



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: June 30, 2023

Certificate Number: 2357.26

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations at the location listed above as well as the satellite laboratory listed below^{1,7}:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Micrometers	(0.05 to 12) in (12 to 48) in	(30 + 1.7L) μin (13 + 3.1L) μin	Grade 2 gage blocks w/ optical parallels
Anvil & Spindle Flatness & Parallelism	Up to 1 in	6.1 μin	Optical flats/parallels
Height Gages	(0.05 to 4) in (4 to 36) in	(58 + 0.25L) μin (46 + 5.1L) μin	Grade 2 gage blocks w/ surface plate
Calipers	(0.05 to 4) in (4 to 12) in (12 to 36) in	(58 + 1.8L) μin (65 + 4.4L) μin (100 + 6.4L) μin	Grade 2 gage blocks
Dial Indicators	Up to 1 in	150 μin	Indi check

Parameter/Equipment	Range	CMC ² (±)	Comments
Radius Gauges – 30 to 45° Arc Angle 45 to 60° Arc Angle 60 to 90° Arc Angle 90 to 150° Arc Angle 150 to 360° Arc Angle	Up to 600 mm	29*(4.7 + 6.7R) μm 13*(4.7 + 6.7R) μm 7*(4.7 + 6.7R) μm 3*(4.7 + 6.7R) μm (4.7 + 6.7R) μm	Mitutoyo QVB-606
Electronic Amplifiers – Linearity	Up to 0.02 in	3.7 μin	Grade 2 gage blocks

II. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Length ⁵ – X Axis Y Axis Z Axis	28 in 40 in 18 in	(230 + 6.9L) μin (230 + 7.0L) μin (230 + 6.8L) μin	Mitutoyo BHN-710
X Axis Y Axis Z Axis	600 mm 600 mm 150 mm	(4.7 + 6.7L') μm (4.7 + 6.7L') μm (5.2 + 3.4L') μm	Mitutoyo QVB-606

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
DC Voltage – Generate ³	0 V	7.6 nV	Copper short
	10 V	24 μV	Fluke 732B
	(0 to 220) mV (0.22 to 2.2) V	6.9 μV/V + 0.40 μV 3.2 μV/V + 0.70 μV	Fluke 5720A

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
DC Voltage – Generate ³ (cont)	(2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	2.4 μ V/V + 2.5 μ V 2.4 μ V/V + 4.0 μ V 3.2 μ V/V + 40 μ V 4.7 μ V/V + 0.40 mV	Fluke 5720A
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V (1.0 to 15) kV	12 μ V/V + 0.23 μ V 7.6 μ V/V + 0.23 μ V 4.6 μ V/V + 0.39 μ V 7.1 μ V/V + 23 μ V 8.5 μ V/V + 78 μ V 1.7 mV/V	HP 3458A opt 002 Ross VD15 w/34401A
DC Current – Generate ³	(0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A (11 to 20.5) A (16.5 to 149.999) A (150 to 1025) A	35 μ A/A + 6.0 nA 30 μ A/A + 7.0 nA 30 μ A/A + 40 nA 37 μ A/A + 0.70 μ A 56 μ A/A + 12 μ A 0.27 mA/A + 0.48 mA 0.78 mA/A + 0.58 mA 3.9 mA/A + 0.11 mA 4.0 mA/A + 0.39 mA	Fluke 5720A w/ 5725A Fluke 5522A w/ 5500A coil
DC Current – Measure ³	(10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 15) A (15 to 100) A (100 to 300) A	22 μ A/A + 0.80 nA 23 μ A/A + 5.0 nA 22 μ A/A + 50 nA 42 μ A/A + 0.50 μ A 0.011 % + 10 μ A 29 μ A/A 71 μ A/A 54 μ A/A	HP 3458A opt 002 HP 3458A opt 002 w/ Guildline 9230/15 Guildline 9230/100 Guildline 9230/300
DC Power – Generate ³	0.01 mW to 337 W (0.01 to 3060) W (3.06 to 20.91) kW	0.24 mW/W 0.17 mW/W 0.56 mW/W	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 4, 6} (\pm)	Comments
DC Resistance – Generate ³	(0 to 10.9999) Ω (11 to 32.9999) Ω (3 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099 999) k Ω (1.1 to 3.299 999) k Ω (3.3 to 10.999 99) k Ω (11 to 32.999 99) k Ω (33 to 109.9999) k Ω (110 to 329.9999) k Ω (0.33 to 1.099 999) M Ω (1.1 to 3.299 999) M Ω (3.3 to 10.999 99) M Ω (11 to 32.999 99) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	46 $\mu\Omega/\Omega + 0.78$ m Ω 52 $\mu\Omega/\Omega + 1.2$ m Ω 34 $\mu\Omega/\Omega + 1.1$ m Ω 29 $\mu\Omega/\Omega + 1.6$ m Ω 27 $\mu\Omega/\Omega + 1.6$ m Ω 28 $\mu\Omega/\Omega + 16$ m Ω 27 $\mu\Omega/\Omega + 16$ m Ω 29 $\mu\Omega/\Omega + 0.16$ Ω 27 $\mu\Omega/\Omega + 0.16$ Ω 25 $\mu\Omega/\Omega + 1.6$ Ω 26 $\mu\Omega/\Omega + 1.6$ Ω 49 $\mu\Omega/\Omega + 23$ Ω 0.11 m $\Omega/\Omega + 39$ Ω 0.20 m $\Omega/\Omega + 1.9$ k Ω 0.40 m $\Omega/\Omega + 2.3$ k Ω 2.4 m $\Omega/\Omega + 78$ k Ω 12 m $\Omega/\Omega + 0.39$ M Ω	Fluke 5522A
	(10 to 100) M Ω (0.1 to 1) G Ω (1 to 10) G Ω (10 to 100) G Ω	0.13 % 0.24 % 0.59 % 1.2 %	IET HRRS
DC Resistance – Fixed Points ³	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	21 $\mu\Omega$ 76 $\mu\Omega$ 0.14 m Ω 0.21 m Ω 0.38 m Ω 1.1 m Ω 1.7 m Ω 7.5 m Ω 14 m Ω 78 m Ω 0.14 Ω 0.88 Ω 1.7 Ω 15 Ω 29 Ω 0.29 k Ω 0.70 k Ω 8.8 k Ω	Copper short Fluke 5720A

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
DC Resistance – Fixed Points ³ (cont)	1 m Ω 10 m Ω 100 m Ω 1 Ω 10 k Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω	2.4 $\mu\Omega$ 3.0 $\mu\Omega$ 17 $\mu\Omega$ 6.3 $\mu\Omega$ 35 m Ω 76 $\mu\Omega$ 0.14 m Ω 0.21 m Ω 0.38 m Ω 1.1 m Ω 1.7 m Ω 7.5 m Ω 14 m Ω 78 m Ω 0.14 Ω	Guildline 9230/15R Guildline 9230/100 Guildline 9230/300 Fluke 742-1 Fluke 742-10k
	800 m Ω 50 k Ω 150 k Ω 500 k Ω 5 M Ω 10 M Ω 100 M Ω 1 G Ω	0.035 Ω 2.0 k Ω 6.1 k Ω 20 k Ω 0.20 M Ω 0.40 M Ω 4.0 M Ω 0.040 G Ω	HPRS-Hipot-Quadtech
DC Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω (100 to 1200) M Ω	12 $\mu\Omega/\Omega$ + 39 $\mu\Omega$ 9.5 $\mu\Omega/\Omega$ + 0.39 m Ω 8.0 $\mu\Omega/\Omega$ + 0.39 m Ω 7.8 $\mu\Omega/\Omega$ + 3.9 m Ω 8.0 $\mu\Omega/\Omega$ + 39 m Ω 12 $\mu\Omega/\Omega$ + 1.6 Ω 39 $\mu\Omega/\Omega$ + 78 Ω 0.40 m Ω/Ω + 0.78 k Ω 4.8 m Ω/Ω + 7.8 k Ω	HP 3458A opt 002

Parameter/Range	Frequency	CMC ^{2, 6} (\pm)	Comments
AC Voltage – Generate ³			
Up to 2.2 mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	1.1 mV/V + 5.0 μ V 0.86 mV/V + 5.0 μ V 0.85 mV/V + 5.0 μ V 1.4 mV/V + 5.0 μ V 2 mV/V + 6.0 μ V 3.5 mV/V + 12 μ V 4.8 mV/V + 25 μ V 6.5 mV/V + 25 μ V	Fluke 5720A w/ 5725A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.30 mV/V + 5.0 μ V 0.18 mV/V + 5.0 μ V 0.16 mV/V + 5.0 μ V 0.3 mV/V + 5.0 μ V 0.55 mV/V + 6.0 μ V 1.2 mV/V + 12 μ V 1.6 mV/V + 25 μ V 2.9 mV/V + 25 μ V	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.38 mV/V + 15 μ V 93 μ V/V + 8.0 μ V 81 μ V/V + 8.0 μ V 0.19 mV/V + 8.0 μ V 0.45 mV/V + 20 μ V 0.74 mV/V + 25 μ V 1.2 mV/V + 30 μ V 2.4 mV/V + 60 μ V	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.52 mV/V + 50 μ V 82 μ V/V + 20 μ V 42 μ V/V + 10 μ V 76 μ V/V + 12 μ V 0.14 mV/V + 40 μ V 0.36 mV/V + 0.10 μ V 0.88 mV/V + 0.25 mV	
(0.22 to 2.2) V	500 kHz to 1 MHz	1.6 mV/V + 0.6 mV	Fluke 5720A w/ 5725A

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Voltage – Generate ³ (cont)			
(0.22 to 2.2) V	500 kHz to 1 MHz	1.6 mV/V + 0.6 mV	Fluke 5720A w/ 5725A
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.39 mV/V + 0.50 mV 88 μV/V + 0.15 mV 44 μV/V + 50 μV 79 μV/V + 0.10 mV 0.11 mV/V + 0.25 mV 0.29 mV/V + 0.8 mV 0.91 mV/V + 2.5 mV 1.6 mV/V + 4.0 mV	
(22 to 220) V (Subject to 2.2 x 10 ⁷ V-Hz limitation)	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.45 mV/V + 5.0 mV 84 μV/V + 2.0 mV 54 μV/V + 0.70 mV 92 μV/V + 1.2 mV 0.15 mV/V + 3.0 mV 0.88 mV/V + 20 mV 4.1 mV/V + 50 mV 7.9 mV/V + 100 mV	
(220 to 250) V	(15 to 50) Hz	0.25 mV/V + 20 mV	
(220 to 1100) V	50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	71 μV/V + 4.0 mV 74 μV/V + 6.0 mV 0.17 mV/V + 11 mV	
(220 to 750) V	30 Hz to 50 kHz (50 to 100) kHz	0.29 mV/V + 11 mV 0.40 mV/V + 45 mV	
AC Voltage – Generate ³ Levelled Output			
(0.3 to 1.1) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.98 mV/V 2.2 mV/V + 2.3 μV 3.7 mV/V + 2.3 μV 5.5 mV/V + 2.3 μV 13 mV/V + 2.3 μV	Fluke 5720A opt 003

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Voltage – Generate ³ , Leveled Output (cont)			
(1.1 to 3) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.94 mV/V 1.3 mV/V + 2.3 μV 2.2 mV/V + 2.3 μV 4.9 mV/V + 2.3 μV 13 mV/V + 2.3 μV	Fluke 5720A opt 003
(3 to 11) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.94 mV/V 1.1 mV/V + 2.3 μV 2 mV/V + 2.3 μV 3.9 mV/V + 2.3 μV 8.6 mV/V + 2.3 μV	
(11 to 33) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.91 mV/V 1 mV/V + 2.3 μV 2 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.5 mV/V + 2.3 μV	
(33 to 110) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.87 mV/V 1 mV/V + 2.3 μV 2 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.1 mV/V + 2.3 μV	
(110 to 330) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1 mV/V + 2.3 μV 2 mV/V + 2.3 μV 3.8 mV/V + 2.3 μV 8.5 mV/V + 2.3 μV	

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Voltage – Measure ³			
(1 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz 100 kHz to 1 MHz	0.38 mV/V + 2.3 μV 0.19 mV/V + 0.85 μV 0.25 mV/V + 0.85 μV 0.79 mV/V + 0.85 μV 3.9 mV/V + 0.85 μV 31 mV/V + 3.9 μV	Agilent/HP 3458A opt 002
(10 to 100) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.30 mV/V + 3.1 μV 87 μV V/V + 1.6 μV 0.12 mV/V + 1.6 μV 0.26 mV/V + 1.6 μV 0.63 mV/V + 1.6 μV 2.3 mV/V + 7.8 μV 7.9 mV/V + 7.8 μV	
100 mV to 1 V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.28 mV/V + 31 μV 75 μV V/V + 16 μV 0.12 mV/V + 16 μV 0.26 mV/V + 16 μV 0.63 mV/V + 16 μV 2.3 mV/V + 78 μV 7.9 mV/V + 78 μV	
(1 to 10) V	(1 to 40) Hz (40 to 1000) Hz 1 to 20 kHz 20 to 50 kHz 50 to 100 kHz (100 to 300) kHz 300 kHz to 1 MHz	0.28 mV/V + 0.31 mV 74 μV V/V + 0.16 mV 0.12 mV/V + 0.16 mV 0.26 mV/V + 0.16 mV 0.63 mV/V + 0.16 mV 2.3 mV/V + 0.78 mV 7.9 mV/V + 0.78 mV	
(10 to 100) V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.31 mV/V + 3.1 mV 0.16 mV V/V + 1.6 mV 0.16 mV/V + 1.6 mV 0.30 mV/V + 1.6 mV 0.94 mV/V + 1.6 mV 3.1 mV/V + 7.8 mV	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
AC Voltage – Measure ³ (cont)			
(100 to 700) V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.42 mV/V + 31 mV 0.31 mV V/V + 16 mV 0.47 mV/V + 16 mV 0.94 mV/V + 16 mV 2.3 mV/V + 16 mV	Agilent/HP 3458A opt 002
700 V to 1 kV	60 Hz	58 mV/V	Fluke 80k-40 w/ 3458A
(1.0 to 10.6) kV	60 Hz	6 mV/V	Ross VD15 w/ 34401A
AC Current – Generate ³			
(9 to 219.999) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1 to 5.0) kHz (5 to 10) kHz	0.40 mA/A + 16 nA 0.15 mA/A + 10 nA 0.12 mA/A + 8.0 nA 0.31 mA/A + 12 nA 0.90 mA/A + 65 nA	Fluke 5720A
(0.22 to 2.199 99) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1 to 5.0) kHz	0.35 mA/A + 40 nA 0.18 mA/A + 35 nA 0.15 mA/A + 35 nA 0.21 mA/A + 0.11 µA	
(0.22 to 2.199 99) mA	(5 to 10) kHz	0.86 mA/A + 0.65 µA	
(2.2 to 21.9999) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1 to 5.0) kHz (5 to 10) kHz	0.36 mA/A + 0.40 µA 0.16 mA/A + 0.35 µA 0.11 mA/A + 0.35 µA 0.19 mA/A + 0.55 µA 0.86 mA/A + 5.0 µA	
(22 to 219.999) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1.0 kHz (1 to 5) kHz (5 to 10) kHz	0.37 mA/A + 4.0 µA 0.16 mA/A + 3.5 µA 0.11 mA/A + 2.5 µA 0.19 mA/A + 3.5 µA 0.87 mA/A + 10 µA	

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Current – Generate ³ (cont)			
(0.22 to 2.2) A	20 Hz to 1.0 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 35 µA 0.38 mA/A + 80 µA 5.5 mA/A + 0.16 mA	Fluke 5720A
(2.2 to 11) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.36 mA/A + 0.17 mA 0.68 mA/A + 0.38 mA 2.6 mA/A + 0.75 mA	
(11 to 20.5) A	(10 to 100) Hz (0.10 to 1.0) kHz (1 to 5.0) kHz	0.94 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	Fluke 5720A w/ 5725A
(16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.31 % 0.81 %	Fluke 5520A
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.33 % 0.82 %	Fluke 5520A w/ 5500A coil
AC Current – Measure ³			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz (45 to 5) kHz	3.1 mA/A + 23 nA 1.2 mA/A + 23 nA 0.49 mA/A + 23 nA	Agilent / HP 3458A
100 µA to 1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 mA/A + 0.16 µA 1.2 mA/A + 0.16 µA 0.52 mA/A + 0.16 µA 0.28 mA/A + 0.16 µA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 mA/A + 1.6 µA 1.2 mA/A + 1.6 µA 0.49 mA/A + 1.6 µA 0.28 mA/A + 1.6 µA	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Current – Measure ³ (cont)			
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 mA/A + 16 µA 1.2 mA/A + 16 µA 0.49 mA/A + 16 µA 0.28 mA/A + 16 µA	Agilent / HP 3458A
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 mA/A + 0.16 mA 1.3 mA/A + 0.16 mA 0.69 mA/A + 0.16 mA 0.83 mA/A + 0.16 mA	
AC Power – Generate ³ PF = 1			
(45 to 65) Hz	(0.1089 to 2.97) mW (0.297 to 10.89) mW (1.089 to 29.7) mW (2.97 to 108.9) mW (10.89 to 297) mW (29.7 to 726) mW 72.6 mW to 1.49 W 149 mW to 6.76 W 1.09 mW to 9.18 W 2.97 mW to 33.6 W 10.9 mW to 91.8 W 29.7 mW to 337 W 109 mW to 918 W 297 mW to 2244 W 72.6 mW to 4.59 kW 1.49 W to 20.91 kW	1.1 mW/W 1.4 mW/W 1.1 mW/W 1.5 mW/W 1.0 mW/W 1.1 mW/W 1.1 mW/W 1.0 mW/W 0.93 mW/W 0.62 mW/W 0.93 mW/W 0.65 mW/W 0.86 mW/W 0.83 mW/W 0.99 mW/W 0.78 mW/W	Fluke 5522A
AC Resistance – Measure ³ –			
10 mΩ to 100 Ω	(20 to 50) Hz (50 to 125) Hz (125 to 1000) Hz (1 to 12.5) kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	2.6 mΩ/Ω 1.7 mΩ/Ω 1.6 mΩ/Ω 1.7 mΩ/Ω 1.7 mΩ/Ω 1.7 mΩ/Ω 1.7 mΩ/Ω	Agilent 4284A

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Resistance – Measure ³ (cont)			
100 Ω to 100 kΩ	(20 to 50) Hz (50 to 125) Hz (125 to 1000) Hz (1 to 12.5) kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	2.3 mΩ/Ω 1.2 mΩ/Ω 1.1 mΩ/Ω 1.3 mΩ/Ω 1.3 mΩ/Ω 1.3 mΩ/Ω 1.2 mΩ/Ω	Agilent 4284A
AC Resistance – Generate ³ , Fixed Points			
10 Ω	DC to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	4.1 mΩ 5.1 mΩ 5.1 mΩ 6.1 mΩ 7.1 mΩ 20 mΩ 40 mΩ	HP 42030 resistor set
100 Ω	DC to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	42 mΩ 42 mΩ 46 mΩ 46 mΩ 44 mΩ 84 mΩ 93 mΩ	
1 kΩ	DC to 3 MHz (3 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.43 Ω 0.42 Ω 0.72 Ω 0.72 Ω	
10 kΩ	DC to 1 MHz	4.3 Ω	
100 kΩ	DC to 1 MHz	53 Ω	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
Capacitance – Generate ³			
(0.19 to 1.1) nF			
(1.1 to 3.3) nF	10 Hz to 10 kHz	4.1 mF/F + 7.8 pF	Fluke 5520A
(3.3 to 11) nF	10 Hz to 3 kHz	4.0 mF/F + 7.8 pF	
(11 to 110) nF	10 Hz to 1 kHz	2.3 mF/F + 7.8 pF	
(110 to 330) nF	10 Hz to 1 kHz	2.3 mF/F + 78 pF	
(0.33 to 1.1) µF	10 Hz to 1 kHz	2.3 mF/F + 0.23 nF	
(1.1 to 3.3) µF	(10 to 600) Hz	2.3 mF/F + 0.78 nF	
(3.3 to 11) µF	(10 to 300) Hz	2.3 mF/F + 2.3 nF	
(11 to 33) µF	(10 to 150) Hz	2.3 mF/F + 7.8 nF	
(33 to 110) µF	(10 to 120) Hz	3.4 mF/F + 23 nF	
(110 to 330) µF	(10 to 80) Hz	3.7 mF/F + 78 nF	
(0.33 to 1.1) mF	(10 to 50) Hz	3.5 mF/F + 0.23 µF	
(1.1 to 3.3) mF	(10 to 20) Hz	3.5 mF/F + 0.78 µF	
(3.3 to 11) mF	(0 to 6) Hz	3.5 mF/F + 2.3 µF	
(11 to 33) mF	(0 to 2) Hz	3.5 mF/F + 7.8 µF	
(33 to 110) mF	(0 to 0.6) Hz	5.8 mF/F + 23 µF	
	(0 to 0.2) Hz	8.5 mF/F + 78 µF	
Fixed Points			
1 pF	100 Hz to 1 kHz	0.40 fF	
	1 kHz to 1 MHz	0.40 fF	
	(1 to 2) MHz	0.39 fF	
	(2 to 3) MHz	0.40 fF	
	(3 to 4) MHz	1.4 fF	
	(4 to 5) MHz	1.2 fF	
	(5 to 10) MHz	0.69 fF	
	(10 to 13) MHz	2.0 fF	
10 pF	100 Hz to 1 kHz	3.5 fF	HP 1638XX standard capacitor
	1 kHz to 1 MHz	3.5 fF	
	(1 to 2) MHz	3.7 fF	
	(2 to 3) MHz	3.7 fF	
	(3 to 4) MHz	3.5 fF	
	(4 to 5) MHz	3.5 fF	
	(5 to 10) MHz	4.0 fF	
	(10 to 13) MHz	4.0 fF	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
Capacitance – Generate ³ (cont)			
100 pF	100 Hz to 1 kHz 1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	43 fF 35 fF 36 fF 36 fF 37 fF 37 fF 41 fF 41 fF	HP 1638XX standard capacitor
1000 pF	100 Hz to 5 MHz (5 to 13) MHz	0.35 pF 0.36 pF	HP 1638XX standard capacitor
1.0 µF	100 Hz to 10 kHz	0.27 nF	General Radio: 1409-Y
0.1 µF	100 Hz to 10 kHz	33 pF	1409-T
0.01 µF	100 Hz to 10 kHz	2.9 pF	1409-L
Capacitance – Measure ³			
Up to 10 pF	20 Hz to 12.5 kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	2.6 mF/F 2.0 mF/F 2.3 mF/F 2.1 mF/F	HP 4284A
(10 to 100) pF	(20 to 500) Hz (500 to 1000) Hz (1 to 12.5) kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	14 mF/F 2.5 mF/F 1.3 mF/F 1.5 mF/F 1.2 mF/F 1.1 mF/F	
(100 to 1000) pF	(20 to 50) Hz (50 to 500) Hz (500 to 1000) Hz (1 to 12.5) kHz (12.5 to 48) kHz (48 to 96) kHz 96 kHz to 1 MHz	25 mF/F 2.5 mF/F 1.1 mF/F 1.1 mF/F 1.2 mF/F 1.2 mF/F 1.6 mF/F	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
Capacitance – Measure ³ (cont) (1 to 10) nF (10 to 100) nF (0.1 to 100) μF 100 μF to 1 mF	20 Hz to 100 kHz 20 Hz to 100 kHz 20 Hz to 100 kHz 20 Hz to 1 kHz	0.96 mF/F 0.95 mF/F 0.96 mF/F 1.1 mF/F	HP 4284A
Inductance – Generate ³ 100 μH 1 mH 10 mH 100 mH 1 H 10 H	(0.1 to 1) kHz (0.1 to 1) kHz (0.1 to 1) kHz (0.1 to 1) kHz (0.1 to 1) kHz (0.1 to 1) kHz	52 nH 0.36 μH 6.1 μH 34 μH 0.88 mH 8.0 mH	General Radio 1482 series
Inductance – Measure ³ (1 to 10) H 10 mH to 1 H (1 to 10) mH 100 μH to 10 mH (1 to 100) μH 10 nH to 1 μH	1 kHz to 1 MHz 100 Hz to 1 MHz 100 Hz to 30 kHz 30 kHz to 1 MHz 100 Hz to 1 MHz 50 Hz to 1 MHz	0.91 mH/H 0.91 mH/H 0.45 mH/H 0.91 mH/H 0.45 mH/H 0.91 mH/H	HP 4284A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples ³ – Generate and Measure Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.34 °C 0.27 °C 0.24 °C 0.26 °C	Fluke 5522A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000C to 1800) °C (1800 to 2316) °C	0.24 °C 0.21 °C 0.25 °C 0.39 °C 0.65 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple ³ – Generate and Measure (cont)			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.39 °C 0.13 °C 0.11 °C 0.13 °C 0.17 °C	Fluke 5522A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.25 °C 0.13 °C 0.12 °C 0.14 °C 0.18 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.45 °C 0.28 °C 0.26 °C 0.32 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.38 °C 0.28 °C 0.29 °C 0.36 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.50 °C 0.19 °C 0.13 °C 0.11 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.44 °C 0.21 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs ³			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.085 °C 0.12 °C 0.12 °C 0.11 °C 0.097 °C 0.11 °C 0.20 °C	Fluke 5522A
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.064 °C 0.076 °C 0.075 °C 0.089 °C 0.095 °C 0.17 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C	0.21 °C 0.060 °C 0.068 °C 0.070 °C 0.077 °C 0.084 °C 0.090 °C 0.13 °C	
Pt 3916, 100 Ω	(600 to 630) °C	0.19 °C	
Pt 385, 200 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C	0.041 °C 0.043 °C 0.044 °C 0.051 °C 0.098 °C 0.11 °C 0.11 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs ³ (cont)			
Pt 385, 200 Ω	(600 to 630) °C	0.13 °C	Fluke 5522A
Pt 385, 500 Ω	(-200 to -80) °C	0.036 °C	
	(-80 to 0) °C	0.043 °C	
	(0 to 100) °C	0.044 °C	
	(100 to 260) °C	0.051 °C	
	(260 to 300) °C	0.066 °C	
	(300 to 400) °C	0.066 °C	
	(400 to 600) °C	0.073 °C	
Pt 385, 1000 Ω	(600 to 630) °C	0.088 °C	
	(-200 to -80) °C	0.029 °C	
	(-80 to 0) °C	0.029 °C	
	(0 to 100) °C	0.036 °C	
PtNi 385, 120 Ω	(100 to 260) °C	0.042 °C	
	(260 to 300) °C	0.050 °C	
	(300 to 400) °C	0.18 °C	
	(400 to 600) °C	0.057 °C	
	(600 to 630) °C	0.18 °C	
Cu 427, 10 Ω	(-80 to 0) °C	0.081 °C	
	(0 to 100) °C	0.11 °C	
	(0 to 100) °C	0.11 °C	
Oscilloscopes ³			
Amplitude – DC Signal 50 Ω Load 1 MΩ Load	1 mV to 5.0 V	0.20 mV/V + 19 μV	Wavetek 9500B w/ 9530
	1 mV to 200 V	0.20 mV/V + 19 μV	
Amplitude – Square Wave 50 Ω Load	1 mV _(p-p) to 5.0 V _(p-p) 10 Hz to 100 kHz	0.89 mV/V + 7.8 μV	
	1 MΩ Load	0.92 mV/V + 7.8 μV	
Time Marker	450.5 ps to 55 s	0.30 μs/s	

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Oscilloscopes ³ – Amplitude (cont)			
Bandwidth ³	0.1 Hz to 300 MHz (300 to 550) MHz 550 MHz to 3.0 GHz	1.7 % 2.1 % 2.9 %	Wavetek 9500B w/ 9530
Rise Time ³			
Generate	≥ 150 ps	18 ps	Tek MSO4102B
Measure	≥ 350 ps	25 ps	
Distortion – Measure ³			
(-99.9 to 0) dB	(20 to 20) kHz (20 to 100) kHz	1.2 dB 2.3 dB	HP 8903B

IV. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
RF Power – Generate			
DC to 20 MHz	(13.5 to 24) dBm (-56 to 13.5) dBm	0.37 dB 0.42 dB	HP 3325B
20 MHz to 2.56 GHz	(16 to -115) dBm (-115 to -127) dBm	1.2 dB 3.5 dB	HP 8663A
10 MHz to 26.5 GHz	(13 to -60) dBm (-120 to -60) dBm	2.2 dB 2.6 dB	HP 83630B

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
RF Attenuation – Tuned RF Power Measure ³			
< 1.3 GHz	(-0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB (-110 to -120) dB (-120 to -127) dB	0.064 dB 0.067 dB 0.069 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB 0.14 dB 0.15 dB 0.18 dB 0.20 dB	Agilent / HP 8902A w/ 11722A, 11792A, or 11793A
(1.3 to 26.5) GHz	(-1 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -85) dB	0.064 dB 0.067 dB 0.080 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB	
RF Power – Measure			
(-30 to 20) dBm	(100 to 500) kHz 500 kHz to 1 MHz 1 MHz to 2 GHz (2 to 4.2) GHz (4.2 to 18) GHz (18 to 26.5) GHz	2.5 % 1.5 % 1.3 % 1.8 % 3.8 % 4.6 %	8482A w/ power meter 8485A w/ power meter
(-10 to 20) dBm	(0.01 to 2) GHz (2 to 4) GHz (4 to 6) GHz (6 to 12) GHz (12 to <18) GHz 18 GHz	1.5 % 1.7 % 1.8 % 1.9 % 2.2 % 2 %	8481A w/ power meter
1 mW	50 MHz	0.86 %	432A, 478A, 3458A

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Amplitude Modulation – Measure ³			
Rate: 50 Hz to 10 kHz Depth: (5 to 99) %	(0.15 to 10) MHz	2.4 % + 1 Digit	HP 8902A
Rate: 20 Hz to 10 kHz Depth: (5 to 99) %	(0.15 to 10) MHz	3.5 % + 1 Digit	
Rate: 50 Hz to 50 kHz Depth: (5 to 99) %	(0.01 to 1.3) GHz	1.2 % + 1 Digit	
Rate: 20 Hz to 100kHz Depth: (5 to 99) %	(0.01 to 1.3) GHz	3.5 % + 1 Digit	
Rate: 50 Hz to 50 kHz Depth: (5 to 99) %	(1.3 to 26.5) GHz	1.8 % + 1 Digit	
Rate: 20 Hz to 100 kHz Depth: (5 to 99) %	(1.3 to 26.5) GHz	3.5 % + 1 Digit	HP 8902A w/microwave converter and LO
Frequency Modulation – Measure ³			
Rate: 20 Hz to 10 kHz Dev: ≤ 40 kHz peak	(0.25 to 10) MHz	2.3 % + 1 Digit	HP 8902A
Rate: 50 Hz to 100kHz Dev: ≤ 400 kHz peak	(0.01 to 1.3) GHz	1.2 % + 1 Digit	
Rate: 20 Hz to 200kHz Dev: ≤ 4.0 kHz peak	(0.01 to 1.3) GHz	5.8 % + 1 Digit	
Rate: 50 Hz to 100kHz Dev: ≤ 400 kHz peak	(1.3 to 26.5) GHz	1.2 % + 1 Digit	HP 8902A w/ microwave converter and LO
Rate: 20 Hz to 200kHz Dev: ≤ 400 kHz peak	(1.3 to 26.5) GHz	5.8 % + 1 Digit	

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Transmission Magnitude ³ (Into 50 Ω)			
30 kHz to 3 GHz	(-15 to 10) dBm (-25 to 0) dBm (-35 to -10) dBm (-45 to -20) dBm (-55 to -30) dBm (-65 to -40) dBm (-75 to -50) dBm (-85 to -60) dBm	0.34 dB 0.21 dB 0.18 dB 0.84 dB 0.30 dB 0.48 dB 0.86 dB 1.1 dB	HP 8753D
(3 to 6) GHz	(-15 to 10) dBm (-25 to 0) dBm (-35 to -10) dBm (-45 to -20) dBm (-55 to -30) dBm (-65 to -40) dBm (-75 to -50) dBm (-85 to -60) dBm	0.11 dB 0.023 dB 0.037 dB 0.061 dB 0.13 dB 0.36 dB 0.72 dB 0.79 dB	
Transmission Phase ³ (Into 50 Ω, 0° to 360°)			
30 kHz to 3 GHz	(-15 to 10) dBm (-25 to 0) dBm (-35 to -10) dBm (-45 to -20) dBm (-55 to -30) dBm (-65 to -40) dBm (-75 to -50) dBm (-85 to -60) dBm	1.2 ° 0.77 ° 3.5 ° 2.4 ° 2.9 ° 1.8 ° 2.7 ° 2.5 °	HP 8753D
(3 to 6) GHz	(-15 to 10) dBm (-25 to 0) dBm (-35 to -10) dBm (-45 to -20) dBm (-55 to -30) dBm (-65 to -40) dBm (-75 to -50) dBm (-85 to -60) dBm	0.76 ° 0.22 ° 0.36 ° 0.57 ° 1.4 ° 2.1 ° 3.2 ° 3.9 °	

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
Return Loss – Measure into 50 Ω			
(0 to 5) dB	10 MHz to 8.4 GHz (8.4 to 12.4) GHz (12.4 to 18) GHz (18 to 20) GHz (20 to 26.5) GHz	2.5 dB 2.5 dB 2.5 dB 2.5 dB 2.5 dB	HP 8757D w/ 85027B
(5 to 10) dB	10 MHz to 8.4 GHz (8.4 to 12.4) GHz (12.4 to 18) GHz (18 to 20) GHz (20 to 26.5) GHz	2.5 dB 2.5 dB 2.5 dB 2.5 dB 2.5 dB	
(10 to 20) dB	10 MHz to 8.4 GHz (8.4 to 12.4) GHz (12.4 to 18) GHz (18 to 20) GHz (20 to 26.5) GHz	2.5 dB 2.5 dB 2.5 dB 2.5 dB 2.6 dB	
(20 to 30) dB	10 MHz to 8.4 GHz (8.4 to 12.4) GHz (12.4 to 18) GHz (18 to 20) GHz (20 to 26.5) GHz	2.7 dB 3.0 dB 2.9 dB 2.8 dB 3.5 dB	
(30 to 40) dB	10 MHz to 8.4 GHz (8.4 to 12.4) GHz (12.4 to 18) GHz (18 to 20) GHz (20 to 26.5) GHz	4.5 dB 7.5 dB 6.3 dB 5.4 dB 12 dB	
LISN –			
Insertion Loss (9 to 150) kHz 150 kHz to 100 MHz (100 to 400) MHz	(0 to -20) dB	2.1 dB 2.1 dB 2.2 dB	HP 4195A w/ E4419B, E9304A, Type N Cal Kit
Impedance Magnitude (9 to 150) kHz 150 kHz to 100 MHz (100 to 400) MHz	(0 to 50) Ω	0.52 Ω 1.0 Ω 1.7 Ω	

V. Mechanical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Torque Wrenches	(5 to 50) lbf·in (25 to 250) lbf·in (100 to 1000) lbf·in (25 to 250) lbf·ft	0.32 % 0.30 % 0.33 % 0.30 %	CDI 950-DT w/ TTPM-41
	(5 to 50) ozf·in (15 to 200) ozf·in	0.31 % 0.31 %	CDI 5000ST w/ 2000-4-02 2000-5-02
Force Gauges – Compression and Tension Test, Dynamometer ³	(0.0125 to 1) lbf (1 to 10) lbf (10 to 50) lbf (50 to 100) lbf (100 to 500) lbf	0.060 % 0.032 % 0.037 % 0.055 % 0.022 %	Class F weights
Pressure – Absolute by Atmosphere	(5 to 350) kPa (350 to 7000) kPa	15 µPa/Pa + 10 Pa 20 µPa/Pa + 10 Pa	DHI 7600
Pressure – Absolute by Vacuum	(5 to 350) kPa (350 to 7000) kPa	14 µPa/Pa + 0.2 Pa 20 µPa/Pa + 1.2 Pa	
Pressure – Differential	(5 to 350) kPa	14 µPa/Pa + 0.3 Pa	
Pressure – Gauge	(5 to 350) kPa (350 to 7000) kPa	15 µPa/Pa + 0.1 Pa 20 µPa/Pa + 1.2 Pa	
Pressure – Absolute ³	(0 to 20) psi (20 to 30) psi (30 to 50) psi	0.0040 % + 0.0064 psi 0.0098 % 0.010 %	Mensor 8100 w/ 17113 (0 to 50) psi module
Pressure – Differential ³	(-2 to 2) psi	0.0077 % + 0.00028 psi	Mensor 8100 w/ 17113 (-2 to 2) psi module

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Scales & Balances ³	(1 to 500) mg (0.5 to 1) g (1 to 2) g (2 to 3) g (3 to 5) g (5 to 10) g (10 to 50) g (50 to 100) g (100 to 200) g (200 to 300) g (300 to 500) g (0.5 to 1) kg (1 to 2) kg (2 to 3) kg (3 to 8.1) kg (8.1 to 24) kg (10 to 25) lb (25 to 50) lb (50 to 100) lb (100 to 250) lb (250 to 500) lb	12 µg 44 µg 44 µg 48 µg 56 µg 60 µg 0.15 mg 0.30 mg 0.60 mg 0.62 mg 1.4 mg 2.9 mg 5.8 mg 9.4 mg 13 mg 73 mg 1.3 g 2.9 g 4.1 g 6.5 g 9.1 g	Actual value of standard weights Mettler Toledo PR8002 w/ transfer weights
Mass	(1 to 500) mg (0.5 to 2) g (2 to 3) g (3 to 5) g (5 to 10) g (10 to 50) g (50 to 100) g (100 to 210) g (210 to 300) g (300 to 500) g (0.5 to 1) kg (1 to 2) kg (2 to 3) kg (3 to 5) kg (5 to 8) kg (8.1 to 24) kg	13 µg 44 µg 47 µg 54 µg 60 µg 0.15 mg 0.30 mg 0.61 mg 5.8 mg 5.9 mg 6.5 mg 8.2 mg 11 mg 16 mg 30 mg 73 mg	Actual value of class 1 weights w/ DV215CD Mettler Toledo PR8002 Actual value of class 1 weights w/ DV215CD

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Accelerometers – Charge Sensitivity, Frequency Response	50 Hz 100 Hz 200 Hz 500 Hz 1 kHz 2 kHz 3 kHz 5 kHz	4.2 % 4.1 % 4.2 % 4.2 % 4.2 % 6.9 % 7.3 % 7.5 %	Hardy HI-803

VI. Thermodynamic

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Relative Humidity – Measure ³	(20 to 80) % RH	1.3 %	Vaisala MI-70 & HP76 probe
Relative Humidity – Measuring Equipment ³	11 % RH 33 % RH 75 % RH 97 % RH	1.6 % 1.6 % 2.0 % 2.6 %	Reference salts
Temperature – Measure ³	(-196 to 420) °C	0.086 °C	Hart 1502A w/ 5626 PRT
Temperature – Measuring Equipment ³	(-100 to 70) °C (70 to 80) °C (80 to 300) °C	0.089 °C 0.16 °C 0.11 °C	Bath w/ Hart 1502A w/ 5626 PRT

VII. Time & Frequency

Parameter/Equipment	Frequency	CMC ^{2,5} (\pm)	Comments
Frequency – Measuring Equipment ³	1 mHz to 10 MHz (10 to 50) MHz	36 μ Hz 0.4 nHz/Hz + 0.58R	Datum w/ HP 3325 HP 8340A
	10 MHz to 26.5 GHz	0.4 nHz/Hz + 0.58R	
Frequency – Measure ³	1 mHz to 6 GHz	0.4 nHz/Hz + 36 μ Hz + 0.58R	Datum w/HP 53220A opt 106
	(6 to 26.5) GHz	0.4 nHz/Hz + 0.58R	Datum w/HP 5351B
RPM – Measuring Equipment ³	(10 to 100 000) RPM	0.0023 RPM	Datum w/ HP 3325

Satellite Facility:
TEKTRONIX SERVICE
 200 Upper Mountain Road, Bldg. 8
 Lockport, NY 14094
 Doug Wiley Phone: 315 334 7600

I. Chemical

Parameter/Equipment	Range	CMC ^{2, 4, 8} (±)	Comments
Gas Flow – Leak ³	(0.1 to 10) cc/min	1.2 %	ATC IFC-010-250P

II. Dimensional

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Plain Plug & Pin Gages ³	Up to 1 inch	70 μin	Beta Products 283-20 Class XX plug gage

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouples ³ – Type E	(-270 to -245) °C (-245 to -195) °C (-195 to -155) °C (-155 to -90) °C (-90 to 15) °C (15 to 890) °C (890 to 1000) °C	1.4 °C 0.29 °C 0.12 °C 0.093 °C 0.082 °C 0.071 °C 0.14 °C	Ectron 1140A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouples ³ – (cont)			
Type J	(-210 to -180) °C (-180 to -120) °C (-120 to -50) °C (-50 to 990) °C (990 to 1200) °C	0.19 °C 0.17 °C 0.15 °C 0.082 °C 0.086 °C	Ectron 1140A
Type K	(-270 to -255) °C (-255 to -195) °C (-195 to -115) °C (-115 to -55) °C (-55 to 1000) °C (1000 to 1372) °C	2.6 °C 0.82 °C 0.18 °C 0.14 °C 0.082 °C 0.10 °C	
Type R	(-50 to -30) °C (-30 to 45) °C (45 to 160) °C (160 to 380) °C (380 to 775) °C (775 to 1768) °C	0.76 °C 0.65 °C 0.49 °C 0.37 °C 0.36 °C 0.30 °C	
Type S	(-50 to -30) °C (-30 to 45) °C (45 to 105) °C (105 to 310) °C (310 to 615) °C (615 to 1768) °C	0.73 °C 0.66 °C 0.49 °C 0.41 °C 0.37 °C 0.32 °C	
Type T	(-270 to -255) °C (-255 to -240) °C (-240 to -210) °C (-210 to -150) °C (-150 to -40) °C (-40 to 100) °C (100 to 400) °C	2.1 °C 0.60 °C 0.40 °C 0.22 °C 0.15 °C 0.094 °C 0.083 °C	

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4, 8} (±)	Comments
Pressure Gages and Transducers ³	(0 to 30) psig	0.016 psi	Fluke 744 w/ Fluke 700PV4 Fluke 700P06
	(0 to 20) psia	0.061 psi	
	(0 to 1000) psig	0.58 psi	Fluke 700P08
Torque Wrenches ³	(5 to 50) in·lbf (40 to 400) in·lbf (100 to 1000) in·lbf (20 to 250) ft·lbf	0.30 % 0.31 % 0.46 % 0.43 %	CDI 2000-400-02 4-in-1 torque calibrator

V. Thermodynamic

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Temperature – Measure ³	(-195 to 420) °C	0.19 °C	Fluke 1523 w/ 5627A probe
Temperature – Measuring Equipment ³	(-20 to 150) °C	0.23 °C	Bath w/ Fluke 1523 w/ 5627 probe

¹ This laboratory offers commercial and field calibration service.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement 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. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

³ Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches, L' is the numerical value of the nominal length of the device measured in meters, R is the numerical value of the nominal radius of the device measured in meters. In the statement of CMC, D is nominal diameter in inches. The symbol ρ refers to the magnitude of the reflection value being read. In the statement of CMC, percentages are to be read as percent of reading, unless noted otherwise.

⁵ This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

⁶ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.

⁸ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



Accredited Laboratory

A2LA has accredited

TEKTRONIX, INC.

Kokomo, IN

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 5th day of April 2021.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.26
Valid to June 30, 2023

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.