

Laboratory Reltec Calibration Private Limited, # 98/50/1, 1st Floor, 2nd Main Road, Industrial Town, Rajajinagar, Bangalore, Karnataka

Accreditation Standard ISO/IEC 17025: 2005

Certificate Number CC-2215

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|---|--------------------------------|--|---|--|
| <u>ELECTRO TECHNICAL CALIBRATION</u> | | | | |
| I. | SOURCE | | | |
| 1. | DC Voltage [#] | 1mV to 329mV 329mV to 10V 10V to 1000V | 0.12 % to 0.003% 0.003% to 0.002% 0.002% | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| 2. | AC Voltage [#] | 50Hz to 1kHz 1mV to 300mV 300mV to 300V 300V to 1000V | 0.71 % to 0.02% 0.02% 0.02% to 0.037% | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| 3. | DC Current [#] | 10 μ A to 1mA 1mA to 329mA 329mA to 10A 10A to 20A 20A to 1000A | 0.25% to 0.017% 0.017% to 0.013% 0.013% to 0.065% 0.065% to 0.13% 0.30% | Using Multi Product Calibrator Fluke 5522A by Direct Method Using Multi Product Calibrator Fluke 5522A with 50 turn Current Coil by Direct Method |
| 4. | AC Current [#] | 50Hz to 1kHz 30 μ A to 1mA 1mA to 329mA 329mA to 10A 10A to 20A 50 Hz 20A to 1000A | 0.54 % to 0.13% 0.13% to 0.054% 0.054% to 0.15% 0.15% to 0.2% 0.34% | Using Multi Product Calibrator Fluke 5522A by Direct Method Using Multi Product Calibrator Fluke 5522A with 50 turn Current Coil by Direct Method |

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|-----|--------------------------------|---|--|---|
| 5. | DC Resistance [#] | 0.02 Ω to 0.1 Ω 0.1 Ω to 1 Ω 1 Ω to 1M Ω 1M Ω to 100M Ω 100M Ω to 1000M Ω 100k Ω to 100G Ω 100G Ω to 1T Ω | 5.9% to 1.2% 1.2% to 0.12% 0.12% to 0.004% 0.004% to 0.06% 0.06% to 1.8% 2.32 % to 6.11% 6.11 % to 6.32% | Using Multi Product Calibrator Fluke 5522A by Direct Method Using Decade Meg Ohm Box Vaiseshika 8400 HV by Direct Method |
| 6. | Capacitance [#] | 1nF to 300nF 300nF to 10 μ F 10 μ F to 100 μ F | 1.88% to 0.45% 0.45% to 0.42% 0.42% to 0.66% | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| 7. | Frequency [#] | 1Hz to 2MHz | 0.06% to 0.003% | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| 8. | DC Power [#] | 15V to 600V 0.1 A to 20A 1.5W to 12.0kW | 0.05% to 0.08% | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| 9. | Power Factor [#] | 0.2PF to UPF | 0.002PF | Using Multi Product Calibrator Fluke 5522A by Direct Method |

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|-----|---|--|---|---|
| 10. | Temperature Simulation # RTD K Type Thermocouple J Type Thermocouple N Type Thermocouple E Type Thermocouple R Type Thermocouple S Type Thermocouple B Type Thermocouple T Type Thermocouple | (-)200°C to 800°C (-)200°C to 1350°C (-)200°C to 1200°C (-)200°C to 1300°C (-)200°C to 1000°C 0°C to 1750°C 0°C to 1750°C 600°C to 1800°C (-)200°C to 400°C | 0.3°C 0.48°C 0.34°C 0.49°C 0.59°C 0.88°C 0.80°C 0.78°C 0.75°C | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| 11. | AC Power# 1Ø | 50Hz @ UPF 120 to 240V 0.01A to 20A 1.2 W to 4.8 kW 50Hz @ 0.8 Lead 120 to 240V 0.1A to 20A 9.6 to 3.84kW 50Hz @ 0.5 Lag 120 to 240 V 0.1A to 20A 6 W to 2.4 kW 50Hz @ 0.2 Lag 120 to 240V 0.1A to 20A 2.4W to 960W | 0.12% 0.19% to 0.24% 0.35 to 0.38% 1.2% | Using Multi Product Calibrator Fluke 5522A by Direct Method |

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| 12. | Oscilloscope [#] Amplitude DC Voltage (1 M Ω Impedance) Amplitude AC Voltage @ 1kHz (1M Ω Impedance) Time Base Bandwidth (5mV to 3.5V) Ref: 50 kHz | 1mV to 130V 1mV to 130V 2nsec to 2sec 2sec to 5sec 1MHz to 1.1GHz | 4.78% to 0.45% 4.77% to 0.46% 0.029% to 0.24% 0.24% to 0.58% 2.5 % to 9.32% | Using Multi Product Calibrator Fluke 5522A With Scope Option by Direct Method |
| II. | MEASURE | | | |
| 1. | DC Current ^{\$} DC Current [*] | 100 μ A to 1A 1A to 10A 10A to 20A 1 μ A to 1mA 1mA to 100mA 100mA to 1A 1A to 10A | 0.002% to 0.023% 0.023% to 0.058% 0.058% to 0.059% 3.0% to 0.064% 0.064% 0.064% to 0.082% 0.082% to 0.18% | Using Digital Multimeter (8½ digit) Fluke 8508A by Direct Method Using Digital Multimeter (6½ digit) Fluke 8845A by Direct Method |
| 2. | AC Current ^{\$} AC Current [*] | 50Hz to 1kHz 100 μ A to 100mA 100mA to 10A 10A to 20A 50Hz to 1kHz 1mA to 100mA 100mA to 1A | 0.06% to 0.057% 0.057% to 0.13% 0.13% 0.24% to 0.16% 0.16% to 0.17% | Using Digital Multimeter (8½ digit) Fluke 8508A by Direct Method Using Digital Multimeter (6½ digit) Fluke 8845A by |

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| | AC Current # | 1A to 10A 10 A to 120A | 0.17% to 0.24% 0.07% to 0.19% | Direct Method Using Portable Reference Standard Zera MT 320 CT: 050040687 By Direct & Comparison Method |
| 3. | Resistance \$ | 1 Ω to 10k Ω 10k Ω to 1M Ω 1M Ω to 100M Ω 100M Ω to 1000M Ω | 0.006% to 0.0012% 0.0012% to 0.002% 0.002% to 0.03% 0.03% to 0.29% | Using Digital Multimeter (8½ digit) Fluke 8508A by Direct Method |
| | Resistance * | 0.1 Ω to 100 Ω 100 Ω to 1M Ω 1M Ω to 10M Ω 10M Ω to 1000M Ω | 4.7 % to 0.02% 0.02% to 0.013% 0.013% to 0.05% 0.05% to 0.94% | Using Digital Multimeter (6½ digit) Fluke 8845A by Direct Method |
| 4. | Frequency# | 10Hz to 100kHz 100kHz to 300kHz | 0.082% to 0.013% 0.013% to 0.059% | Using Digital Multimeter (6½ digit) Fluke 8845A by Direct Method |
| 5. | Timer # | 1s to 900min | 0.007sec to 71 sec | Using Time Totalizer by Comparison Method |
| | Stop Watch# | 5 sec to 900 min. | 0.2sec to 71 sec | |
| 6. | DC Voltage\$ | 1mV to 10V 10V to 100V 100V to 1000V | 0.014% to 0.00046% 0.00046% to 0.00069% 0.00069% to 0.00071% | Using Digital Multimeter (8½ digit) Fluke 8508A by Direct Method |
| | DC Voltage* | 1mV to 1V 1V to 10V 10V to 1000V | 0.41% to 0.006% 0.006% to 0.005% 0.005% to 0.006% | Using Digital Multimeter (6½ digit) Fluke 8845A by Direct Method |
| | DC High Voltage# | 1kV to 40 kV | 2.5% | Using High Voltage Probe |

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| | | | | Fluke 80K-40 with DMM Fluke 289 By Direct / Comparison Method |
| 7. | AC Voltage ^s | 50 Hz 100mV to 1V 1V to 1000V | 0.018% to 0.013% 0.013% to 0.02% | Using Digital Multimeter (8½ digit) Fluke 8508A by Direct Method |
| | AC Voltage* | 1 kHz 10mV to 100mV 100mV to 1V 1V to 100V 100V to 1000V | 0.042% to 0.016% 0.016% to 0.019% 0.019% to 0.011% 0.011% to 0.019% | |
| | AC Voltage* | 50Hz to 1 kHz 10mV to 100V 100V to 750V | 0.54% to 0.1% 0.1% to 0.11% | Using Digital Multimeter (6½ digit) Fluke 8845A by Direct Method |
| | AC High Voltage [#] | 50Hz 1kV to 28kV | 3.8% | Using High Voltage Probe Fluke 80K-40 with DMM Fluke 289 By Direct / Comparison Method |
| 8. | Temperature Simulation ^s K Type Thermocouple J Type Thermocouple N Type Thermocouple E Type Thermocouple R Type Thermocouple S Type Thermocouple B Type Thermocouple T Type Thermocouple | (-)200°C to 1350°C (-)200°C to 1200°C (-)200°C to 1300°C (-)200°C to 1000°C 0°C to 1750°C 0°C to 1750°C 600°C to 1800°C (-)200°C to 400°C | 0.47°C 0.32°C 0.47°C 0.6°C 0.88°C 0.79°C 0.79°C 0.73°C | Using Multi Product Calibrator Fluke 5522A by Direct Method |

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| 9. | Active/Reactive Power/Energy Single/Three Phase # | 63.5 V to 240 V, 0.01 A to 12A UPF to 0.5 PF 0.5 PF to 0.2PF 63.5 to 240 V, 12 A to 35A UPF to 0.5 PF 0.5 PF to 0.2PF | 0.068% to 0.13% 0.13% to 0.31% 0.23% to 0.46% 0.46% to 1.24% | Using Portable Reference Standard By Direct & Comparison Method |
| 10. | Power Factor # @ 240V, 5A, 50Hz | 0.2 PF to 1 PF | 0.002 PF | Using Portable Reference Standard By Direct & Comparison Method |
| 11. | Phase Angle # @240V, 5A,50Hz | 1° to 360° | 0.02° | Using Portable Reference Standard By Direct & Comparison Method |
| 12. | Harmonics # (Voltage and Current) | 1 to 40 | 1.3% | Using Portable Reference Standard By Direct & Comparison Method |
| 13. | Temperature Simulation* RTD | (-)200°C to 800°C | 0.59°C | Using Multi Product Calibrator Fluke 725 by Direct Method |
| | K Type Thermocouple | (-)200°C to 1350°C | 0.47°C | Using Multi Product Calibrator Fluke 5522A by Direct Method |
| | J Type Thermocouple | (-)200°C to 1200°C | 0.32°C | |
| | N Type Thermocouple | (-)200°C to 1300°C | 0.47°C | |
| | E Type Thermocouple | (-)200°C to 1000°C | 0.6°C | |
| | R Type Thermocouple | 0°C to 1750°C | 0.88°C | |
| | S Type Thermocouple | 0°C to 1750°C | 0.79°C | |

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| | B Type Thermocouple | 600°C to 1800°C | 0.79°C | |
| | T Type Thermocouple | (-)200°C to 400°C | 0.73°C | |

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| <u>MECHANICAL CALIBRATION</u> | | | | |
| I. | PRESSURE INDICATING DEVICES | | | |
| 1. | Pressure-Pneumatic # (Analogue, Digital) Pressure Gauges/ Indicators, Pressure sensor with indicator, and Pressure Transmitter, Pressure Switch | 0 to 2 bar 0 to 40bar | 0.29% of rdg 0.18% of rdg | Using Digital Pressure Gauge & Pressure Calibrator by Comparison Method as per DKD R-6-1 |
| 2. | Hydraulic Pressure # (Analogue, Digital) Pressure Gauges/ Indicators, Pressure sensor with indicator, and Pressure Transmitter, Pressure Switch) | 0 to 700bar 0 to 1000bar | 0.10% of rdg 0.12% of rdg | Using Digital Pressure Gauge & Pressure Calibrator by Comparison Method as per DKD R-6-1 |
| 3. | Vacuum # (Analogue, Digital) Vacuum Gauges/ Indicators, Vacuum Transmitter, Vacuum sensor with indicator Vacuum Switch | (-)0.85 to 0bar | 0.69% of rdg | Using Digital Pressure Gauge & Pressure Calibrator by Comparison Method as per DKD R-6-1 |

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| 4. | Differential Pressure Gauges, Transmitters, Indicators, Differential Pressure sensor with indicator, and Differential Pressure Switch [#] | 0 to 100 mbar (-)100 mbar to 0 | 0.93% of rdg 0.93% of rdg | Using Digital Manometer & Pressure Calibrator by Comparison Method as per DKD R-6-1 |
| II. | ACCELERATION AND SPEED | | | |
| 1. | RPM [*] | 10RPM to 14000RPM | 8.25% to 0.12% | Using Digital Tachometer by Comparison Method SANASTR-45-01 |
| III. | ACOUSTICS | | | |
| 1. | Sound Level Meter ^{\$} | 94dB 114dB | 0.48dB | Using Sound Level Calibrator by Comparison method By OIML R-58 |
| IV. | DIMENSION (BASIC MEASURING INSTRUMENT, GAUGE ETC.) | | | |
| 1. | Calipers ^{\$} (Dial/Digital/Vernier) L.C.: 10 μ m | 0 to 300 mm Above 300mm Up to 600 mm Above 600mm Up to 1000mm | 13.2 μ m 13.4 μ m 13.7 μ m | Using Gauge Block Set and Gauge Block Accessories & Caliper Checker as per IS:3651(Part 1& 2) by Comparison Method |
| 2. | Depth Gauge ^{\$} (Vernier /Dial/Digital) L.C.: 10 μ m | 0 to 150mm | 9.0 μ m | Using Gauge Block Sets & Surface Plate as per IS:4213 by Comparison Method |

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| 3. | Height Gauge [§] (Vernier/Dial/Digital) L.C.: 10 μ m | Upto 600 mm Above 600mm Upto 1000mm | 11.1 μ m 11.5 μ m | Using Gauge Block Sets & Caliper Checker as per IS:2921 by Comparison Method |
| 4. | External Micrometer [§] (Analog/Dial/Digital) L.C.: 1 μ m | Upto 100 mm Above 100mm Upto 300 mm | 2.0 μ m 5.3 μ m | Using Gauge Block Set as per IS:2967 by Comparison Method |
| 5. | Internal / Stick [§] Micrometer (Analog/Dial/Digital) L.C.: 1 μ m L.C.: 10 μ m | Upto 100 mm Above 100 mm Upto 300 mm | 3.4 μ m 6.1 μ m | Using Gauge Block and Gauge Block Accessories as per IS:2966 by Comparison Method |
| 6. | Depth Micrometer [§] L.C.: 1 μ m | Upto 100 mm | 6.1 μ m | Using Gauge Block Set as per BS:6468 by Comparison Method |
| 7. | Plunger Dial Gauge [§] (Analog / Digital) L.C.: 1 μ m | Up to 25 mm | 3.9 μ m | Using Electronic Dial Calibration Tester as per IS:2092 by Comparison Method |

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| 8. | Lever Dial Gauge [§] L.C.: 1 μ m L.C.: 10 μ m | Up to 0.2 mm Up to 1.0 mm | 3.9 μ m 6.3 μ m | Using Electronic Dial Calibration Tester as per IS:11498 by Comparison Method |
| 9. | Bore Gauge [§] Transmission Error L.C.: 1 μ m | Dia Range: \varnothing 6 -500 mm Probing Range Up to 2 mm | 3.8 μ m | Using Electronic Dial Calibration Tester as per JIS:B7515 by Comparison Method |
| 10. | Micrometer Setting Rods [§] | Up to 75mm | 3.4 μ m | Using Gauge Block Set & Electronic Probe & Comparator Stand by Comparison Method |
| 11. | Feeler Gauge [§] | 0.03 to 1mm | 2.9 μ m | Using Plunger Dial Gauge & Comparator Stand as per IS:3179 by Comparison Method |
| 12. | Dial Thickness Gauge [§] L.C.: 10 μ m | Upto 10mm | 5.8 μ m | Using Gauge Block Set as per IS:2092 by Comparison Method |
| 13. | Pistol Caliper OD Caliper/ Leg Caliper [§] L.C.: 100 μ m | 0 to 100mm | 75 μ m | Using Gauge Block Sets by Comparison Method |

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| 14. | Plane Plug Gauge ^{\$} | 0 to \varnothing 100mm | 3.3 μ m | Using Gauge Block Set & Electronic Probe as per IS:3455 by Comparison Method |
| 15. | Snap Gauge ^{\$} (Fixed / Adjustable) | 12.5 mm to 150mm | 3.5 μ m | Using Gauge Block Set as per IS:3455 by Comparison Method |
| V. | WEIGHTS | | | |
| 1. | Mass /Weights ^{\$} | 1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50g 100g 200g | 0.008mg 0.008mg 0.007mg 0.008mg 0.009mg 0.011mg 0.009mg 0.012mg 0.012mg 0.014mg 0.015mg 0.019mg 0.022mg 0.028mg 0.03mg 0.09mg 0.12mg | Using E2 class Standard Weights Upto 200g And Balance (Readability:0.01mg/0.1mg) Calibration of F1 class weights and coarser as per OIML R- 111 Substitution method through ABBA cycles |

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| | | 500g 1000g | 1.34 mg 2.40mg | Using E2 class Standard Weights Upto 1000g And Balance (Readability:0.001g/0.01g) Calibration of F1 class weights and coarser as per OIML R- 111 Substitution method through ABBA cycles |
| | | 2000g | 8.5mg | |
| | | 5000g | 13.6mg | |

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| VI. | WEIGHING SCALE AND BALANCES | | | |
| 1. | Mass / Electronic weighing balance # $d \geq 0.01\text{mg}$ $d \geq 0.1\text{mg}$ | 1mg to 100g 10mg to 200g | 0.05 mg 0.12 mg | Using E2 class Standard Weights Upto 200g Calibration of Class 1 weighing balances and coarser as per OIML R-76 |
| | $d \geq 0.1\text{mg}$ | Upto 500g Upto 1000g | 0.71 mg 0.83 mg | Using E2 class Standard Weights Upto 1000g Calibration of Class 1 weighing balances and coarser as per OIML R-76 |
| | $d \geq 0.1\text{ g}$ $d \geq 2\text{ g}$ $d \geq 10\text{ g}$ $d \geq 50\text{ g}$ | Upto 3 kg Upto 40 kg Upto 150 kg Upto 300 kg | 9 mg 1.61 g 33.3 g 34 g | Using E2, F1 & M1 class Standard Weights Calibration of Class-II weighing balances and coarser as per OIML R-76 |
| VII. | VOLUME | | | |
| 1. | Micro Pipette § | $10\ \mu\text{l} < V \leq 100\ \mu\text{l}$ $100\ \mu\text{l} < V \leq 1000\ \mu\text{l}$ $1\ \text{ml} < V \leq 5\ \text{ml}$ | 0.17 μl 0.61 μl 1.18 μl | Using Weighing balance withd : 0.01 / 0.1 mg and distilled water Calibration of Micro pipettes based on Gravimetric method as per ISO:8655-6 |

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| 2. | Glassware [§] Burettes, Measuring Cylinder, Volumetric Flask, Glass Pipettes | 1 ml < V ≤ 10 ml 10 ml < V ≤ 100 ml | 0.002ml 0.15 ml | Using weighing balance of d : 0.01/0.1 mg and distilled water Calibration of Glassware based on Gravimetric method as per ISO:4787 |
| | | 100 ml < V ≤ 150 ml 150 ml < V ≤ 500 ml 500 ml < V ≤ 1000 ml 1000 ml < V ≤ 5000 ml | 0.205 ml 0.59 ml 1.03 ml 1.46 ml | Using weighing balance of d : 0.001/0.01 g and distilled water Calibration of Glassware based on Gravimetric method as per ISO:4787 |

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| <u>THERMAL CALIBRATION</u> | | | | |
| I. | TEMPERATURE | | | |
| 1. | Temperature / RTD & Thermocouple With & Without Indicator, Temperature Gauges, Temperature Data Loggers With Sensor [#] | (-)40°C to 50°C 50°C to 250°C 250°C to 400°C | 0.19°C 0.29°C 0.37°C | Using RTD With Indicator & Low / High Temperature Dry Block Furnace & Liquid Baths as a source by Comparison Method |
| 2. | Temperature / RTD & Thermocouple With & Without Indicator, Temperature gauges, Temperature data loggers with sensor [#] | 400°C to 800°C 800°C to 1200°C | 1.7°C 2.5°C | Using S Type Thermocouple With Indicator & Dry Block Furnace as a source by Comparison Method |
| 3. | Temperature / Indicator of Freezer, Ovens, Incubators, Furnaces, Chambers, Autoclaves, Dry Block Calibrator, Oil baths, Water Bath [#] (Single Point) | (-)80°C to 400°C 400°C to 800°C 800°C to 1200°C | 0.21°C 1.7°C 2.5°C | Using RTD With Indicator & S Type Thermocouple With Indicator by Direct Method |

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Accreditation Standard ISO/IEC 17025: 2005

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| Sl. | Quantity Measured / Instrument | Range/Frequency | *Calibration Measurement Capability (\pm) | Remarks |
|---------------------------------------|---|---|---|--|
| 4. | Temperature [§] / Glass Thermometer | (-)40°C to 50°C 50°C to 250°C | 0.33°C 0.39°C | Using RTD With Indicator & Low / High Liquid Baths as a source by Comparison Method |
| 5. | Non Contact Temperature / IR Thermometer / Pyrometer / IR Sensor with Indicator [§] | 50°C to 500°C | 2.55°C | Using IR Thermometer & Black body Furnace as a source by Comparison Method |
| II. SPECIFIC HEAT AND HUMIDITY | | | | |
| 1. | Relative Humidity & Temperature / Temperature Humidity Meter / Thermo Hygrometer / Temperature Humidity Sensor with Indicator / Controller / Recorder & Temperature Humidity Transmitters, etc [§] | 15% to 95%RH @25°C 15°C to 50°C @49%RH | 1.05%RH 0.25°C | Using Temperature & Humidity Meter & Portable Temperature Humidity calibrator as a source by Comparison Method |
| 2. | Temperature / Multi Position calibration of Freezers, Chambers, Cold Rooms, Furnaces, Autoclave, Incubators, Ovens*. | (-)80°C to 300°C 300°C to 900°C 900°C to 1200°C | 0.62°C 1.8°C 2.6°C | Using RTD Sensors with Paperless Recorder and "N" Type Thermocouple with Paperless Recorder by Direct Method |

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|-----|---|---|---|---|
| 3. | Relative Humidity & Temperature / Temperature Humidity Chamber / Environmental / Climatic Chambers* | 15% to 95% @25°C 15°C to 50°C @49%RH | 0.81 %RH 0.21°C | Using Temperature & Humidity Meter by Direct Method |

* Measurement Capability is expressed as an uncertainty (\pm) 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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