

Scope of Accreditation For Indiana Standards Laboratory

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In recognition of a successful assessment to ISO/IEC 17025:2005, accreditation is granted to **Indiana Standards Laboratory** to perform the following Calibrations:

Accreditation granted through: **October 31, 2012**

Calibration

Length – Hand Tools and Precision Gages 1D

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) ³	Remarks
Calipers & Linear Scales ¹	(0 to 304.8) mm	(12 + 0.00092L) μm	Gage Block
	(304.8 to 1524) mm	(15 + 0.0014L) μm	
Tape Measures	Up to 30.48 m	(1.5 + 0.00015L) mm	Steel Rule
Height Gages	(0 to 610) mm	(23 + 0.01L) μm	Gage Block Surface Plate
Height Master & Riser Block	(0 to 304.8) mm	(7.1 + 0.01L) μm	Gage Block
Indicators, Digital, Dial & Test ¹	(0 to 101.6) mm	(2 + 0.0043L) μm	Gage Block
Micrometers ¹ , Inside, Outside, Depth, Bore Gages	(2.54 to 101.6) mm	(1.4 + 0.0024L) μm	Gage Block
	(101.6 to 508) mm	(1.3 + 0.03L) μm	

Length – Hand Tools and Precision Gages 2D

Calibration Parameter/Equipment	Range ⁵	Calibration and Measurement Capability(+/-)	Remarks
Bubble Levels Level Vial Setting Vial Sensitivity	(50 to 609.6) mm	3.81 μm	Gage Block Surface Plate
Optical Flatness ⁵	To 25 mm <i>D</i>	0.36 μm	Optical Parallel Helium-Neon Light

Calibration Parameter/Equipment	Range⁵	Calibration and Measurement Capability(+/-)	Remarks
Optical Parallelism ⁵	To 25 mm <i>D</i>	0.43 μm	Optical Parallel Helium-Neon Light
Digital Protractors & Inclinometers	(0 to 90) °	0.036 °	Gage Block Surface Plate Sine Bar
Measuring Microscopes ¹			
Linear Scale	(0 to 101.6) mm	5.08 μm	Gage Blocks
Angle	(0 to 90) °	2.6 min	Angle Blocks
Profilometers ¹ & Surface Roughness Testers ¹	16 Ra 119 Ra	0.1 μm	Roughness Standard
Optical Comparators ¹			
Linear Scale	(0 to 254) mm	4.06 μm	Linear Scale
Angular Scales	90 °	36 s	Angle Block

Length – Artifacts and Standards 1D

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)³	Remarks
Cylindrical Pins, Plugs & Thread Wires	(0.127 to 101.6) mm	(0.94 + 0.01 <i>L</i>) μm	ULM Grade 0 Gage Blocks
End Measuring Rods (Micrometer Standards)	(25.4 to 304.8) mm	(0.93 + 0.0027 <i>L</i>) μm	Master Blocks Test Indicator
Thickness Gages	(0.0254 to 1.270) mm	(11 + 0.02 <i>L</i>) μm	ULM
Steel Rules	Up to 914.4 mm	(0.27 + 0.00014 <i>L</i>) mm	Steel Rule
Gage Blocks	(0.203 to 1.27) mm	(0.099 + 0.000063 <i>L</i>) μm	Comparator Grade 0 Blocks
	(1.27 to 101.6) mm	(0.091 + 0.0018 <i>L</i>) μm	
	(125 to 500) mm	(1.7 + 0.002 <i>L</i>) μm	Test Indicator Master Blocks
Plain Ring Gages	Up to 50.8 mm	(1.2 + 0.000064 <i>L</i>) μm	ULM Master Ring
	(50.8 to 101.6) mm	(1.2 + 0.00034 <i>L</i>) μm	
	(101.6 to 203.2) mm	(1.3 + 0.00059 <i>L</i>) μm	

Length – Artifacts and Standards 2D

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)³	Remarks
Radius Gages	(0.39624 to 25.4) mm	0.05 mm	Measuring Microscope Master Radius Gages

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) ³	Remarks
Thread Plug Gages Pitch Diameter	Up to 101.6 mm	(1.8 + 0.0089L) μ m	ULM Gage Block Thread Wires
Major Diameter	Up to 101.6 mm	(0.72 + 0.0055L) μ m	

Mass – Scales and Balances

Calibration Parameter/Equipment ¹	Range	Calibration and Measurement Capability(+/-)	Remarks
Precision Balances (Resolution 0.1 mg)	(0 to 205) g	0.35 mg	Standard Mass
Analytical Balances (Resolution 1 mg)	(0 to 500) g	0.8 mg	Standard Mass
	(Resolution 10 mg) (0 to 3200) g	8.1 mg	
Bench Scales (Resolution 0.1 g)	(0 to 32) kg	69 mg	Standard Mass
Floor Scales (Resolution 22 g)	(0 to 907) kg	100 g	Standard Mass

Mass – Pressure and Low Vacuum

Calibration Parameter/Equipment ¹	Range	Calibration and Measurement Capability(+/-)	Remarks
Pressure-Pneumatic Gage and Absolute Gage Only	(18 to 1000) psia	0.0023 % of reading	Ruska 2465 or Transducers ¹
	(124.1 to 6894.7) kPa		
	(0.2 to 18.2) psia	0.013 % of reading	
	(1.37 to 124.1) kPa		
Pressure, Hydraulic Gage	(1000 to 15 000) psi	0.0067 % of reading	Ruska 2485 or Portable Dead Weight Tester ¹
	(6.894 to 103.42) MPa		
Manometers	(0 to 20) inH ₂ O	0.003 in H ₂ O	Meriam Micromanometer
	(0 to 2) inH ₂ O	0.0014 in H ₂ O	Dwyer Microtector

Mass – Medium and High Vacuum

Calibration Parameter/Equipment ¹	Range	Calibration and Measurement Capability(+/-)	Remarks
Vacuum	(0.001 to 10) torr	0.02 torr	Capacitance Manometer High Vacuum Pump Diffusion Pump

Mass – Torque

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) ⁴	Remarks
Torque Analyzers	0.1 Nm to 1356 Nm (0.1 lbf·ft to 1000 lbf·ft)	0.04 % of range	Torque Arm Weights
Torque Wrenches ¹	0.05 Nm to 5.6 Nm (0.5 lbf·in to 50 lbf·in)	(0.0058 + 0.0032 <i>T</i>) Nm (0.051 + 0.0032 <i>T</i>) lbf·in	Torque Calibrator
	5.6 Nm to 28 Nm (50 lbf·in to 250 lbf·in)	(0.0088 + 0.0038 <i>T</i>) Nm (0.078 + 0.0038 <i>T</i>) lbf·in	
	1.76 Nm to 112 Nm (1.3 lbf·ft to 83 lbf·ft)	(0.14 + 0.003 <i>T</i>)Nm (0.089 + 0.0032 <i>T</i>) lbf·ft	
	113 Nm to 339 Nm (83 lbf·ft to 250 lbf·ft)	(0.23 + 0.0036 <i>T</i>)Nm (0.17 + 0.0036 <i>T</i>) lbf·ft	
	339 Nm to 1 356 Nm (250 lbf·ft to 1000 lbf·ft)	(0.42 + 0.0039 <i>T</i>)Nm (0.31 + 0.0039 <i>T</i>) lbf·ft	
Torque Watches ¹	2 Nm to 17 Nm (0.5 ozf·in to 2.5 ozf·in)	0.42 Nm (0.059 ozf·in)	Torque Watch Calibrator
	8 Nm to 70 Nm (2 ozf·in to 10 ozf·in)	0.64 Nm (0.091 ozf·in)	
	42 Nm to 303 Nm (6 ozf·in to 43 ozf·in)	1.56 Nm (0.22 ozf·in)	
	211 Nm to 1518 Nm (30 ozf·in to 215 ozf·in)	6.76 Nm (0.96 ozf·in)	

Mass – Force

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Force	(9.8 to 4452) mN	0.018 mN + 0.00018 mN/mN	Dead Weight
	(4.44 to 4440) N	7.4 mN + 0.12 mN/N	
	(1.45 to 22.24) kN	7.82 N	5 000 lb Proving Ring
	(5 to 89) kN	0.04 kN	20 000 lb Proving Ring
	(8.5 to 222) kN	0.10 kN	50 000 lb Proving Ring
	(39 to 445) kN	0.17 kN	100 000 lb Proving Ring

Mass – Hardness

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Durometer Spring Force Type A, B, E, M & O	(0 to 100) Duro	0.03 N	Weights Equal Arm Balance
Type C, D, & DO		0.06 N	

Mass – Mass Artifacts

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Weights	(0 to 3) g	7.2 μ g + 0.0035 μ g/mg	Mettler M3 Balance Class 3 Weights
	(0 to 200) g	0.027 mg + 0.00082 mg/g	Mettler H51 Balance Class 3 Weights
	(0 to 210) g	0.046 mg + 0.00077 mg/g	Sartorius BP2100 Balance Class 3 Weights
	(0 to 5000) g	0.83 mg + 0.00065 mg/g	Voland Scale Class 3 Weights
	(0 to 32 500) g	57 mg + 0.00038 mg/g	Sartorius F32000S Scale Class 3 Weights

Mass – Viscosity

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Viscometers	< 10 cP	0.3 % of reading	Viscosity Standard Thermometer Water Bath
	(10 to 100) cP	0.46 % of reading	
	(100 to 1000) cP	0.5 % of reading	
	(1000 to 10 000) cP	0.68 % of reading	
	(10 000 to 100 000) cP	0.71 % of reading	
Viscosity Cups	< 10 cSt	0.98 % of reading	Viscosity Standard Thermometer Water Bath Stop Watch
	(10 to 100) cSt	1.7 % of reading	
	(100 to 1000) cSt	1.7 % of reading	

Fluid Properties and Quantities – Flow

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Air Speed Velocity	(1.5 to 15.4) m/s	0.03 m/s / m/s	Pitot Tube Manometer
Gas Flow ¹	(30 to 400) L/m	0.2 L/m + 0.0027 L/m / L/m	Bell Prover
	(0.1 to 35) L/m	0.002 L/m + 0.0013 L/m / L/m	Piston Prover
	(0 to 100) cm ³ /m	0.42 cm ³ /m + 0.0098 cm ³ /m / cm ³ /m	
Liquid Flow ¹	(1 to 190) L/m	0.0014 L/m + 0.0062 L/m / L/m	Turbine Flowmeter

Electrical – Voltage

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Source) ¹	1 mV 50 Hz to 1 kHz	0.25 % of reading	Ratio Transformer
	10 mV 50 Hz to 1 kHz	120 μ V/V	
	100 mV 50 Hz to 1 kHz	46 μ V/V	
	100 mV 1 kHz to 20 kHz	0.035 %	Fluke 5200A
	100 mV 20 kHz to 100 kHz	0.081 %	
	0.25 V to 0.5 V 10 Hz	150 μ V/V	Holt 6A Thermal Transfer Standard
	0.25 V to 0.5 V 20 Hz	70 μ V/V	
	0.25 V to 0.5 V 50 Hz to 50 kHz	65 μ V/V	
	0.25 V to 0.5 V 50 kHz to 100 kHz	70 μ V/V	
	0.25 V to 0.5 V 100 kHz to 500 kHz	225 μ V/V	
	0.25 V to 0.5 V 500 kHz to 1 MHz	750 μ V/V	
	> 0.5 V to 1 V; 10 Hz	135 μ V/V	
	> 0.5 V to 1 V 20 Hz	65 μ V/V	
	> 0.5 V to 1 V 50 Hz to 1 kHz	55 μ V/V	
	> 0.5 V to 1 V 1 kHz to 10 kHz	45 μ V/V	
	> 0.5 V to 1 V 10 kHz to 50 kHz	40 μ V/V	
	> 0.5 V to 1 V 50 kHz to 100 kHz	50 μ V/V	
	> 0.5 V to 1 V 100 kHz to 500 kHz	150 μ V/V	
	> 0.5 V to 1 V 500 kHz to 1 MHz	625 μ V/V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Source) ¹	> 1 V to 10 V 10 Hz	125 μ V/V	Holt 6A Thermal Transfer Standard
	> 1 V to 10 V 20 Hz	50 μ V/V	
	> 1 V to 10 V 50 Hz to 20 kHz	30 μ V/V	
	> 1 V to 10 V 20 kHz to 50 kHz	40 μ V/V	
	> 1 V to 10 V 50 kHz to 100 kHz	50 μ V/V	
	> 1 V to 10 V 100 kHz to 500 kHz	150 μ V/V	
	> 1 V to 10 V 500 kHz to 1 MHz	625 μ V/V	
	> 10 V to 50 V 10 Hz	125 μ V/V	
	> 10 V to 50 V 20 Hz	50 μ V/V	
	> 10 V to 50 V 50 Hz to 20 kHz	30 μ V/V	
	> 10 V to 50 V 20 Hz to 50 kHz	40 μ V/V	
	> 10 V to 50 V 50 Hz to 100 kHz	50 μ V/V	
	> 10 V to 50 V 100 Hz to 200 kHz	150 μ V/V	
	> 50 V to 100 V 10 Hz	125 μ V/V	
	> 50 V to 100 V 20 Hz	50 μ V/V	
	> 50 V to 100 V 50 Hz to 20 kHz	30 μ V/V	
	> 50 V to 100 V 20 kHz to 50 kHz	40 μ V/V	
	> 50 V to 100 V 50 kHz to 100 kHz	50 μ V/V	
	> 100 V to 150 V 10 Hz	125 μ V/V	
	> 100 V to 150 V 20 Hz	50 μ V/V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Source) ¹	> 100 V to 150 V 50 Hz to 1 kHz	30 μ V/V	Holt 6A Thermal Transfer Standard
	> 100 V to 150 V 1 kHz to 10 kHz	40 μ V/V	
	> 100 V to 150 V 10 kHz to 20 kHz	50 μ V/V	
	> 100 V to 150 V 20 kHz to 50 kHz	65 μ V/V	
	> 100 V to 150 V 50 kHz to 100 kHz	100 μ V/V	
	> 150 V to 300 V 10 Hz	125 μ V/V	
	> 150 V to 300 V 20 Hz	50 μ V/V	
	> 150 V to 300 V 50 Hz to 1 kHz	30 μ V/V	
	> 150 V to 300 V 1 kHz to 10 kHz	40 μ V/V	
	> 150 V to 300 V 10 kHz to 20 kHz	50 μ V/V	
	> 150 V to 300 V 20 kHz to 50 kHz	65 μ V/V	
	> 300 V to 500 V 10 Hz	125 μ V/V	
	> 300 V to 500 V 20 Hz	50 μ V/V	
	> 300 V to 500 V 50 Hz to 1 kHz	35 μ V/V	
	> 300 V to 500 V 1 kHz to 10 kHz	60 μ V/V	
	> 300 V to 500 V 10 kHz to 20 kHz	90 μ V/V	
	> 300 V to 500 V 20 kHz to 50 kHz	110 μ V/V	
	> 500 V to 1200 V 10 Hz	125 μ V/V	
	> 500 V to 1200 V 20 Hz	50 μ V/V	
> 500 V to 1200 V 50 Hz to 1 kHz	40 μ V/V		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Source) ¹	> 500 V to 1200 V 1 kHz to 10 kHz	60 μ V/V	Holt 6A Thermal Transfer Standard
	> 500 V to 1200 V 10 kHz to 20 kHz	120 μ V/V	
	> 500 V to 1200 V 20 kHz to 50 kHz	145 μ V/V	
AC Voltage (Measure) ¹	1 mV 50 Hz to 1 kHz	0.26 % of reading	Ratio Transformer
	10 mV 50 Hz to 1 kHz	120 μ V/V	
	100 mV 50 Hz to 1 kHz	49 μ V/V	
	100 mV 1 kHz to 20 kHz	0.36 % of reading	Fluke 8506A
	100 mV 20 kHz to 50 kHz	0.07 % of reading	
	100 m 50 kHz to 100 kHz	0.23 % of reading	
	0.25 V to 0.5 V 10 Hz	150 μ V/V	Holt 6A Thermal Transfer Standard
	0.25 V to 0.5 V 20 Hz	70 μ V/V	
	0.25 V to 0.5 V 50 Hz to 50 kHz	65 μ V/V	
	0.25 V to 0.5 V 50 kHz to 100 kHz	70 μ V/V	
	0.25 V to 0.5 V 100 kHz to 500 kHz	225 μ V/V	
	0.25 V to 0.5 V 500 kHz to 1 MHz	750 μ V/V	
	> 0.5 V to 1 V 10 Hz	135 μ V/V	
	> 0.5 V to 1 V 20 Hz	65 μ V/V	
	> 0.5 V to 1 V 50 Hz to 1 kHz	55 μ V/V	
	> 0.5 V to 1 V 1 kHz to 10 kHz	45 μ V/V	
> 0.5 V to 1 V 10 kHz to 50 kHz	40 μ V/V		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Measure) ¹	> 0.5 V to 1 V 50 kHz to 100 kHz	50 μ V/V	Holt 6A Thermal Transfer Standard
	> 0.5 V to 1 V 100 kHz to 500 kHz	150 μ V/V	
	> 0.5 V to 1 V 500 kHz to 1 MHz	625 μ V/V	
	> 1 V to 10 V 10 Hz	125 μ V/V	
	> 1 V to 10 V 20 Hz	50 μ V/V	
	> 1 V to 10 V 50 Hz to 20 kHz	30 μ V/V	
	> 1 V to 10 V 20 kHz to 50 kHz	40 μ V/V	
	> 1 V to 10 V 50 kHz to 100 kHz	50 μ V/V	
	> 1 V to 10 V 100 kHz to 500 kHz	150 μ V/V	
	> 1 V to 10 V 500 kHz to 1 MHz	625 μ V/V	
	> 10 V to 50 V 10 Hz	125 μ V/V	
	> 10 V to 50 V 20 Hz	50 μ V/V	
	> 10 V to 50 V 50 Hz to 20 kHz	30 μ V/V	
	> 10 V to 50 V 20 Hz to 50 kHz	40 μ V/V	
	> 10 V to 50 V 50 Hz to 100 kHz	50 μ V/V	
	> 10 V to 50 V 100 Hz to 200 kHz	150 μ V/V	
	> 50 V to 100 V 10 Hz	125 μ V/V	
	> 50 V to 100 V 20 Hz	50 μ V/V	
	> 50 V to 100 V 50 Hz to 20 kHz	30 μ V/V	
	> 50 V to 100 V 20 kHz to 50 kHz	40 μ V/V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Measure) ¹	> 50 V to 100 V 50 kHz to 100 kHz	50 μ V/V	Holt 6A Thermal Transfer Standard
	> 100 V to 150 V 10 Hz	125 μ V/V	
	> 100 V to 150 V 20 Hz	50 μ V/V	
	> 100 V to 150 V 50 Hz to 1 kHz	30 μ V/V	
	> 100 V to 150 V 1 kHz to 10 kHz	40 μ V/V	
	> 100 V to 150 V 10 kHz to 20 kHz	50 μ V/V	
	> 100 V to 150 V 20 kHz to 50 kHz	65 μ V/V	
	> 100 V to 150 V 50 kHz to 100 kHz	100 μ V/V	
	> 150 V to 300 V 10 Hz	125 μ V/V	
	> 150 V to 300 V 20 Hz	50 μ V/V	
	> 150 V to 300 V 50 Hz to 1 kHz	30 μ V/V	
	> 150 V to 300 V 1 kHz to 10 kHz	40 μ V/V	
	> 150 V to 300 V 10 kHz to 20 kHz	50 μ V/V	
	> 150 V to 300 V 20 kHz to 50 kHz	65 μ V/V	
	> 300 V to 500 V 10 Hz	125 μ V/V	
	> 300 V to 500 V 20 Hz	50 μ V/V	
	> 300 V to 500 V 50 Hz to 1 kHz	35 μ V/V	
	> 300 V to 500 V 1 kHz to 10 kHz	60 μ V/V	
> 300 V to 500 V 10 kHz to 20 kHz	90 μ V/V		
> 300 V to 500 V 20 kHz to 50 kHz	110 μ V/V		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Voltage (Measure) ¹	> 500 V to 1200 V 10 Hz to 50 kHz	125 μ V/V	Holt 6A Thermal Transfer Standard
	> 500 V to 1200 V 20 Hz	50 μ V/V	
	> 500 V to 1200 V 50 Hz to 1 kHz	40 μ V/V	
	> 500 V to 1200 V 1 kHz to 10 kHz	60 μ V/V	
	> 500 V to 1200 V 10 kHz to 20 kHz	120 μ V/V	
	> 500 V to 1200 V 20 kHz to 50 kHz	145 μ V/V	
AC High Voltage (Source)	(1 to 30) kV	1.2 % of reading	Voltage Divider Voltmeter High Voltage Source
AC High Voltage (Measure)	(1 to 5) kV	0.34 % of reading	Voltage Divider Voltmeter
	(5 to 30) kV	0.35 % of reading	
	(30 to 200) kV	1.2 % of reading	
DC Voltage (Source) Lab Reference	10 V	3.5 μ V/V	Fluke 732A
DC Voltage (Source) ¹	(10 to 100) μ V	0.25 μ V + 0.5% of reading	Keithley 260
	100 μ V	4100 μ V/V	Fluke 732A Kelvin Varley Divider
	1 mV	480 μ V/V	
	10 mV	13 μ V/V	
	100 mV	4.6 μ V/V	Fluke 732A Fluke 752A
	1 V	3.5 μ V/V	
	100 V	3.6 μ V/V	
	1000 V	3.7 μ V/V	
DC High Voltage (Source)	(0 to 70) kV	0.59 % of reading	Voltmeter Voltage Divider High Voltage Source
DC Voltage (Measure) ¹	(0 to 100) μ V	(3 % FS + 0.25 μ V)	Keithley 155
	(0 to 10) μ V		
	(0 to 1) μ V		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
DC Voltage (Measure) ¹	100 μ V	4500 μ V/V	Null Detector Kelvin Varley Divider
	1 mV	510 μ V/V	
	10 mV	13 μ V/V	Fluke 732A Fluke 752A Reference Divider Null Detector
	100 mV	4.9 μ V/V	
	1 V	3.5 μ V/V	
	10 V	3.5 μ V/V	
	100 V	3.6 μ V/V	
	1000 V	3.7 μ V/V	
DC High Voltage (Measure)	(1 to 5) kV	0.13 % of reading	Voltmeter Voltage Divider
	(5 to 30) kV	0.044 % of reading	
	(30 to 100) kV	0.1 % of reading	
	(10 to 200) kV	0.7 % of reading	
DC Ratio (Source)	(0 to 0.1) ratio	0.28 μ V/V + (0.22 μ V/V of input X ratio)	Fluke 720A Kelvin Varley Divider
	(0.1 to 1) ratio	0.6 μ V/V of input ratio	
Thermocouple Simulation			Ectron 1100
Type E	(-270 to 1000) $^{\circ}$ C	0.02 % reading + 0.07 $^{\circ}$ C	
Type J	(-200 to 760) $^{\circ}$ C	0.02 % reading + 0.06 $^{\circ}$ C	
Type K	(-270 to 1372) $^{\circ}$ C	0.02 % reading + 0.1 $^{\circ}$ C	
Type T	(-270 to 400) $^{\circ}$ C	0.02 % reading + 0.08 $^{\circ}$ C	
Type S	(-50 to 1760) $^{\circ}$ C	0.02 % reading + 0.21 $^{\circ}$ C	
Type R	(-50 to 1760) $^{\circ}$ C	0.02 % reading + 0.2 $^{\circ}$ C	

Electrical – Resistance

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Resistance (Source) ¹	100 μ Ω	5 μ Ω / Ω	Otto Wolff 0.0001
	1 m Ω	2.9 μ Ω / Ω	Leeds & Northrup 4223-B
	10 m Ω	2.9 μ Ω / Ω	Leeds & Northrup 4222-B
	100 m Ω	1.8 μ Ω / Ω	Leeds & Northrup 4221-B
	1 Ω	0.64 μ Ω / Ω	Leeds & Northrup 4210
	10 Ω	1.1 μ Ω / Ω	Leeds & Northrup 4025-B

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Resistance (Source) ¹	100 Ω	0.63 μΩ/Ω	Leeds & Northrup 4030-B
	1 kΩ	1.2 μΩ/Ω	Leeds & Northrup 4035-B
	10 kΩ	1.7 μΩ/Ω	Leeds & Northrup 4040-B
	100 kΩ	2.3 μΩ/Ω	Leeds & Northrup 4045-B
	1 MΩ	3.3 μΩ/Ω	Leeds & Northrup 4050-B
	10 MΩ	50 μΩ/Ω	PPM-R3-1110M
	100 MΩ	96 μΩ/Ω	
	1 GΩ	0.02 % of reading	
Resistance (Measure) ¹	(0 to 100) μΩ	0.01Ω + 0.02% of reading	Leeds & Northrup BD-829 Ottowolf 0.000 1 Ω
	100 μΩ	5 μΩ/Ω	Guildline 9975/9923 Leeds & Northrup 4210 Reference Resistor
	1 mΩ	2.9 μΩ/Ω	
	10 mΩ	2.9 μΩ/Ω	
	100 mΩ	1.8 μΩ/Ω	
	1 Ω	1.6 μΩ/Ω	Guildline 9975 Leeds & Northrup 4210 Reference Resistor
	10 Ω	1.1 μΩ/Ω	Guildline 9975 100 Ω Reference Resistor
	100 Ω	1.4 μΩ/Ω	Guildline 9975 Leeds & Northrup 4030-B Reference Resistor
	1 kΩ	1.2 μΩ/Ω	
	10 kΩ	1.7 μΩ/Ω	Guildline 9975 Leeds & Northrup 4035-B Reference Resistor
	100 kΩ	2.3 μΩ/Ω	Guildline 9975 Leeds & Northrup 4040-B Reference Resistor
	1 MΩ	3.3 μΩ/Ω	Guildline 9975 Leeds & Northrup 4045-B Reference Resistor
	10 MΩ	27 μΩ/Ω	Guildline 9975 Leeds & Northrup 4050-B Reference Resistor
	100 MΩ	0.01 % of reading	Leeds & Northrup 4232B Guarded Wheatstone Bridge
1 GΩ	0.29 % of reading		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Electrical Calibration of RTD Indicators ¹	(-200 to 0) °C	0.01 °C	Resistance Decade RTD Tables
	(0 to 130) °C	0.02 °C	
	(130 to 600) °C	0.12 °C	
	(600 to 849) °C	0.16 °C	

Electrical – Current

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Current (Source) ¹	100 µA 10 Hz to 5 kHz	0.01 % of reading	GR 1440 Fluke 8506A
	1 µA 10 Hz to 5 kHz	0.01 % of reading	
	1 mA 10 Hz to 5 kHz	0.01 % of reading	
	0.1 A 10 Hz to 5 kHz	44 µA/A	Holt CS1 Holt 6A
	0.1 A 10 Hz to 10 kHz	42 µA/A	
	1 A 10 Hz to 5 kHz	45 µA/A	
	10 A 10 Hz to 1 kHz	62 µA/A	
	20 A 10 Hz to 1 kHz	130 µA/A	
AC Current (Measure) ¹	100 µA 10 Hz to 5 kHz	0.01 % of reading	GR 1440 Fluke 8506A
	1 µA 10 Hz to 5 kHz	0.01 % of reading	
	1 mA 10 Hz to 5 kHz	0.01 % of reading	
AC Current (Measure) ¹	0.01 A 10 Hz to 10 kHz	48 µA/A	Holt CS1 Holt 6A
	0.1 A 10 Hz to 10 kHz	42 µA/A	
	1 A 10 Hz to 10 kHz	44 µA/A	
	10 A 10 Hz to 10 kHz	62 µA/A	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Current (Measure) ¹	10 A to 1200 A 60 Hz	830 μ A/A	CT Ammeter
	20 A 10 Hz to 1 kHz	130 μ A/A	Holt CS1 Holt 6A
	20 A 10 Hz to 10 kHz	130 μ A/A	
DC Current (Source) ^{1,3}	10 μ A	59 μ A/A	Multi-function Calibrator 10 V Reference
	100 μ A	6.9 μ A/A	
	1 mA	6.8 μ A/A	
	10 mA	7.5 μ A/A	
	100 mA	12 μ A/A	
	1 A	14 μ A/A	
	10 A	31 μ A/A	
	20 A	31 μ A/A	
DC Current (Measure) ¹	10 μ A	59 μ A/A	Multi-function Calibrator 10 V Reference
	100 μ A	6.9 μ A/A	
	1 mA	6.8 μ A/A	
	10 mA	7.5 μ A/A	
	100 mA	12 μ A/A	
	1 A	14 μ A/A	
	10 A	31 μ A/A	
	20 A	31 μ A/A	
	(20 to 100) A	0.02 % of reading	
	(100 to 2000) A	0.05 % of reading	

Electrical – Inductance

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Inductance (Source)	100 μ H, 1 kHz	0.08 % of nominal	General Radio 1482-B
	1 mH, 1 kHz	0.02 % of nominal	General Radio 1482-E
	10 mH, 100 Hz	0.07 % of nominal	General Radio 1482-H
	10 mH, 1 kHz	0.02 % of nominal	
	100 mH, 100 Hz	0.08 % of nominal	General Radio 1482-L

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Inductance (Source)	100 mH, 1 kHz	0.02 % of nominal	General Radio 1482-L
	1 H, 100 Hz	0.07 % of nominal	General Radio 1482-P
	1 H, 1 kHz	0.02 % of nominal	
	10 H, 100 Hz	0.07 % of nominal	General Radio 1482-T
	10 H, 1 kHz	0.02 % of nominal	
Inductance (Measure)	100 μ H, 1 kHz	0.1 % of reading	General Radio 1689
	1 mH, 1 kHz	0.03 % of reading	
	10 mH, 100 Hz	0.09 % of reading	
	10 mH, 1 kHz	0.03 % of reading	
	100 mH, 100 Hz	0.09 % of reading	
	100 mH, 1 kHz	0.03 % of reading	
	1 H, 100 Hz	0.08 % of reading	
	1 H, 1 kHz	0.03 % of reading	
	10 H, 100 Hz	0.09 % of reading	
	10 H, 1 kHz	0.03 % of reading	

Electrical – Capacitance

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Capacitance (Source)	1 pF	77 μ F/F	1422-CD GR 1615A
	10 pF	23 μ F/F	GR1403G GR 1615A
	100 pF	11 μ F/F	GR 1404-B GR 1615A
	1000 pF Primary	9.2 μ F/F	GR 1404A Reference
	10 nF	21 μ F/F	GR 1615
	100 nF	29 μ F/F	GR 1409
	1 μ F	65 μ F/F	GR 1615A
	10 μ F	0.04 % of reading	ISL 10 μ F Standard GR 1615A
	100 μ F	0.04 % of reading	ISL 100 μ F Standard GR 1615A

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Capacitance (Measure)	1 pF	65 μ F/F	GR 1615A
	10 pF	20 μ F/F	
	100 pF	9.6 μ F/F	
	1000 pF	9.3 μ F	
	10 nF	17 μ F/F	
	100 nF	27 μ F/F	
	1 μ F	64 μ F/F	GR 1615A GR 1409-T
	10 μ F	0.03 % of reading	GR 1615A GR 1615-p1
	100 μ F	0.03 % of reading	GR 1615A Decade Capacitor Decade Resistor

Electrical – RF Power

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
RF Power (Source)	10 μ W to 10 nW 10 MHz to 2 GHz	2.5 % of reading	HP437B Power Meter HP 8484A Sensor
	100 mW to 10 μ W 100 kHz to 2 GHz	2.6 % of reading	HP437B Power Meter HP 8482A Sensor
RF Power (Measure)	10 μ W to 1 nW 10 MHz to 2 GHz	2.8 % of reading	HP437B Power Meter HP 8484A Sensor
	100 mW to 10 μ W 100 kHz to 2 GHz	2.5 % of reading	HP437B Power Meter HP 8482A Sensor

Electrical – Magnetic Properties

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Magnetometers / Flux Meters	(0 to 50) G	0.04 G + 0.01 G/G	Gaussmeter
	(50 to 20 000) G	0.045 G + 0.0073 G/G	Gaussmeter Magnetic Yoke

Time and Frequency – Oscilloscopes

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Squarewave (Source) Amplitude (1 M Ω)	200 μ V to 100 V	0.29 % of reading	Tektronix PG506
Time Mark (Source)	1 ns/div to 5 s/div	12 μ s/s	Tektronix TG501

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Leveled Sinewave (Source) Flatness	250 kHz to 50 MHz	1.4 % of reading	Tektronix SG503
	(50 to 250) MHz	3.5 % of reading	
	(250 to 500) MHz	4.5 % of reading	Hewlett Packard 437B

Time and Frequency – Frequency / Period

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Frequency (Measure)	0 Hz to 1.3 GHz	1.7×10^{-9} Hz/Hz	Electronic Counter
Frequency (Source)	0 Hz to 1.3 GHz	1.7×10^{-9} Hz/Hz	Electronic Counter Signal Generator
Stop Watches	(1 to 3600) s	0.12 s	Timer Counter
Tachometers ¹ (Contact)	(5.76 to 4189) rad/s	(0.21 rad/s + 0.00007 rad/s) rad/s	Rpm Standard
	(55 to 40 000) rpm	(0.2 rpm + 0.00007 rpm/rpm)	
	(100 to 1000) ft/min	0.026 % of reading	Rpm Standard Standard Wheel
Tachometers ¹ (Non-Contact) Strobo & Photo ¹	(0.62 to 10 472) rad/s	(0.0062 rad/s + 0.000013 rad/s) rad/s	Function Generator
	(6 to 100 000) rpm	(0.059 rpm + 0.000013 rpm) rpm	
Rpm (Measure)	(6 to 100 000) rpm	1.2 rpm	Optical Tachometer

Thermodynamic – Humidity

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Humidity (Source) ¹	(10 to 95) % RH	0.59 % RH + 0.058 % of reading	Thunder 2500
Humidity (Measure) ¹	(10 to 95) % RH	1.4 %RH	Vaisala HMP37E

Thermodynamic – Thermometers and Probes

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Temperature Measuring Equipment ¹	(-196 to 0) °C	0.013 °C + 0.014 % of reading	Rosemount SPRT Instrulab Indicator Bath
	(0 to 410) °C	0.014 °C + 0.0012 % of reading	
Thermocouple – Fixed Point	660 °C	0.54 °C	Aluminum Freeze Point Thermocouple Indicator
Surface Temperature Measurement ¹	(0 to 250) °C	1.3 °C	Fluke 741 Type K Surface Probe

Thermodynamic – Thermodynamic Sources

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Temperature Uniformity ¹	(-90 to 1000) °C	(1.2 °C + 0.00059 °C) °C	Datalogger w/ External CJC Thermocouple
	(-90 to 250) °C	(0.25 °C + 0.00015 °C/C)	Datalogger w/RTDs

Thermodynamic – Infrared Temperature

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Infrared Pyrometers	Ambient to 250 °C	(0.33 °C + 0.00051 °C) °C	Blackbody Source RTD

Acoustic – Sound Pressure Level

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Sound Level	114 dB	0.47 dB	GR 1562A

Amount of Substance – Refractive Index

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Refractive Index Brix	(0 to 20) Brix	0.2 % of reading	Scale Sugar Distilled Water

Amount of Substance – Conductivity and pH

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
pH ¹	4 pH 7 pH 10 pH	0.02 pH	Standard pH Buffers Thermometer 0.1 °C
Conductivity Solution ¹	10 µS	0.62 µS	Standard Solutions
	100 µS	0.92 µS	
	1000 µS	4 µS	
	10 000 µS	36 µS	
	100 000 µS	320 µS	
	1412 µS	4.3 µS	

Luminous Intensity

Calibration Parameter/Equipment	Range ⁶	Calibration and Measurement Capability(+/-)	Remarks
UV (Black) Light Meters	(1 to 20 000) $\mu\text{W}/\text{cm}^2$	6.8 % of reading	Radiometer & Black Light Detector
White Light Meters ⁶	(1 to 21 528) lx	2.1 % of reading	Radiometer & White Light Detector
	(1 to 50 000) fl	2.3 % of reading	

Calibration and Measurement Capability (CMC) represents expanded uncertainties at approximately a 95% confidence level using a coverage factor of k=2.

Notes:

- 1) Laboratory offers calibration services at the laboratory's own facilities and at the client or other agreed upon facilities.
- 2) Test currents up to 1000 A are generated using 50 turn coil with no loss of accuracy.
- 3) L = length in mm
- 4) T = applied torque
- 5) D = diameter in mm
- 6) fl = foot lambert, lx = lux

Approved by: _____



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