universal Length Measuring System by Comparison Method	Upto 100 mm	0.9 µm
31.	Taper Thread Ring Gauge[$]	Using Universal Length Measuring System by Comparison Method	8 mm to 100 mm	1.8 µm
32.	Caliper Checker[$]	Using Height Measuring System by Comparison Method	Up to 600 mm	6.6 µm

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33.	Flush Pin Gauge[$]	Using Height Measuring System by Comparison Method	Up to 50 mm	5.91 µm
34.	Coating Thickness Gauge[$] L.C.: 0.1 µm L.C.: 1 µm	 Using Standard Foils by Comparison Method	 Upto 20 µm >20 µm to 2000 µm	 0.5 µm 1.5 µm
II.	**DIMENSION (PRECISION INSTRUMENTS)**			
1.	Height Measuring System[#] L.C.: 0.1 µm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 300 mm >300 mm to 1000 mm	4.8 µm 7.0 µm
2.	Length Measuring System[#] L.C.: 0.1 µm	Using Gauge Blocks and Long Gauge Blocks by Comparison Method	Upto 100mm (absolute Scale) Upto 600 mm (Differential Scale)	0.9 µm 1.2 µm
3.	Surface Plate[#]	Using Precision Spirit Level by Comparison Method	3500 mm x 2600 mm	$2.3\sqrt{\frac{W+L}{200}}$ µm W=Width, L=Length
III.	**WEIGHTS**			
1.	Weights[$] (Conventional) Calibration of Weights Class F1 accuracy and Coarser	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg	0.01 mg 0.01 mg 0.01 mg 0.01 mg 0.01 mg 0.01 mg	Using E2 Class Standard Weights and Electronic Weighing Balance (Readability: 0.01 mg upto 82 g / 0.1 mg above)

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		100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g	0.01 mg 0.01 mg 0.01 mg 0.02 mg 0.02 mg 0.02 mg 0.02 mg 0.02 mg 0.02 mg 0.2 mg 0.2 mg	
IV.	**WEIGHING SCALE AND BALANCE**			
1.	Electronic Weighting Balance [#] d=0.01 mg d=0.1 mg	 1 mg to 80 g 10 mg to 200 g	 0.05 mg 0.1 mg	 Using Standard Weights (E2 Class) & Calibration of Electronic Weighing Balance of Class I and Coarser as per OIML R-76-1
2.	Electronic Weighting Balance [#] d = 10 mg d = 1 g d = 10 g	 Using Standard Weights M1 Class & Calibration of Electronic Weighing Balance of Class III and Coarser as per OIML R 76	 0.5 g to 600 g >20 g to 10 kg >500g to 200 kg	 10 mg 1 g 10g

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3.	Hydrometers[$]	Using Hydrometer of resolution : 0.0005 g/ml and Appropriate liquid by Comparison Method as per Archimedes Principle based on IS 3104	0.600 g/ml to 1.600 g/ml	0.0012 g/m
V.	**PRESSURE INDICATING DEVICES**			
1.	Dial & Digital Vacuum Gauges, Transducers/ Transmitters, Switches[#]	Using Standard Digital Vacuum Calibrator by Comparison Method as per DKD-R-6-2	(-) 0.90 bar to 0 bar	0.0012 bar
2.	Pneumatic - Dial & Digital Pressure Gauges, Pressure Switches,Pressure Transmitters[#]	Using Standard Digital Pressure Calibrator by Comparison Method as per DKD-R-6-1	0 to 20 bar	0.003 bar
3.	Hydraulic :- Dial & Digital Pressure Gauges, Pressure Transmitters[#]	Using Standard Digital Pressure Calibrator with external sensor by Comparison Method as per DKD-R-6-1	0 to 700 bar	0.13 bar
4.	Low Pressure (Pneumatic) (Maghnelic Gauges, Manometer, Low Pressure/Vacuum Gauges, Calibrators)[#]	Using Standard Digital Pressure calibrator by Comparison Method as per DKD-R-6-1/2	(-) 900 mbar to 0 mbar 0 to 700 mbar	0.61 mbar 0.12 mbar

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5.	Low Pressure (Pneumatic) (Maghnelic Gauges, Manometer, Barometer, Low Pressure Gauges/Vacuum, Calibrators, Pressure Transmitter, Differential Pressure Gauge)[#]	Using Standard Digital Pressure Gauge by Comparison Method as per DKD-R-6-1/2	(-) 0.95 bar to 2 bar	0.80 mbar
6.	Absolute Pressure (Pneumatic) (Absolute Pressure Gauges/Barometers / Manometers)[#]	Using Standard Digital Barometer by Comparison Method as per OIML-R-97	300 mbar to 1100 mbar	0.68 mbar
VI.	**ACOUSTICS**			
1.	Sound Level Meter [$]	Using Sound Level Calibrator By Direct Method as per IS 15575 / OIML-R-58	94 dB & 114 dB	0.52 dB
VII.	**ACCELERATION & SPEED**			
1.	Mechanical /Digital Tachometers/ Centrifuge/RPM Indicators / Stirrers[#] (Non Contact Type)	Using Digital Tachometer By Comparison Method	100 rpm to 90,000 rpm	1.53% to 0.06%

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2.	Mechanical / Digital Tachometers [#] (Contact Type)	Using Digital Tachometer By Comparison Method	100 rpm to 10000 rpm	2.20% to 0.08%
VIII.	**DUROMETERS**			
1.	Durometers / Shore Hardness Tester[$] Shore A Shore D	Using Shore Hardness Tester Calibrator As per ASTM D2240-05	20 Shore A to 90 Shore A 20 Shore D to 90 Shore D	1.34 Shore A 1.37 Shore A
XI.	**FORCE PROVING INSTRUMENTS**			
1	Universal Testing Machine (in Compression mode) Compression Testing Machine (CTM)[♣]	Using Master Load Cell As per IS 1828(Part -1)/ ISO 7500	100 N to 1kN 1 kN to 10kN 10 kN to 100 kN 100 kN to 500kN	0.30% 0.12% 0.08% 0.10%
2	Universal Testing Machine (in Tension mode) Tensile Testing Machine(TTM)[♣]	Using Master Load Cell As per IS 1828(Part -1)/ ISO 7500	100 N to 1kN 1 kN to 10kN 10 kN to 100 kN 100 kN to 500kN	0.30% 0.12% 0.08% 0.10%

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	THERMAL CALIBRATION			
I.	**TEMPERATURE**			
1.	Liquid-In-Glass Thermometers[$]	Using 4-Wire RTD Sensor & Portable Calibrator with Liquid Temperature Bath by Comparison Method	(-)80°C to 50 °C 50 °C to 250 °C	0.72°C 0.79°C
2.	RTD's, Thermocouple With & Without Controllers, Temperature Indicator With Sensor, Recorders With Probes, Data Logger With Sensor, Digital Thermometers With Sensor, Temperature Gauges, Temperature Transmitter, Switch, Temperature Transducer[#]	Using PRT Sensor, 4-Wire RTD Sensor &Portable Calibrator with Low Temperature Bath by Comparison Method S-type Thermocouple, Portable Calibrator with Dry Block Temperature Calibrators by Comparison Method	(-) 80 °C to 50 °C 50 °C to 250 °C 250°C to 1200 °C	0.39°C 0.47°C 1.87°C
3.	Oven, Incubator, Furnace, Deep Freezer, Refrigerator, Water Bath, Low Temperature Bath, Dry Block Furnace, Dry Block Calibrators,	Using 4-Wire RTD Sensor with Portable Calibrator by Comparison Method S-type Thermocouple with Portable Calibrator by Comparison Method	(-) 80 °C to 250 °C 250 °C to 1200 °C	0.70°C 1.60°C

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	Autoclaves[#] (Single Point)			
4.	Non-Contact Type Thermometer (Infrared Thermometer / Digital Pyrometer) [#]	Using Infrared Thermometer & Black Body Source By comparison method	50 °C to 500 °C	1.50°C
5.	Temperature By Spatial Mapping Thermal Chamber/ Furnace/ Oven/ Incubator/ Water Bath/ Refrigerator/ Deep Freezer, Autoclave[♣]	Using RTD (Pt 100) & N-Type Thermocouple with Paperless Recorder by Comparison Method	(-) 80 °C to 250 °C 250 °C to 1200 °C	2.61°C 3.24°C
II.	**SPECIFIC HEAT AND HUMIDITY**			
1.	Thermo-Hygrometers (Analog/Digital), Humidity Indicator, Humidity Sensors, Humidity Data Loggers, Humidity Transmitters[$]	Using Digital Temp. & Humidity Indicator with Sensor, Temp. & Humidity Generator by Comparison method	20% RH to 95 % RH @25°C 10 °C to 50 °C @50%RH	1.50% RH 0.43°C

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2.	Humidity & Temperature Indicator Of Environmental Chamber/ Temperature & Humidity Indicators (Digital / Analog)/ Humidity Sensor With Indicator/Controller/ Data Logger/ Recorder[♣] Humidity Sensor With Indicator/Controller/ Data Logger/ Recorder[♣]	Using Digital Temp & Humidity Indicator with Sensor by Comparison method	20% RH to 95% RH @20 °C to 50 °C	1.68% RH 0.43°C

*** Measurement Capability is expressed as an uncertainty (±) at a confidence probability of 95%**
[$]Only in Permanent Laboratory
[♣]Only for Site Calibration
[#] The laboratory is also capable for site calibration however, the uncertainty at site depends on the prevailing actual environmental conditions and master equipment used.

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