

# Scope of Accreditation For Inspec, Inc.

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In recognition of a successful assessment to ISO/IEC 17025:2005, accreditation is granted to **Inspec, Inc.** to perform **Calibrations / Testing / Dimensional Inspection** as shown in the following tables:

Accreditation Granted Through: **July 22, 2013**

## Calibration

### Length – Hand Tools and Precision Gages 1D

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) <sup>2</sup>	Remarks
Bore Gages – 2 pt (0.0001 in Resolution)	100 µin to 1 in	(150 + 1.43L) µin	Height Master, Surface Plate
(0.0005 in Resolution)		(580 + 0.357L) µin	
Calipers <sup>1</sup> (0.0005 in Resolution)	(0 to 40) in	(570 + 2.92L) µin	Gage Blocks, Surface Plate, Ring Gage
(0.001 in Resolution)		(1200 + 1.57L) µin	
Depth Micrometers / Depth Gages <sup>1</sup> (0.00005 in Resolution)	(0 to 12) in	(52 + 6.01L) µin	Gage Blocks, Surface Plate
(0.001 in Resolution)		(1200 + 0.474L) µin	
Indicators High Resolution Digital / Dial (0.001 in Resolution)	(0 to 1) in	1200 µin	Bench Micrometer
(0.0005 in Resolution)		580 µin	
(0.0001 in Resolution)		120 µin	
(0.00005 in Resolution)		60 µin	

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability(+/-) <sup>2</sup></b>	<b>Remarks</b>	
Digital / Dial <sup>1</sup> (0.001 in Resolution) (0.0005 in Resolution) (0.0001 in Resolution) (0.00005 in Resolution)	(0 to 1) in	1200 μin 590 μin 180 μin 150 μin	Indicator Checker	
Indicators <sup>1</sup> , Test (0.001 in Resolution) (0.0005 in Resolution) (0.0001 in Resolution) (0.00005 in Resolution)	(0 to 0.06) in	1200 μin 580 μin 140 μin 97 μin	Height Master, Surface Plate	
Height Gages <sup>1</sup> (0.001 in Resolution) (0.0005 in Resolution)	(0 to 24) in	(1200 + 0.465L) μin (580 + 0.915L) μin	Reference Bar, Gage Blocks, Surface Plate	
(0.001 in Resolution) (0.0005 in Resolution)	(25 to 40) in	(1100 + 0.999L) μin (550 + 1.9L) μin		
Outside Micrometers <sup>1</sup> O.D. (0.001 in Resolution) (0.0001 in Resolution) (0.00005 in Resolution)	(0 to 12) in	(1200 + 0.778L) μin (110 + 6.01L) μin (52 + 8.42L) μin		Gage Block Comparison, Optical Flats, Surface Plate
(0.001 in Resolution) (0.0001 in Resolution) (0.00005 in Resolution)	(13 to 24) in	(1100 + 1.69L) μin (84 + 8.32L) μin (45 + 9.21L) μin		
Bench Micrometer <sup>1</sup>	(0 to 5) in	(8.1 + 2.88L) μin	Gage Blocks	

**Length – Hand Tools and Precision Gages 1D Non Contact**

<b>Calibration Parameter/Equipment <sup>1</sup></b>	<b>Range</b>	<b>Calibration and Measurement Capability(+/-)</b>	<b>Remarks</b>
Laser Micrometer	10 μin to 1 in	23 μin	Master Plug Gages

**Length – Hand Tools and Precision Gages 2D**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) <sup>2</sup>	Remarks
Bore Gages <sup>1</sup> – 3 pt (0.0001 in Resolution)	(0.275 to 4) in	240 μin	Master Rings
Levels – Bubble	± 0.002 in	250 μin	Surface Plate, Gage Blocks
Levels – Electronic	± 990 Arc-Sec	62.8 Arc-Sec	Sine Plate, Gage Blocks, Surface Plate
Optical Comparator <sup>1</sup>	50 μin to 12 in	(78 + 24.2L) μin	High Precision Glass Scale
Vision System <sup>1</sup>	(0 to 30) in	(21 + 5.43L) μin	

**Length – Hand Tools and Precision Gages 3D**

Calibration Parameter/Equipment <sup>1</sup>	Range	Calibration and Measurement Capability(+/-) <sup>2</sup>	Remarks
Coordinate Measuring Machine Linearity	(0.1 to 325) in	(7.9 + 25.5L) μin	Renishaw Laser System
Coordinate Measuring Machine, Volumetric	(4 to 40) in	(43 + 11L) μin	Ball Bar
Coordinate Measuring Machine, Repeatability	1 in	53 μin	Sphere
Machine Tool Linearity	(0.1 to 325) in	(48 + 0.377L) μin	Renishaw Laser System
Machine Tool Volumetric	(4 to 24) in	(50 + 3.86L) μin	Ball Bar, Laser Transducer

**Length – Artifacts and Standards 1D**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) <sup>2</sup>	Remarks
Feeler Gages	(0.001 to 0.1) in	78 μin	Digital Micrometer
Gear / Thread Measuring Wires <sup>1</sup>	(0.001 to 1) in	20 μin	Bench Micrometer
Height Master <sup>1</sup>	(0.3 to 24) in	(51 + 3.36L) μin	Reference Bar, Amplifier, Gage Blocks, Surface Plate
Length Standards <sup>1</sup>	(1 to 37) in	(120 + 3.09L) μin	Reference Bar, Amplifier, Surface Plate
Pin Gages <sup>1</sup>	(0.011 to 1) in	33 μin	Laser Micrometer
Plug Gages	(0.004 to 5) in	(14 + 6.71L) μin	Bench Micrometer
Ring Gages	(0.24 to 4) in	(13 + 6.671L) μin	Bench Micrometer
	(4.1 to 8) in	(14 + 9.43L) μin	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) <sup>2</sup>	Remarks
Gage Blocks	Up to 4 in		Comparator, Gage Blocks
Steel		(2.6 + 2.59L) μin	
Ceramic		(2.6 + 2.74L) μin	
Tungsten Carbide		(2.5 + 4.89L) μin	
Chrome Carbide		(2.6 + 3.12L) μin	

**Length – Artifacts and Standards 2D**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) <sup>3</sup>	Remarks
Surface Plate Repeatability <sup>1</sup>	10 μin to 0.002 in	84 μin	Repeat-o-Meter
Surface Plate Angularity <sup>1</sup> / Flatness <sup>1</sup>	(6 to 144) in	(27 + 0.03DL) μin	Electronic Levels
Parallels – Flatness & Parallelism Vee Block, Square	(0.1 to 4) in	100 μin	Surface Plate, Amplifier, Granite Angle Comparison
Spheres	Up to 2 in		Bench Micrometer, Talyrond 300
Size		18 μin	
Sphericity		6.9 μin	

**Length – Other**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-) <sup>2</sup>	Remarks
Thread / Set Plugs	(0.01 to 8) in	(93 + 3.95L) μin	Bench Micrometers / Thread Wires

**Mass – Force**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Force	(1 to 118) lb	14.4 μlb/lb + 0.058 lb	NIST Class F Weights

**Mass – Hardness**

Calibration Parameter/Equipment <sup>1</sup>	Range	Calibration and Measurement Capability(+/-)	Remarks
Rockwell Hardness Testers	Low Medium High	0.41 HRA	Indirect Comparison with Test Blocks to ASTM E-18
A Scale		0.34 HRA	
		0.34 HRA	

Calibration Parameter/Equipment <sup>1</sup>	Range	Calibration and Measurement Capability(+/-)	Remarks
B Scale	Low Medium High	0.42 HRB 0.76 HRB 0.56 HRB	Indirect Comparison with Test Blocks to ASTM E-18
C Scale	Low Medium High	0.42 HRC 0.63 HRC 0.39 HRC	
HR15N Scale	Low Medium High	0.46 HR15N 0.44 HR15N 0.41 HR15N	
HR30N Scale	Low Medium High	0.39 HR30N 0.34 HR30N 0.38 HR30N	
HR45N Scale	Low Medium High	0.48 HR45N 0.51 HR45N 0.36 HR45N	
HR15T Scale	Low Medium High	0.41 HR15T 0.37 HR15T 0.42 HR15T	
HR30T Scale	Low Medium High	0.46 HR30T 0.44 HR30T 0.48 HR30T	
HR45T Scale	Low Medium High	0.53 HR45T 0.47 HR30T 0.39 HR30T	
Brinell Hardness Testers			
3000 kgf	(100 to 200) BHN	3.8 BHN	
	(200 to 300) BHN	5.2 BHN	
Micro Indentation Hardness Testers			Indirect Comparison with Test Blocks to ASTM E-384
Knoop	(100 to 250) HK	20 HK	
	(250 to 650) HK	11 HK	
	(650 to 700) HK	7.5 HK	
Vickers	(100 to 240) HV	18 HV	
	(240 to 600) HV	14 HV	
	(600 to 700) HV	8.5 HV	

**Mass – Torque**

Calibration Parameter/Equipment <sup>1</sup>	Range	Calibration and Measurement Capability(+/-)	Remarks
Torque Wrenches	(5 to 50) lbf·in	0.67 lbf·in + 0.103 % of reading	Measured using Torque Transducer
	(40 to 400) lbf·in	3.7 lbf·in + 0.0361 % of reading	
	(100 to 1000) lbf·in	6.2 lbf·in + 0.057 % of reading	
	(25 to 250) lbf·ft	2.1 lbf·ft + 0.0393 % of reading	
	(60 to 600) lbf·ft	5.8 lbf·ft + 0.0481 % of reading	

**Electrical – Voltage**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
DC Voltage – Generate	(0 to 330) mV	22.5 $\mu$ V/V + 1.6 $\mu$ V	Fluke 5520A / SC600
	(0 to 3.3) V	13 $\mu$ V/V + 2.4 $\mu$ V	
	(3.3 to 33) V	14.1 $\mu$ V/V + 25 $\mu$ V	
	(33 to 330) V	21.3 $\mu$ V/V + 180 $\mu$ V	
	(330 to 1000) V	23.9 $\mu$ V/V + 1.5 mV	
DC Voltage – Measure	(0 to 100) mV	6.48 $\mu$ V/V + 0.86 $\mu$ V	HP 3458A Option 002
	100 mV to 1 V	6.29 $\mu$ V/V + 0.43 $\mu$ V	
	(1 to 10) V	5.41 $\mu$ V/V + 0.9 $\mu$ V	
	(10 to 100) V	6.41 $\mu$ V/V + 34 $\mu$ V	
	(100 to 1000) V	7.51 $\mu$ V/V + 170 $\mu$ V	
AC Voltage – Source  Up to 33 mV	(10 to 45) Hz	945 $\mu$ V/V + 7.1 $\mu$ V	Fluke 5520A-SC600
	45 Hz to 10 kHz	177 $\mu$ V/V + 7.1 $\mu$ V	
	(10 to 20) kHz	236 $\mu$ V/V + 7.1 $\mu$ V	
	(20 to 50) kHz	1.18 mV/V + 7.1 $\mu$ V	
	(50 to 100) kHz	4.13 mV/V + 7.1 $\mu$ V	
	(100 to 500) kHz	9.45 mV/V + 7.1 $\mu$ V	
(33 to 330) mV	(10 to 45) Hz	354 $\mu$ V/V + 9.5 $\mu$ V	
	45 Hz to 10 kHz	171 $\mu$ V/V + 9.5 $\mu$ V	
	(10 to 20) kHz	189 $\mu$ V/V + 9.5 $\mu$ V	
	(20 to 50) kHz	413 $\mu$ V/V + 9.7 $\mu$ V	
	(50 to 100) kHz	945 $\mu$ V/V + 38 $\mu$ V	
	(100 to 500) kHz	23.6 mV/V + 83 $\mu$ V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
330 mV to 3.3 V	(10 to 45) Hz	354 $\mu$ V/V + 59 $\mu$ V	Fluke 5520A-SC600
	45 Hz to 10 kHz	177 $\mu$ V/V + 71 $\mu$ V	
	(10 to 20) kHz	224 $\mu$ V/V + 72 $\mu$ V	
	(20 to 50) kHz	354 $\mu$ V/V + 60 $\mu$ V	
	(50 to 100) kHz	827 $\mu$ V/V + 150 $\mu$ V	
	(100 to 500) kHz	2.8 mV/V + 710 $\mu$ V	
(3.3 to 33) V	(10 to 45) Hz	354 $\mu$ V/V + 770 $\mu$ V	
	45 Hz to 10 kHz	177 $\mu$ V/V + 710 $\mu$ V	
	(10 to 20) kHz	283 $\mu$ V/V + 720 $\mu$ V	
	(20 to 50) kHz	413 $\mu$ V/V + 710 $\mu$ V	
	(50 to 100) kHz	1.06 mV/V + 1.9 mV	
(33 to 330) V	45Hz to 1 kHz	224 $\mu$ V/V + 2.5 mV	
	(1to 10) kHz	236 $\mu$ V/V + 7.1 mV	
	(10 to 20) kHz	293 $\mu$ V/V + 7.8 mV	
	(20 to 50) kHz	354 $\mu$ V/V + 7.1 mV	
	(50 to 100) kHz	2.36 mV/V + 6 mV	
220 V to 1.1 kV	45 Hz to 1 kHz	376 $\mu$ V/V + 14 mV	
	(1 to 5) kHz	294 $\mu$ V/V + 13 mV	
	(5 to 10) kHz	353 $\mu$ V/V + 13 mV	
AC Voltage – Measure  (1 to 10) mV	(1 to 40) Hz	350 $\mu$ V/V + 3.5 $\mu$ V	HP 3458A Option 002
	40 Hz to 1 kHz	303 $\mu$ V/V + 1.2 $\mu$ V	
	(1 to 20) kHz	191 $\mu$ V/V + 3.5 $\mu$ V	
	(20 to 50) kHz	1.08 mV/V + 1.4 $\mu$ V	
	(50 to 100) kHz	4.75 mV/V + 2.3 $\mu$ V	
	(100 to 300) kHz	37.8 mV/V + 11 $\mu$ V	
	300 kHz to 1 MHz	15.5 mV/V + 8 $\mu$ V	
	(1 to 4) MHz	66.2 mV/V + 23 $\mu$ V	
	(4 to 8) MHz	23.2 mV/V + 63 $\mu$ V	
(10 to 100) mV	(1 to 40) Hz	93.8 $\mu$ V/V + 4.8 $\mu$ V	
	40 Hz to 1 kHz	83 $\mu$ V/V + 3.8 $\mu$ V	
	(1 to 20) kHz	171 $\mu$ V/V + 2.4 $\mu$ V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
(10 to 100) mV	(20 to 50) kHz	341 $\mu\text{V}/\text{V}$ + 3.4 $\mu\text{V}$	HP 3458A Option 002
	(50 to 100) kHz	930 $\mu\text{V}/\text{V}$ + 4 $\mu\text{V}$	
	(100 to 300) kHz	3.46 mV/V + 14 $\mu\text{V}$	
	300 kHz to 1 MHz	11.6 mV/V + 14 $\mu\text{V}$	
	(1 to 4) MHz	46.2 mV/V + 84 $\mu\text{V}$	
	(4 to 8) MHz	47.9 mV/V + 100 $\mu\text{V}$	
	(8 to 10) MHz	216 mV/V + 100 $\mu\text{V}$	
100 mV to 1 V	(1 to 40) Hz	83.5 $\mu\text{V}/\text{V}$ + 47 $\mu\text{V}$	
	40 Hz to 1 kHz	82.5 $\mu\text{V}/\text{V}$ + 26 $\mu\text{V}$	
	(1 to 20) kHz	163 $\mu\text{V}/\text{V}$ + 24 $\mu\text{V}$	
	(20 to 50) kHz	350 $\mu\text{V}/\text{V}$ + 23 $\mu\text{V}$	
	(50 to 100) kHz	926 $\mu\text{V}/\text{V}$ + 25 $\mu\text{V}$	
	(100 to 300) kHz	3.45 mV/V + 130 $\mu\text{V}$	
	300 kHz to 1 MHz	11.6 mV/V + 120 $\mu\text{V}$	
	(1 to 4) MHz	46 mV/V + 980 $\mu\text{V}$	
	(4 to 8) MHz	43.5 mV/V + 4.1 mV	
	(8 to 10) MHz	173 mV/V + 1.3 mV	
(1 to 10) V	(1 to 40) Hz	84.3 $\mu\text{V}/\text{V}$ + 470 $\mu\text{V}$	
	40 Hz to 1 kHz	59 $\mu\text{V}/\text{V}$ + 670 $\mu\text{V}$	
	(1 to 20) kHz	164 $\mu\text{V}/\text{V}$ + 240 $\mu\text{V}$	
	(20 to 50) kHz	350 $\mu\text{V}/\text{V}$ + 240 $\mu\text{V}$	
	(50 to 100) kHz	929 $\mu\text{V}/\text{V}$ + 230 $\mu\text{V}$	
	(100 to 300) kHz	3.47 mV/V + 1.2 mV	
	300 kHz to 1 MHz	11.6 mV/V + 1.1 mV	
	(1 to 4) MHz	46.2 mV/V + 8.1 mV	
	(4 to 8) MHz	46.1 mV/V + 10 mV	
	(8 to 10) MHz	142 mV/V + 43 mV	
(10 to 100) V	(1 to 40) Hz	234 $\mu\text{V}/\text{V}$ + 4.7 mV	
	40 Hz to 1 kHz	234 $\mu\text{V}/\text{V}$ + 2.3 mV	
	(1 to 20) kHz	234 $\mu\text{V}/\text{V}$ + 2.3 mV	
	(20 to 50) kHz	413 $\mu\text{V}/\text{V}$ + 2.3 mV	
	(50 to 100) kHz	1.39 mV/V + 2.3 mV	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
(10 to 100) V	(100 to 300) kHz	4.62 mV/V + 12 mV	HP 3458A Option 002
	300 kHz to 1 MHz	17.3 mV/V + 12 mV	
100 V to 1 kV	(1 to 40) Hz	416 $\mu$ V/V + 37 mV	
	40 Hz to 1 kHz	464 $\mu$ V/V + 16 mV	
	(1 to 20) kHz	695 $\mu$ V/V + 16 mV	
	(20 to 50) kHz	1.39 mV/V + 16 mV	
	(50 to 100) kHz	3.46 mV/V + 17 mV	

**Electrical – Current**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
DC Current – Generate	(0 to 330) $\mu$ A	177 $\mu$ A/A + 24 nA	Fluke 5520A/SC600
	330 $\mu$ A to 3.3 mA	118 $\mu$ A/A + 60 nA	
	(3.3 to 33) mA	122 $\mu$ A/A + 170 nA	
	(33 to 330) mA	176 $\mu$ A/A + 320 nA	
	330 mA to 1.1 A	235 $\mu$ A/A + 48 $\mu$ A	
	(1.1 to 3) A	428 $\mu$ A/A + 110 $\mu$ A	
	(3 to 11) A	590 $\mu$ A/A + 590 $\mu$ A	
	(11 to 20.5) A	1.18 mA/A + 960 $\mu$ A	
	(20.5 to 1000) A	30.7 mA/A + 3100 mA	
DC Current – Measure	(0 to 100) nA	2.15 $\mu$ A/A + 0.77 nA	HP 3458A Option 002
	100 nA to 1 $\mu$ A	1.76 $\mu$ A/A + 0.77 nA	
	(1 to 10) $\mu$ A	6.87 $\mu$ A/A + 0.78 nA	
	(10 to 100) $\mu$ A	21 $\mu$ A/A + 1.2 nA	
	100 $\mu$ A to 1 mA	24 $\mu$ A/A + 5.9 nA	
	(1 to 10) mA	24 $\mu$ A/A + 59 nA	
	(10 to 100) mA	40.4 $\mu$ A/A + 660 nA	
	100 mA to 1 A	127 $\mu$ A/A + 12 $\mu$ A	
(1 to 10) A	2.36 mA/A + 890 $\mu$ A	Fluke 45	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
AC Current – Source  (29 to 330) $\mu$ A	(10 to 20) Hz	2.36 mA/A + 120 nA	Fluke 5520A-SC600
	(20 to 45) Hz	1.77 mA/A + 120 nA	
	45 Hz to 1 kHz	1.48 mA/A + 120 nA	
	(1 to 5) kHz	3.54 mA/A + 180 nA	
	(5 to 10) kHz	9.45 mA/A + 240 nA	
	(10 to 30) kHz	18.9 mA/A + 470 nA	
330 $\mu$ A to 3.3 mA	(10 to 20) Hz	2.36 mA/A + 180 nA	
	(20 to 45) Hz	1.48 mA/A + 180 nA	
	45 Hz to 1 kHz	1.18 mA/A + 180 nA	
	(1 to 5) kHz	2.13 mA/A + 310 nA	
	(5 to 10) kHz	5.91 mA/A + 350 nA	
	(10 to 30) kHz	11.7 mA/A + 740 nA	
(3.3 to 33) mA	(10 to 20) Hz	2.13 mA/A + 2.4 $\mu$ A	
	(20 to 45) Hz	1.06 mA/A + 2.4 $\mu$ A	
	45 Hz to 1 kHz	472 $\mu$ A/A + 2.4 $\mu$ A	
	(1 to 5) kHz	945 $\mu$ A/A + 2.4 $\mu$ A	
	(5 to 10) kHz	2.36 mA/A + 3.5 $\mu$ A	
	(10 to 30) kHz	4.73 mA/A + 4.7 $\mu$ A	
(33 to 330) mA	(10 to 20) Hz	2.13 mA/A + 24 $\mu$ A	
	(20 to 45) Hz	1.15 mA/A + 21 $\mu$ A	
	45 Hz to 1 kHz	472 $\mu$ A/A + 24 $\mu$ A	
	(1 to 5) kHz	1.18 mA/A + 59 $\mu$ A	
	(5 to 10) kHz	2.36 mA/A + 120 $\mu$ A	
	(10 to 30) kHz	4.73 mA/A + 240 $\mu$ A	
330 mA to 1.1 A	(10 to 45) Hz	2.13 mA/A + 120 $\mu$ A	
	45 Hz to 1 kHz	591 $\mu$ A/A + 120 $\mu$ A	
	(1 to 5) kHz	7.09 mA/A + 1.2 mA	
	(5 to 10) kHz	29.5 mA/A + 5.9 mA	
(1.1 to 3) A	(20 to 45) Hz	2.13 mA/A + 120 $\mu$ A	
	45 Hz to 1 kHz	708 $\mu$ A/A + 120 $\mu$ A	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks	
(1.1 to 3) A	(1 to 5) kHz	6.09 mA/A + 5.6 mA	Fluke 5520A-SC600	
	(5 to 10) kHz	29.5 mA/A + 5.9 mA		
(3 to 11) A	(45 to 100) Hz	709 $\mu$ A/A + 2.4 mA		
	100 Hz to 1 kHz	1.18 mA/A + 2.4 mA		
	(1 to 5) kHz	35.4 mA/A + 2.4 mA		
(11 to 20.5) A	(45 to 100) Hz	1.42 mA/A + 5.9 mA		
	100 Hz to 1 kHz	1.77 mA/A + 5.9 mA		
	(1 to 5) kHz	35.4 mA/A + 5.9 mA		
(20.5 to 1000) A	(45 to 65) Hz	15 mA/A + 1.9 A		Fluke 5520A w/ 50-turn coil
	(65 to 440) Hz	51.9 mA/A + 2.1 A		
AC Current – Measure			HP 3458A Option 002	
(5 to 100) $\mu$ A	(10 to 20) Hz	4.59 mA/A + 46 nA		
	(20 to 45) Hz	1.7 mA/A + 46 nA		
	(45 to 100) Hz	667 $\mu$ A/A + 46 nA		
	100 Hz to 5 kHz	667 $\mu$ A/A + 46 nA		
100 $\mu$ A to 1 mA	(10 to 20) Hz	4.61 mA/A + 290 nA		
	(20 to 45) Hz	1.72 mA/A + 300 nA		
	(45 to 100) Hz	678 $\mu$ A/A + 300 nA		
	100 Hz to 5 kHz	334 $\mu$ A/A + 310 nA		
	(5 to 20) kHz	678 $\mu$ A/A + 300 nA		
	(20 to 50) kHz	4.61 mA/A + 560 nA		
	(50 to 100) kHz	6.35 mA/A + 2.1 $\mu$ A		
(1 to 10) mA	(10 to 20) Hz	461 $\mu$ A/A + 2.9 $\mu$ A		
	(20 to 45) Hz	172 $\mu$ A/A + 3 $\mu$ A		
	(45 to 100) Hz	67.5 $\mu$ A/A + 3.1 $\mu$ A		
	100 Hz to 5 kHz	33 $\mu$ A/A + 3.1 $\mu$ A		
	(5 to 20) kHz	67.5 $\mu$ A/A + 3.1 $\mu$ A		
	(20 to 50) kHz	461 $\mu$ A/A + 5.7 $\mu$ A		
	(50 to 100) kHz	635 $\mu$ A/A + 21 $\mu$ A		
(10 to 100) mA	(10 to 20) Hz	4.61 mA/A + 29 $\mu$ A		
	(20 to 45) Hz	1.72 mA/A + 30 $\mu$ A		
	(45 to 100) Hz	677 $\mu$ A/A + 30 $\mu$ A		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks	
(10 to 100) mA	100 Hz to 5 kHz	333 $\mu$ A/A + 31 $\mu$ A	HP 3458A Option 002	
	(5 to 20) kHz	677 $\mu$ A/A + 30 $\mu$ A		
	(20 to 50) kHz	4.61 mA/A + 56 $\mu$ A		
	(50 to 100) kHz	6.35 mA/A + 210 $\mu$ A		
100 mA to 1 A	(10 to 20) Hz	4.57 mA/A + 290 $\mu$ A		
	(20 to 45) Hz	1.77 mA/A + 320 $\mu$ A		
	(45 to 100) Hz	0.845 mA/A + 340 $\mu$ A		
	100 Hz to 5 kHz	1.08 mA/A + 340 $\mu$ A		
	(5 to 20) kHz	3.4 mA/A + 310 $\mu$ A		
	(20 to 50) kHz	11.5 mA/A + 490 $\mu$ A		
(1 to 10) A	(20 to 50) Hz	23.6 mA/A + 12 mA		Fluke 45
	(0.05 to 2) kHz	12 mA/A + 13 mA		

**Electrical – Resistance**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Resistance – Source	Up to 11 $\Omega$	45.4 $\mu\Omega/\Omega$ + 1.3 m $\Omega$	Fluke 5520A-SC600
	(11 to 33) $\Omega$	35 $\mu\Omega/\Omega$ + 1.8 m $\Omega$	
	(33 to 110) $\Omega$	32.9 $\mu\Omega/\Omega$ + 1.7 m $\Omega$	
	(110 to 330) $\Omega$	33 $\mu\Omega/\Omega$ + 2.4 m $\Omega$	
	330 $\Omega$ to 1.1 k $\Omega$	33.3 $\mu\Omega/\Omega$ + 2.3 m $\Omega$	
	(1.1 to 3.3) k $\Omega$	33 $\mu\Omega/\Omega$ + 2.4 m $\Omega$	
	(3.3 to 11) k $\Omega$	33 $\mu\Omega/\Omega$ + 2.4 m $\Omega$	
	(11 to 33) k $\Omega$	33.1 $\mu\Omega/\Omega$ + 240 m $\Omega$	
	(33 to 110) k $\Omega$	33.1 $\mu\Omega/\Omega$ + 240 m $\Omega$	
	(110 to 330) k $\Omega$	37.8 $\mu\Omega/\Omega$ + 2.4 $\Omega$	
	330 k $\Omega$ to 1.1 M $\Omega$	36.4 $\mu\Omega/\Omega$ + 4.4 $\Omega$	
	(1.1 to 3.3) M $\Omega$	70.5 $\mu\Omega/\Omega$ + 37 $\Omega$	
	(3.3 to 11) M $\Omega$	152 $\mu\Omega/\Omega$ + 81 $\Omega$	
	(11 to 33) M $\Omega$	290 $\mu\Omega/\Omega$ + 3.2 k $\Omega$	
	(33 to 110) M $\Omega$	512 $\mu\Omega/\Omega$ + 6.3 k $\Omega$	
	(110 to 330) M $\Omega$	3.53 m $\Omega/\Omega$ + 120 k $\Omega$	
330 M $\Omega$ to 1.1 G $\Omega$	17.7 m $\Omega/\Omega$ + 610 k $\Omega$		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Resistance – Measure	Up to 10 Ω	15.4 μΩ/Ω + 95 μΩ	HP 3458A Option 002
	(10 to 100) Ω	13.7 μΩ/Ω + 610 μΩ	
	100 Ω to 1 kΩ	11.6 μΩ/Ω + 680 μΩ	
	(1 to 10) kΩ	11.7 μΩ/Ω + 5.7 mΩ	
	(10 to 100) kΩ	11.6 μΩ/Ω + 58 mΩ	
	100 kΩ to 1 MΩ	10.3 μΩ/Ω + 13 Ω	
	(1 to 10) MΩ	58.8 μΩ/Ω + 120 Ω	
	(10 to 100) MΩ	561 μΩ/Ω + 3 kΩ	
	100 MΩ to 1 GΩ	5.4 mΩ/Ω + 430 kΩ	
Electrical Simulation of RDTs  Pt 385 (100 Ω)	(-200 to 0) °C	0.06 °C	Fluke 5520A-SC600
	(0 to 100) °C	0.08 °C	
	(100 to 300) °C	0.1 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 630) °C	0.13 °C	
	(630 to 800) °C	0.24 °C	
Pt 385 (200 Ω)	(-200 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.13 °C	
	(300 to 400) °C	0.14 °C	
	(400 to 600) °C	0.15 °C	
	(600 to 630) °C	0.17 °C	
Pt 385 (500 Ω)	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.09 °C	
	(400 to 600) °C	0.1 °C	
	(600 to 630) °C	0.12 °C	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Pt 385 (1000 Ω)	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.04 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.07 °C	
	(300 to 400) °C	0.08 °C	
	(400 to 600) °C	0.08 °C	
	(600 to 630) °C	0.24 °C	
Pt 3926 (100 Ω)	(-200 to -80) °C	0.06 °C	Fluke 5520A-SC600
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 300) °C	0.1 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 630) °C	0.13 °C	
Pt 3916 (100 Ω)	(-200 to -190) °C	0.26 °C	
	(-190 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 260) °C	0.08 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.11 °C	
	(600 to 630) °C	0.24 °C	
PtNi 385 (120 Ω)	(-80 to 0) °C	0.09 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 260) °C	0.15 °C	
Cu 427 (10 Ω)	(-100 to 260) °C	0.31 °C	
Electrical Simulation of Thermocouples			Fluke 5520A-SC600
Type B	(600 to 800) °C	0.45 °C	
	(800 to 1000) °C	0.35 °C	
	(1000 to 1550) °C	0.31 °C	
	(1550 to 1820) °C	0.34 °C	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Type C	(0 to 150) °C	0.31 °C	Fluke 5520A-SC600
	(150 to 650) °C	0.27 °C	
	(650 to 1000) °C	0.32 °C	
	(1000 to 1800) °C	0.51 °C	
	(1800 to 2316) °C	0.85 °C	
Type E	(-250 to -100) °C	0.51 °C	
	(-100 to -25) °C	0.17 °C	
	(-25 to 350) °C	0.15 °C	
	(350 to 650) °C	0.17 °C	
	(650 to 1000) °C	0.22 °C	
Type J	(-210 to -100) °C	0.28 °C	
	(-100 to -30) °C	0.17 °C	
	(-30 to 150) °C	0.15 °C	
	(150 to 760) °C	0.18 °C	
	(760 to 1200) °C	0.24 °C	
Type K	(-200 to -100) °C	0.34 °C	
	(-100 to -25) °C	0.19 °C	
	(-25 to 120) °C	0.17 °C	
	(120 to 1000) °C	0.27 °C	
	(1000 to 1372) °C	0.41 °C	
Type L	(-200 to -100) °C	0.38 °C	
	(-100 to 800) °C	0.27 °C	
	(800 to 900) °C	0.18 °C	
Type N	(-200 to -100) °C	0.41 °C	
	(-100 to -25) °C	0.23 °C	
	(-25 to 120) °C	0.2 °C	
	(120 to 410) °C	0.19 °C	
	(410 to 1300) °C	0.28 °C	
Type R	(0 to 250) °C	0.58 °C	
	(250 to 400) °C	0.36 °C	
	(400 to 1000) °C	0.34 °C	
	(1000 to 1767) °C	0.41 °C	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Type S	(0 to 250) °C	0.48 °C	Fluke 5520A-SC600
	(250 to 1000) °C	0.37 °C	
	(1000 to 1400) °C	0.38 °C	
	(1400 to 1767) °C	0.47 °C	
Type T	(-250 to -150) °C	0.64 °C	
	(-150 to 0) °C	0.21 °C	
	(0 to 120) °C	0.17 °C	
	(120 to 400) °C	0.15 °C	
Type U	(-200 to 0) °C	0.57 °C	
	(0 to 600) °C	0.28 °C	

**Electrical – Capacitance**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability(+/-)	Remarks
Capacitance – Source 10 Hz to 3 kHz	(0.19 to 3.3) nF	5.91 mF/F + 12 pF	Fluke 5520A-SC600  Frequencies indicate Maximum Charge / Discharge Rate from a measuring device such as an Instek 819 LCR Meter
10 Hz to 1 kHz	(3.3 to 11) nF	2.96 mF/F + 12 pF	
	(11 to 33) nF	3.16 mF/F + 120 pF	
	(33 to 110) nF	2.96 mF/F + 120 pF	
	(110 to 330) nF	2.95 mF/F + 350 pF	
	(10 to 600) Hz	330 nF to 1.1 µF	
(10 to 300) Hz	(1.1 to 3.3) µF	2.95 mF/F + 3.5 nF	
(10 to 150) Hz	(3.3 to 11) µF	2.95 mF/F + 12 nF	
(10 to 120) Hz	(11 to 33) µF	4.73 mF/F + 35 nF	
(10 to 80) Hz	(33 to 110) µF	5.32 mF/F + 120 nF	
(0 to 50) Hz	(110 to 330) µF	5.32 mF/F + 350 nF	
(0 to 20) Hz	330 µF to 1.1 mF	5.33 mF/F + 1.2 µF	
(0 to 6) Hz	(1.1 to 3.3) mF	5.32 mF/F + 1.2 µF	
(0 to 2) Hz	(3.3 to 11) mF	5.32 mF/F + 12 µF	
(0 to 0.6) Hz	(11 to 33) mF	8.86 mF/F + 35 µF	
(0 to 0.2) Hz	(33 to 110) mF	13 mF/F + 120 µF	

**Thermodynamics – Infrared Temperature**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability(+/-)</b>	<b>Remarks</b>
Infrared Thermometers	(122 to 932) °F	0.0008 °F/°F + 0.91 °F	Hart Scientific 9132

**Time and Frequency – Oscilloscopes**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability(+/-)</b>	<b>Remarks</b>
Oscilloscopes Amplitude DC Signal Into 50 Ω Load	1 mV to 6.6 V	2.9 mV/V + 450 μV	Fluke 5520A/SC600
Into 1 MΩ Load	1 mV to 100 V	591 μV/V + 62 μV	
Leveled Sine Wave	50 kHz to 600 MHz	70.8 mV/V + 350 μV	
Time Marker in 50 Ω	2 ns to 5 s	11.9 μs/s	

**Time and Frequency – Frequency / Period**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability(+/-) <sup>4</sup></b>	<b>Remarks</b>
Frequency – Source	10 MHz	1 x 10 <sup>-9</sup> per 24 hrs	Spectracom 8194B
	(0 to 20) MHz	1 x 10 <sup>-8</sup> · f + 0.1 Hz	HP 3325A
Frequency – Measure	DC to 3 GHz	1 x 10 <sup>-9</sup> · f + 50 μHz	Agilent 53132 A Option 030 Spectracom 8194B

**Time and Frequency – Time Dissemination**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability(+/-)</b>	<b>Remarks</b>
Stopwatches and Timers	(0 to 1) hr	0.034 s	Frequency Counter

## Dimensional Inspection

### Length - Dimensional Inspection – Dimensional Measurement 1D

Inspection Parameter	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Roundness Measurement	(0.25 to 4) in	7.9 μin	Talyrond 300
Surface Finish	(1 to 300) Ra	22 μin	Profilometer
Length 1D	Up to 12 in	(76 + 5.64L) μin	Height Master, Surface Plate, Amplifier

### Length - Dimensional Inspection – Dimensional Measurement 2D

Inspection Parameter	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Length 2D	Up to 48 in	(230 + 8.71L) μin	Video Inspection Machine
	Up to 8 x 12 in	(260 + 20.6L) μin	Optical Comparator

### Length - Dimensional Inspection – Dimensional Measurement 3D

Inspection Parameter	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Volumetric 3D Position Steel <sup>1</sup>	Up to (80 x 48 x40) in	(130 + 9.51L) μin	Coordinate Measuring Machine
Volumetric 3D Position Aluminum <sup>1</sup>	Up to (80 x 48 x40) in	(98 + 24.2L) μin	
Volumetric 3D Position Plastic <sup>1</sup>	Up to (80 x 48 x40) in	(14 + 159L) μin	
Angle	0° to 360°	4.043 Arc-Sec	


## Testing

Technology	Range, when necessary	Methods Used	Product Types	Remarks
Hardness Tester Rockwell	HRB Low Middle High	ASTM E18	Metallic Materials	
	HRC Low Middle High			
	HR30T Low Middle High			

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. Calibration /Testing uncertainties are higher.
- 2)  $L$  = the nominal length of device in inches
- 3)  $DL$  = the diagonal length of device in inches
- 4)  $f$  = frequency in MHz

Approved by:   
R. Douglas Leonard  
Chief Technical Officer

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