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: 2357.22

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location above as well as the three satellite locations listed below to perform the following calibrations[1, 8]:

I. Acoustical

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
Microphones Sensitivity – Class 1 and 2	250 Hz & 1 kHz	0.14 dB re 1.0 V/Pa	B&K 4228, B&K 4160, B&K 5936, Agilent 34401
Microphone Frequency Response – Class 1 and 2	20 Hz to 20 kHz	0.15 dB	Agilent 33220A, 34401A
Acoustic Calibrators – Class 1 and 2			
Sound Pressure Level: (74, 84, 94, 104 & 114) dB	125 Hz to 4 kHz	0.11 dB	B&K 4228, B&K 5936, Agilent 34401
Frequency: SPL Re: 20 µPa	125 Hz to 4 kHz	0.015 Hz	

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Parameter/Equipment	Frequency	CMC[2] (±)	Comments
Sound Level Meters – Type 1 & 2 and Noise Dosimeters (Acoustical Portion- SPL) 94 dB, Re: 20 µPa 104 dB, Re: 20 µPa 114 dB, Re: 20 µPa	31.5 Hz 63 Hz 125 Hz 250 Hz 500 Hz 1 kHz 2 kHz 4 kHz 8 kHz 12 kHz 16 kHz	0.53 dB 0.36 dB 0.31 dB 0.26 dB 0.31 dB 0.31 dB 0.31 dB 0.36 dB 0.42 dB 0.47 dB 0.54 dB	B&K 4226
Piston Phones – Sound Pressure Level Frequency: SPL Re: 20 µPa	 124 dB @ 250 Hz 250 Hz	 0.11 dB 0.015 Hz	 B&K 4228, HP 34401 B&K 5936 (4228 comparison method)
Sound Level Meters Type 1 (Electrical Portion)	125 Hz, 200 Hz, 250 Hz, 400 Hz, 630 Hz, 1 kHz, 1.6 kHz, 2.5 kHz, 3.15 kHz, 4 kHz, 5 kHz, 6.3 kHz, 8 kHz	0.011 dB	HP 34401A

II. Chemical Quantities

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
pH – Measuring Equipment	(4, 7 & 10) pH ± 10 % pH	0.018 pH	pH buffer solutions

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Conductivity – Measuring Equipment[8]	0.6 to 10 µS ± 10 % 100 µS ± 10 % 1000 µS ± 10 % 1411 µS ± 10 % 10 000 µS ± 10 % 100 000 µS ± 10 % 150 000 µS ± 10 % 200 000 µS ± 10 %	0.31 µS 0.84 µS 5.4 µS 4.6 µS 44 µS 0.35 mS 0.58 mS 0.63 mS	Conductivity buffer solutions

III. Dimensional

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Micrometers –			
Inside, Outside, and Depth[3]	Up to 4 in (4 to 12) in (12 to 36) in	(10 + 1.9*L*) µin (17 + 4.3*L*) µin (51 + 1.9*L*) µin	Gage blocks w/ optical parallels
Flatness	Up to 1 in	4.9 µin	
Parallelism	Up to 1 in	25 µin	
Calipers[3]	Up to 4 in (4 to 12) in (12 to 48) in	(30 + 1.0*L*) µin (290 + 1.0*L*) µin (280 + 1.1*L*) µin	Gage blocks
Height Gages[3]	(0.05 to 4) in (4 to 12) in (12 to 48) in	(92 + 0.25*L*) µin (86 + 2*L*) µin (90 + 1.7*L*) µin	Gage blocks w/ surface plate
Dial Indicators[3]	Up to 1 in	21 µin	Super micrometer

IV. Electrical – DC / Low Frequency

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Generate[3]	0 V	0.21 nV	Copper short
	Up to 100 mV	1.7 µV/V	Fluke 732B w/752A 720A dividers
	(0.1 to 1) V	1.6 µV/V	
	(1 to 10) V	1.5 µV/V	
	(10 to 100) V	1.6 µV/V	
	(100 to 1000) V	1.6 µV/V	Fluke 8508A w/ 752A, 5720A
	(1000 to 1100) V	4.4 µV/V	
	(0 to 220) mV	7.6 µV/V + 0.39 µV	Fluke 5720A/5725A
	(0.22 to 2.2) V	4.8 µV/V + 0.62 µV	
	(2.2 to 11) V	3.1 µV/V + 2.3 µV	
	(11 to 22) V	3.2 µV/V + 3.9 µV	
	(22 to 220) V	1.7 µV/V + 39 µV	
	(220 to 1100) V	6.3 µV/V + 390 µV	
Fixed Point	100 mV	1.5 µV	732B w/ 720A, 752A 34420A, 5720A
	1 V	1.5 µV	
	1.018 V	1.5 µV	
	10 V	1.0 µV	
	100 V	1.7 µV	
	1000 V	1.8 µV	
	1100 V	4.4 µV/V	
DC Voltage – Measure[3]	Up to 200 mV	6.0 µV/V + 0.93 µV	Fluke 8508A opt 01
	(0.2 to 2) V	3.6 µV/V + 0.39 µV	
	(2 to 20) V	3.6 µV/V + 3.9 µV	
	(20 to 200) V	5.5 µV/V + 39 µV	
	(0.200 to 1) kV	5.5 µV/V + 490 mV	
	Up to 120 kV	1.2 mV/V	Ross VD120-6.2Y
Fixed Point	10 V	0.33 µV/V	Data proof scanner w/ 734A & Agilent 34420A
	1.018 V	1.5 µV/V	
	1.000 V	1.5 µV/V	
DC Current – Generate[3]	Up to 220 µA	40 µA/A + 5.4 nA	Fluke 5720A
	220 µA to 2.2 mA	32 µA/A + 6.2 nA	
	(2.2 to 22) mA	32 µA/A + 39 nA	
	(22 to 220) mA	39 µA/A + 0.62 µA	
	220 mA to 2.2 A	70 µA/A + 12 µA	
	(2.2 to 11) A	0.28 mA/A + 0.37 mA	Fluke 5720A/5725A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Current – Generate[3] (cont)	(1.1 to 3) A (3 to 11) A (11 to 20.5) A	0.30 mA/A + 31 µA 0.39 mA/A + 0.39 mA 0.78 mA/A + 0.58 mA	Fluke 5520
Clamp-On Only	(16.5 to 149.999) A (150 to 1025) A	3.9 mA/A + 0.11 mA 4 mA/A + 0.39 mA	Fluke 5520A w/ coil
DC Current – Generate and Measure[3]	0 A (0 to 100) nA (0.1 to 1) µA (1 to 10) µA (10 to 100) µA (100 to 200) µA (0.1 to 1) mA (1 to 2) mA (2 to 10) mA (10 to 20) mA (20 to 100) mA (100 to 200) mA 200 mA to 1 A (1 to 2) A (2 to 10) A (10 to 20) A (20 to 100) A (100 to 300) A	4.0 pA 13 µA/A 13 µA/A 6.3 µA/A 4.1 µA/A 4.2 µA/A 3.9 µA/A 4.2 µA/A 4.7 µA/A 5.8 µA/A 5.7 µA/A 6.2 µA/A 6.1 µA/A 14 µA/A 6.1 µA/A 33 µA/A 0.10 mA/A 0.50 mA/A	Reference open, standard resistors and 8508A Y5020, 8508A, 9211
DC Resistance – Generate, Fixed Points	0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ	7.6 µΩ/Ω 1.9 µΩ/Ω 3.1 µΩ/Ω 2.7 µΩ/Ω 3.2 µΩ/Ω 2.0 µΩ/Ω 12 µΩ/Ω 2.2 µΩ/Ω 7.3 µΩ/Ω 14 µΩ/Ω 0.16 mΩ/Ω	Standard resistors Fluke 8508A 7000K

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance – Measure and Generate	(0 to 0.01) mΩ (0.01 to 0.1) mΩ (0.1 to 1) mΩ (0.001 to 0.1) Ω (0.1 to 10) Ω (>10 to 100) Ω (>100 to 1000) Ω (>1 to 10) kΩ (>10 to 100) kΩ >100 kΩ to 1 MΩ (>1 to 10) MΩ (>10 to 100) MΩ 100 MΩ to 1 GΩ	3.5 µΩ 0.020 % 90 µΩ/Ω 0.71 µΩ/Ω 0.68 µΩ/Ω 0.80 µΩ/Ω 1.0 µΩ/Ω 1.2 µΩ/Ω 1.4 µΩ/Ω 3.5 µΩ/Ω 4.0 µΩ/Ω 15 µΩ/Ω 19 µΩ/Ω	MI 6010B range extenders and standard resistors MI 6010B and standard resistors MI 6000B and standard resistors
DC Resistance – Measure and Generate[3]	0 Ω (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ (20 to 200) GΩ 200 GΩ to 2 TΩ (2 to 20) TΩ (20 to 200) TΩ	6.4 µΩ 90 nΩ 0.30 mΩ/Ω 0.19 mΩ/Ω 0.26 mΩ/Ω 0.73 mΩ/Ω 0.97 mΩ/Ω 1.3 mΩ/Ω 4.1 mΩ/Ω 7.5 mΩ/Ω	Fluke 8508A open Fluke 8508A short Guidline 6520A
DC Resistance – Measure[3]	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (2 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ	21 µΩ/Ω + 4.0 µΩ 15 µΩ/Ω + 14 µΩ 12 µΩ/Ω + 50 µΩ 11 µΩ/Ω + 0.50 mΩ 9.2 µΩ/Ω + 5.0 mΩ 12 µΩ/Ω + 50 mΩ 17 µΩ/Ω + 1.0 Ω 20 µΩ/Ω + 10 Ω 77 µΩ/Ω + 1.00 kΩ 0.22 mΩ/Ω + 0.10 MΩ 1.5 mΩ/Ω + 10 MΩ	Fluke 8508A: true ohms mode 8508A normal mode 8508A high voltage mode

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Resistance – Generate[3]	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ (1 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099 999) kΩ (1.1 to 3.29999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.9999) kΩ (110 to 329.9999) kΩ (0.33 to 1.099 999) MΩ (1.1 to 3.2999 99) MΩ (3.3 to 10.999 99) MΩ (11 to 32.999 99) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	90 nΩ 0.11 mΩ 0.16 mΩ 0.21 mΩ 0.41 mΩ 0.96 mΩ 1.8 mΩ 8.6 mΩ 16 mΩ 80 mΩ 0.15 Ω 1.2 Ω 2.2 Ω 20 Ω 38 Ω 0.37 kΩ 0.84 kΩ 12 kΩ 1.2 mΩ/Ω 2.5 mΩ/Ω 5.8 mΩ/Ω 17 mΩ/Ω 33 µΩ/Ω + 0.78 mΩ 24 µΩ/Ω + 1.2 mΩ 22 µΩ/Ω + 1.1 mΩ 23 µΩ/Ω + 1.6 mΩ 22 µΩ/Ω + 1.6 mΩ 23 µΩ/Ω + 16 mΩ 23 µΩ/Ω + 16 mΩ 23 µΩ/Ω + 0.16 Ω 23 µΩ/Ω + 0.16 Ω 26 µΩ/Ω + 1.6 Ω 26 µΩ/Ω + 1.6 Ω 48 µΩ/Ω + 23 Ω 0.10 mΩ/Ω + 39 Ω 0.21 mΩ/Ω + 1.9 kΩ 0.40 mΩ/Ω + 2.3 kΩ 2.3 mΩ/Ω + 78 kΩ 12 mΩ/Ω + 390 kΩ	Copper short Fluke 5720A Biddle 72-6346-1 Fluke 5520A
DC Power – Generate[3]	(0.01 to 337) W (0.33 to 3.06) kW (3.06 to 20.91) kW	0.055 % 0.060 % 0.072 %	Fluke 5520A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Current – Measure[3]	Up to 100 µA (100 to 200) µA 200 µA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A (1 to 20) A (20 to 1000) A	13 µA/A + 0.40 nA 13 µA/A + 0.4 nA 14 µ/A + 4.0 nA 14 µA/A + 40 nA 48 µA/A + 0.80 µA 0.18 mA/A + 16 µA 0.41 mA/A + 0.40 mA 0.17 mA/A 3.0 mA/A	Fluke 8508A opt 01 Fluke Y5020 w/ HP 3458A w/ current shunts
DC Resistance – Measure [3]	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ	22 µΩ/Ω + 5.0 µΩ 11 µΩ/Ω + 18 µΩ 8.7 µΩ /Ω + 60 µΩ 8.7 µΩ/Ω + 0.60 mΩ 8.8 µΩ/Ω + 6.0 mΩ 9.1 µΩ/Ω + 60 mΩ 12 µΩ/Ω + 1.2 Ω 25 µΩ/Ω + 0.12 kΩ 0.14 mΩ/Ω + 12 kΩ 1.6 mΩ/Ω + 1.2 MΩ	Fluke 8508A opt 01

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3]			
2 mV	1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz 40 Hz 20 Hz 10 Hz	0.90 µV 1.0 µV 0.98 µV 1.4 µV 2.0 µV 2.9 µV 4.1 µV 0.93 µV 0.94 µV 1.0 µV	Fluke 5720A and 5790A characterized w/ 792A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3] (cont)			
3 mV	45 Hz 10 kHz	1.5 µV 1.5 µV	Fluke 5720A and 5790A characterized w/ 792A
10 mV	1 kHz 20 kHz 100 kHz 300 kHz	1.0 µV 1.0 µV 4.4 µV 9.5 µV	
20 mV	1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz 40 Hz 20 Hz 10 Hz	1.6 µV 1.7 µV 2.1 µV 3.2 µV 4.8 µV 6.9 µV 8.5 µV 1.5 µV 1.6 µV 1.9 µV	
30 mV	9.5 Hz 10 Hz 45 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 450 kHz	25 µV 3.5 µV 2.3 µV 2.3 µV 2.3 µV 2.5 µV 4.9 µV 8.4 µV 23 µV	
33 mV	45 Hz 10 kHz	3.1 µV 3.1 µV	
100 mV	20 Hz 55 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 60 kHz 100 kHz 300 kHz	3.4 µV 2.4 µV 2.5 µV 2.6 µV 2.4 µV 3.2 µV 7.6 µV 15 µV 16 µV 24 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3] (cont)			
200 mV	1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz 40 Hz 20 Hz 10 Hz	4.2 µV 5.9 µV 7.8 µV 11 µV 17 µV 24 µV 48 µV 5.3 µV 7.8 µV 13 µV	Fluke 5720A and 5790A characterized w/ 792A
300 mV	9.5 Hz 10 Hz 45 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 500 kHz	0.24 mV 19 µV 11 µV 9.6 µV 9.9 µV 11 µV 18 µV 26 µV 90 µV	
0.33 V	45 Hz 10 kHz	17 µV 21 µV	
1 V	20 Hz 55 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 60 kHz 100 kHz 300 kHz 500 kHz 1 MHz	21 µV 29 µV 21 µV 21 µV 20 µV 20 µV 37 µV 74 µV 56 µV 0.13 mV 0.20 mV 0.70 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3] (cont)			
2 V	1 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz 40 Hz 20 Hz 10 Hz	24 µV 23 µV 24 µV 33 µV 57 µV 78 µV 0.20 mV 23 µV 45 µV 0.13 mV	Fluke 5720A and 5790A characterized w/ 792A
2.3 V	1 kHz	35 µV	
3 V	9.5 Hz 10 Hz 45 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 450 kHz	2.4 mV 1.9 mV 90 µV 67 µV 72 µV 67 µV 0.12 mV 0.20 mV 1.0 mV	
3.3 V	45 Hz 10 kHz	0.19 mV 0.18 mV	
10 V	10 Hz 20 Hz 40 Hz 55 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 60 kHz 100 kHz 300 kHz 500 kHz 1 MHz	0.28 mV 0.18 mV 0.11 mV 0.28 mV 0.24 mV 0.24 mV 0.24 mV 0.23 mV 0.42 mV 0.42 mV 0.67 mV 0.68 mV 1.5 mV 3.1 mV 9.4 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3] (cont)			
19 V	1 kHz	0.40 mV	Fluke 5720A and 5790A characterized w/ 792A
20 V	1 kHz	0.23 mV	
	20 kHz	0.22 mV	
	50 kHz	0.23 mV	
	100 kHz	0.31 mV	
	300 kHz	0.53 mV	
	500 kHz	0.80 mV	
	1 MHz	6.3 mV	
	40 Hz	0.25 mV	
	20 Hz	0.36 mV	
	10 Hz	0.55 mV	
2.3 V	1 kHz	35 µV	
3 V	9.5 Hz	2.4 mV	
	10 Hz	1.9 mV	
	45 Hz	90 µV	
	1 kHz	67 µV	
	10 kHz	72 µV	
	20 kHz	67 µV	
	50 kHz	0.12 mV	
	100 kHz	0.20 mV	
	450 kHz	1.0 mV	
3.3 V	45 Hz	0.19 mV	
	10 kHz	0.18 mV	
10 V	10 Hz	0.28 mV	
	20 Hz	0.18 mV	
	40 Hz	0.11 mV	
	55 Hz	0.28 mV	
	1 kHz	0.24 mV	
	3 kHz	0.24 mV	
	10 kHz	0.24 mV	
	20 kHz	0.23 mV	
	30 kHz	0.42 mV	
	50 kHz	0.42 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3] (cont)			
10 V	60 kHz 100 kHz 300 kHz 500 kHz 1 MHz	0.67 mV 0.68 mV 1.5 mV 3.1 mV 9.4 mV	Fluke 5720A and 5790A characterized w/ 792A
19 V	1 kHz	0.40 mV	
30 V	9.5 Hz 10 Hz 45 Hz 1 kHz 10 kHz 20 kHz 50 kHz 90 kHz	24 mV 1.8 mV 0.99 mV 0.84 mV 0.82 mV 0.83 mV 1.4 mV 2.3 mV	
33 V	45 Hz 10 kHz	1.1 mV 1.6 mV	
100 V	20 Hz 55 Hz 1 kHz 3 kHz 10 kHz 20 kHz 30 kHz 50 kHz 60 kHz 100 kHz	1.9 mV 1.6 mV 1.4 mV 2.6 mV 2.6 mV 2.6 mV 5.5 mV 5.4 mV 7.9 mV 7.8 mV	
200 V	1 kHz 20 kHz 50 kHz 100 kHz 40 Hz 20 Hz 10 Hz	2.7 mV 2.8 mV 2.9 mV 4.5 mV 3.1 mV 5.5 mV 7.6 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate and Measure[3] (cont)			
300 V	45 Hz 1 kHz 10 kHz 18 kHz 50 kHz	11 mV 11 mV 11 mV 11 mV 18 mV	Fluke 5720A and 5790A characterized w/ 792A
330 V	45 Hz 10 kHz	13 mV 12 mV	
500 V	50 Hz 1 kHz 3 kHz 10 kHz 30 kHz	19 mV 17 mV 17 mV 17 mV 17 mV	
700 V	1 kHz	27 mV	
1000 V	45 Hz 50 Hz 300 Hz 1 kHz 5 kHz 8 kHz 30 kHz	16 mV 48 mV 48 mV 17 mV 40 mV 35 mV 22 mV	
1020 V	1 kHz 8 kHz	35 mV 63 mV	
AC Voltage – Measure[3]			
Up to 2.2 mV	(1 to 10) Hz (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 (0.5 to 1) MHz	0.64 mV/V + 14 µV 1.3 mV/V + 1.0 µV 0.58 mV/V + 1.0 µV 0.34 mV/V + 1.0 µV 0.63 mV/V + 1.6 µV 0.94 mV/V + 2.5 µV 1.8 mV/V + 3.1 µV 1.9 mV/V + 6.2 µV 2.7 mV/V + 6.2 µV	Fluke 8508A, Fluke 5790A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(2.2 to 7) mV	(1 to 10) Hz (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 (0.5 to 1) MHz	0.64 mV/V + 14 µV 0.66 mV/V + 1.0 µV 0.29 mV/V + 1.0 µV 0.17 mV/V + 1.0 µV 0.31 mV/V + 1.6 µV 0.47 mV/V + 2.5 µV 0.95 mV/V + 3.1 µV 1.0 mV/V + 6.2 µV 1.6 mV/V + 6.2 µV	Fluke 8508A, Fluke 5790A
(7 to 22) mV	(1 to 10) Hz (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 (0.5 to 1) MHz	0.64 mV/V + 14 µV 0.23 mV/V + 1.0 µV 0.16 mV/V + 1.0 µV 94 µV/V + 1.0 µV 0.17 mV/V + 1.6 µV 0.25 mV/V + 2.5 µV 0.65 mV/V + 3.1 µV 0.73 mV/V + 6.2 µV 1.4 mV/V + 6.2 µV	
(22 to 70) mV	(1 to 10) Hz (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 (0.5 to 1) MHz	0.64 mV/V + 14 µV 0.19 mV/V + 1.0 µV 0.10 mV/V + 1.0 µV 60 µV/V + 1.0 µV 0.11 mV/V + 1.6 µV 0.22 mV/V + 2.5 µV 0.42 mV/V + 3.1 µV 0.56 mV/V + 6.2 µV 0.90 mV/V + 6.2 µV	
(70 to 220) mV	(1 to 10) Hz (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 (0.5 to 1) MHz	0.64 mV/V + 14 µV 0.17 mV/V + 1.0 µV 72 µV/V + 1.0 µV 33 µV/V + 1.0 µV 59 µV/V + 1.6 µV 0.13 mV/V + 2.5 µV 0.21 mV/V + 3.1 µV 0.31 mV/V + 6.2 µV 0.80 mV/V + 6.2 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(220 to 700) mV	(1 to 10) Hz (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 (0.5 to 1) MHz	0.93 mV/V + 0.12 mV 0.16 mV/V + 1.0 µV 62 µV/V + 1.0 µV 27 µV/V + 1.0 µV 40 µV/V + 1.6 µV 63 µV/V + 2.5 µV 0.14 mV/V + 3.1 µV 0.23 mV/V + 6.2 µV 0.75 mV/V + 6.2 µV	Fluke 8508A, Fluke 5790A
(0.7 to 2.2) V	(1 to 10) Hz (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 (0.5 to 1) MHz	0.93 mV/V + 0.12 mV 0.16 mV/V 55 µV/V 20 µV/V 36 µV/V 56 µV/V 0.13 mV/V 0.20 mV/V 0.70 mV/V	
(2.2 to 7) V	(1 to 10) Hz (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 (0.5 to 1) MHz	0.69 mV/V + 1.2 mV 0.16 mV/V 56 µV/V 20 µV/V 39 µV/V 65 µV/V 0.15 mV/V 0.31 mV/V 0.93 mV/V	
(7 to 22) V	(1 to 10) Hz (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 (0.5 to 1) MHz	0.69 mV/V + 1.2 mV 0.16 mV/V 56 µV/V 23 µV/V 42 µV/V 67 µV/V 0.15 mV/V 0.31 mV/V 0.93 mV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(22 to 70) V	(1 to 10) Hz (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 (0.5 to 1) MHz	0.82 mV/V + 12 mV 0.16 mV/V 56 µV/V 26 µV/V 45 µV/V 74 µV/V 0.16 mV/V 0.32 mV/V 0.93 mV/V	Fluke 8508A, Fluke 5790A
(70 to 220) V	(1 to 10) Hz (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 (0.5 to 1) MHz	0.82 mV/V + 12 mV 0.16 mV/V 57 µV/V 26 µV/V 54 µV/V 78 µV/V 0.16 mV/V 0.39 mV/V 10 mV/V + 2.0 mV	
(220 to 700) V	(1 to 10) Hz (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.15 mV/V + 70 mV 0.16 mV/V 78 µV/V 34 µV/V 0.10 mV/V 0.39 mV/V	
(700 to 1050) V	(1 to 10) Hz (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.15 mV/V + 70 mV 0.16 mV/V 79 µV/V 35 µV/V 0.10 mV/V 0.39 mV/V	Fluke 5790A wideband
Wideband Up to 2.2 mV	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.61 mV/V + 0.78 µV 0.97 mV/V + 0.78 µV 1.6 mV/V + 0.78 µV 2.9 mV/V + 0.78 µV 5.8 mV/V + 0.78 µV	Note: uncertainty of wideband is for flatness relative to 1 kHz

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
Wideband			
(2.2 to 7) mV	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.58 mV/V + 0.78 µV 0.71 mV/V + 0.78 µV 1.1 mV/V + 0.78 µV 2.2 mV/V + 0.78 µV 3.4 mV/V + 0.78 µV	Fluke 5790A wideband Note: uncertainty of wideband is for flatness relative to 1 kHz
(7 to 22) mV	(0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.58 mV/V 0.71 mV/V 1.1 mV/V 2.2 mV/V 3.4 mV/V	
(22 to 70) mV	(0.5 to 1) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.45 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.3 mV/V	
(70 to 220) mV	(0.5 to 1) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.3 mV/V	
(220 to 700) mV	(0.5 to 1) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.60 mV/V 1.1 mV/V 2.1 mV/V 3.2 mV/V	
(0.7 to 2.2) V	(0.5 to 1) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.59 mV/V 1.1 mV/V 2.1 mV/V 3.2 mV/V	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
Wideband			
(2.2 to 7) V	(0.5 to 1) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.43 mV/V 0.59 mV/V 1.1 mV/V 1.2 mV/V 2.7 mV/V	Fluke 5790A wideband Note: uncertainty of wideband is for flatness relative to 1 kHz
AC Voltage – Generate[3]			
(0.2 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 (0.5 to 1) MHz	0.79 mV/V + 4.0 µV 0.76 mV/V + 4.0 µV 0.81 mV/V + 4.0 µV 1.1 mV/V + 4.0 µV 1.4 mV/V + 5.0 µV 2.3 mV/V + 10 µV 3.3 mV/V + 20 µV 5.0 mV/V + 20 µV	Fluke 5720A
(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 (0.5 to 1) MHz	0.25 mV/V + 4.0 µV 0.12 mV/V + 4.0 µV 0.11 mV/V + 4.0 µV 0.25 mV/V + 4.0 µV 0.54 mV/V + 5.0 µV 1.1 mV/V + 10 µV 1.4 mV/V + 20 µV 2.8 mV/V + 20 µV	
(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 (0.5 to 1) MHz	0.38 mV/V + 12 µV 92 µV/V + 7.0 µV 81 µV/V + 7.0 µV 0.20 mV/V + 7.0 µV 0.47 mV/V + 17 µV 0.87 mV/V + 20 µV 1.3 mV/V + 25 µV 2.6 mV/V + 45 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate[3] (cont)			
(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 (0.5 to 1) MHz	0.52 mV/V + 40 µV 88 µV/V + 15 µV 46 µV/V + 8.0 µV 77 µV/V + 10 µV 0.14 mV/V + 30 µV 0.44 mV/V + 80 µV 0.94 mV/V + 0.20 mV 1.6 mV/V + 0.30 mV	Fluke 5720A
(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 (0.5 to 1) MHz	0.39 mV/V + 0.40 mV 93 µV/V + 0.15 mV 46 µV/V + 50 µV 77 µV/V + 0.10 mV 0.10 mV/V + 0.20 mV 0.27 mV/V + 0.60 mV 0.94 mV/V + 2.0 mV 1.6 mV/V + 3.2 mV	
(22 to 220) 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 (0.5 to 1) MHz	0.46 mV/V + 4.0 mV 88 µV/V + 1.5 mV 55 µV/V + 0.60 mV 0.11 mV/V + 1.0 mV 0.18 mV/V + 2.5 mV 0.95 mV/V + 16 mV 4.2 mV/V + 40 mV 8.6 mV/V + 80m V	
(220 to 250) V	(15 to 50) Hz	0.28 mV/V + 16 mV	
(220 to 1100) V	(0.05 to 1) kHz	72 µV/V + 3.5 mV	
(0.22 to 1.1) kV	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	77 µV/V + 3.5 mV 0.11 mV/V + 4.7 mV 0.32 mV/V + 8.5 mV	Fluke 5720/5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.34 mV/V + 8.5 mV 1.1 mV/V + 35 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate[3] (cont)			
Wideband Option: Absolute			
Up to 1.1 mV	30 Hz to 500 kHz	6.4 mV/V + 1.6 µV	Fluke 5700-3 wideband
(1.1 to 3) mV	30 Hz to 500 kHz	5.5 mV/V + 2.3 µV	
(3 to 11) mV	30 Hz to 500 kHz	5.5 mV/V + 6.2 µV	
(11 to 33) mV	30 Hz to 500 kHz	4.7 mV/V + 12 µV	
(33 to 110) mV	30 Hz to 500 kHz	4.7 mV/V + 31 µV	
(110 to 300) mV	30 Hz to 500 kHz	3.9 mV/V + 78 µV	
330 mV to 1.1 V	30 Hz to 500 kHz	3.9 mV/V + 0.31 mV	
(1.1 to 3.5) V	30 Hz to 500 kHz	3.1 mV/V + 0.39 mV	
Wideband Option: Flatness			
Up to 1.1 mV	(10 to 30) Hz	2.4 mV/V	
	30 Hz to 120 kHz	0.98 mV/V	
	(0.12 to 2) MHz	2.2 mV/V + 2.3 µV	
	(2 to 10) MHz	3.7 mV/V + 2.3 µV	
	(10 to 20) MHz	5.5 mV/V + 2.3 µV	
	(20 to 30) MHz	13 mV/V + 12 µV	
(1.1 to 3) mV	(10 to 30) Hz	2.4 mV/V	
	30 Hz to 120 kHz	0.94 mV/V	
	(0.12 to 2) MHz	1.3 mV/V + 2.3 µV	
	(2 to 10) MHz	2.2 mV/V + 2.3 µV	
	(10 to 20) MHz	4.9 mV/V + 2.3 µV	
	(20 to 30) MHz	13 mV/V + 2.3 µV	
(3 to 11) mV	(10 to 30) Hz	2.4 mV/V	
	30 Hz to 120 kHz	0.94 mV/V	
	(0.12 to 2) MHz	1.1 mV/V + 2.3 µV	
	(2 to 10) MHz	2 mV/V + 2.3 µV	
	(10 to 20) MHz	3.9 mV/V + 2.3 µV	
	(20 to 30) MHz	8.6 mV/V + 2.3 µV	
(11 to 33) mV	(10 to 30) Hz	2.4 mV/V	
	30 Hz to 120 kHz	0.91 mV/V	
	(0.12 to 2) MHz	1 mV/V + 2.3 µV	
	(2 to 10) MHz	2 mV/V + 2.3 µV	
	(10 to 20) MHz	3.8 mV/V + 2.3 µV	
	(20 to 30) MHz	8.5 mV/V + 2.3 µV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate[3] (cont)			
Wideband Option: Flatness			
(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	Fluke 5700-3 wideband
(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	
330 mV to 1.1 V	(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	
(1.1 to 3.5) V	(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	
AC Voltage – Measure[3]			
Up to 200 mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.35 mV/V+ 14 µV 0.16 mV/V + 4.0 µV 0.12 mV/V + 4.0 µV 0.12 mV/V + 2.0 µV 0.14 mV/V + 4.0 µV 0.35 mV/V + 8.0 µV 0.77 mV/V + 20 µV	Fluke 8508A opt 01

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure[3] (cont)			
(0.2 to 2) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.50 mV/V + 0.12 mV 0.12 mV/V + 20 µV 0.11 mV/V + 20 µV 79 µV/V + 20 µV 0.11 mV/V + 20 µV 0.23 mV/V + 40 µV 0.59 mV/V + 0.20 mV 3 mV/V + 2.0 mV 10 mV/V + 20 mV	Fluke 8508A opt 01
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.36 mV/V + 1.2 mV 0.13 mV/V + 0.20 mV 95 µV/V + 0.20 mV 85 µV/V + 0.20 mV 0.11 mV/V + 0.20 mV 0.22 mV/V + 0.40 mV 0.58 mV/V + 2.0 mV 3.0 mV/V + 20 mV 10 mV/V + 0.20 V	
(20 to 200) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.43 mV/V + 12 mV 0.13 mV/V + 2.0 mV 98 µV/V + 2.0 mV 83 µV/V + 2.0 mV 0.12 mV/V + 2.0 mV 0.22 mV/V + 4.0 mV 0.58 mV/V + 20 mV 1.6 mV/V + 0.20 V 5.2 mV/V + 2.0 V	
(0.10 to 1.05) kV	(1 to 10) Hz (10 to 40) Hz (0.01 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.50 mV/V + 10 mV 0.13 mV/V + 20 mV 0.13 mV/V + 20 mV 0.38 mV/V + 40 mV 0.66 mV/V + 0.20 V	
Up to 85 kV	60 Hz	14 mV/V	Ross 120 kV divider

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC/DC Difference –			
Fixed Points @ 2 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.049 % 0.048 % 0.048 % 0.050 % 0.050 % 0.048 % 0.049 % 0.047 % 0.064 % 0.079 % 0.093 % 0.11 % 0.11 %	Fluke 5720A w/ 792A and 8508A
Fixed Points @ 6 mV	10 Hz 20 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 1 MHz	0.033 % 0.033 % 0.025 % 0.025 % 0.025 % 0.025 % 0.033 % 0.044 % 0.063 % 0.074 % 0.092 %	
Fixed Points @ 10 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.013 % 0.011 % 0.012 % 0.011 % 0.011 % 0.012 % 0.011 % 0.013 % 0.022 % 0.033 % 0.043 % 0.049 % 0.055 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC/DC Difference – (cont)			
Fixed Points @ 20 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.015 % 0.013 % 0.012 % 0.010 % 0.010 % 0.010 % 0.010 % 0.012 % 0.022 % 0.034 % 0.047 % 0.057 % 0.056 %	Fluke 5720A w/792A and 8508A
Fixed Points @ 60 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.0063 % 0.0055 % 0.0048 % 0.0040 % 0.0025 % 0.0025 % 0.0037 % 0.0037 % 0.0061 % 0.012 % 0.018 % 0.028 % 0.028 %	
Fixed Points @ 200 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.0040 % 0.0032 % 0.0019 % 0.0018 % 0.0018 % 0.0019 % 0.0020 % 0.0031 % 0.0061 % 0.011 % 0.017 % 0.025 % 0.028 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC/DC Difference – (cont)			
Fixed Points @ 600 mV	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.0039 % 0.0028 % 0.0026 % 0.0011 % 0.00093 % 0.00093 % 0.0011 % 0.0011 % 0.0018 % 0.0039 % 0.0046 % 0.0086 % 0.0094 %	Fluke 5720A w/ 792A and 8508A
Fixed Points @ 1 V & 2 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.0039 % 0.0031 % 0.0026 % 0.0011 % 0.0008 % 0.0013 % 0.0015 % 0.0016 % 0.0018 % 0.0031 % 0.0042 % 0.0053 % 0.0067 %	
Fixed Points @ 6 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.0039 % 0.0031 % 0.0026 % 0.0011 % 0.00077 % 0.00082 % 0.00083 % 0.0011 % 0.0011 % 0.0032 % 0.0043 % 0.0047 % 0.0065 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC/DC Difference – (cont)			
Fixed Points @ 10 V & 20 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	0.0039 % 0.0031 % 0.0026 % 0.0011 % 0.00092 % 0.00094 % 0.00094 % 0.0011 % 0.0015 % 0.0031 % 0.0040 % 0.0054 % 0.0063 %	Fluke 5720A w/ 792A and 8508A
Fixed Points @ 60 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz	0.0038 % 0.0031 % 0.0028 % 0.0011 % 0.00093 % 0.00093 % 0.00095 % 0.0013 % 0.0016 % 0.0047 %	
Fixed Points @ 100 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	0.0039 % 0.0031 % 0.0028 % 0.0011 % 0.00093 % 0.0010 % 0.0011 % 0.0014 % 0.0025 %	
Fixed Points @ 200 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	0.0056 % 0.0032 % 0.0029 % 0.0014 % 0.0012 % 0.0012 % 0.0012 % 0.0016 % 0.0025 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC/DC Difference – (cont)			
Fixed Points @ 600 V	10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz	0.0062 % 0.0032 % 0.0029 % 0.0016 % 0.0013 % 0.0013 % 0.0013 % 0.0020 % 0.0047 %	Fluke 5720A w/ 792A and 8508A
Fixed Points @ 1000 V	40 Hz 100 Hz 1 kHz 10 kHz 20 kHz	0.0032 % 0.0029 % 0.0026 % 0.0026 % 0.0028 %	
AC Current – Generate[3]			
(0 to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.042 % + 16 nA 0.023 % + 10 nA 0.021 % + 8 nA 0.032 % + 12 nA 0.10 % + 65 nA	Fluke 5720A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.044 % + 40 nA 0.033 % + 35 nA 0.031 % + 35 nA 0.035 % + 0.11 µA 0.10 % + 0.65 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.035 % + 0.40 µA 0.017 % + 0.35 µA 0.013 % + 0.35 µA 0.020 % + 0.55 µA 0.10 % + 5.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.036 % + 4.0 µA 0.017 % + 3.5 µA 0.013 % + 2.5 µA 0.020 % + 3.5 µA 0.10 % + 10 µA	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Generate[3]			
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % + 35 µA 0.047 % + 80 µA 0.63 % + 160 mA	Fluke 5720A
(2.2 to 11) A	40 Hz to 1 kHz (0.1 to 1) kHz (1 to 5) kHz	0.37 mA/A + 0.17 mA 0.76 mA/A + 0.17 mA 2.8 mA/A + 0.17 mA	Fluke 5720A/5725A
(1.1 to 3) A	(10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 0.08 mA 0.048 % + 0.08 mA 0.47 % + 0.08 mA 2.0 % + 4.0 mA	Fluke 5520A
(3 to 11) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.047 % + 1.6 mA 0.078 % + 1.6 mA 2.3 % + 1.6 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.093 % + 4.0 mA 0.12 % + 4.0 mA 2.3 % + 4.0 mA	
Toroidal Type Clamps			
(16.5 to 150) A	(45 to 65) Hz (65 to 440) Hz	0.31 % 0.81 %	Fluke 5520A w/coil
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.33 % 0.82 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure[3]			
Up to 200 µA	(1 to 10) Hz (0.10 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 24 nA 0.038 % + 24 nA 0.072 % + 24 nA 0.34 % + 24 nA	Fluke 8508A opt 01
(0.2 to 2) mA	(1 to 10) Hz (0.10 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 0.24 µA 0.034 % + 0.24 µA 0.074 % + 0.24 µA 0.34 % + 0.24 µA	
(2 to 20) mA	(1 to 10) Hz (0.10 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 2.4 µA 0.033 % + 2.4 µA 0.069 % + 2.4 µA 0.41 % + 2.4 µA	
(20 to 200) mA	(1 to 10) Hz (10 to 30) kHz (30 to 100) kHz	0.032 % + 24 µA 0.031 % + 24 µA 0.074 % + 24 µA	
(0.2 to 2) A	(10 to 20) Hz (45 to 100) Hz (0.1 to 5) kHz	0.062 % + 0.24 mA 0.075 % + 0.24 mA 0.25 % + 0.24 mA	
(2 to 20 A)	10 Hz to 2 kHz (2 to 10) kHz	0.078 % + 2.4 mA 0.28 % + 2.4 mA	
Up to 20 A	50 Hz to 1 kHz (1 to 5) kHz	0.31 mA/A 0.44 mA/A	HP 3458A w/ Fluke Y5020

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure and Generate[3]			
33 µA	(1 to <10) kHz (10 to <30) kHz 30 kHz	5.0 nA 5.1 nA 7.5 nA	Fluke 5790A w/ metal film resistors
190 µA	45 Hz to 10 kHz (>10 to 30) kHz	18 nA 22 nA	
200 µA	(10 to 40) Hz	26 nA	
329 µA	10 Hz 45 Hz to 10 kHz 30 kHz	76 nA 40 nA 26 nA	
1.9 mA	(1 to 20) kHz 30 kHz	0.19 µA 0.28 µA	
2.0 mA	(10 to 40) Hz	16 µA	
3.29 mA	10 Hz 45 Hz to 5 kHz (10 to 30) kHz	0.77 µA 0.40 µA 0.54 µA	
Up to 33 µA	(1 to 30) kHz	0.86 mA/A	Fluke 5790A characterized w/ 5790A and AC shunts
(33 to 200) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 10 kHz	82 µA/A 52 µA/A 49 µA/A	
(200 to 329.99) µA	10 Hz to 10 kHz (10 to 30) kHz	0.25 mA/A 0.34 mA/A	
300 µA	(1 to 30) kHz	0.29 mA/A	
(0.33 to 2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz	77 µA/A 69 µA/A 86 µA/A 0.16 mA/A	
(2 to 3.29) mA	(10 to 40) Hz 40 Hz to 10 kHz	0.21 mA/A 0.15 mA/A	
3.3 mA	(1 to 30) kHz	0.15 mA/A	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure and Generate[3] (cont)			
(3.3 to 20) mA	(10 to 40) Hz (20 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz	64 µA/A 57 µA/A 58 µA/A 65 µA/A	Fluke 5790A characterized w/ 5790A and AC shunts
(5 to 26) mA	(30 to 50) kHz	94 µA/A	
(20 to 32.9) mA	(10 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 30) kHz	65 µA/A 65 µA/A 66 µA/A 0.23 mA/A	
33 mA	(1 to 30) kHz	0.14 mA/A	
(33 to 200) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz	69 µA/A 57 µA/A 56 µA/A 0.33 mA/A	
(50 to 260) mA	(30 to 50) kHz	97 µA/A	
(200 to 329.99) mA	(10 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 30) kHz	0.10 mA/A 83 µA/A 70 µA/A 0.20 mA/A	
330 mA	(1 to 30) kHz	0.13 mA/A	
(125 to 650) mA	(30 to 50) kHz	0.10 mA/A	
(0.33 to 2) A	(10 to 40) Hz 40 Hz to 10 kHz	70 µA/A 68 µA/A	
(0.5 to 2.6) A	(10 to 20) kHz (20 to 50) kHz	68 µA/A 0.15 mA/A	
(2 to 2.99999) A	(10 to 45) Hz 45 Hz to 5 kHz (5 to 10) kHz	0.12 mA/A 0.18 mA/A 0.33 mA/A	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure and Generate[3] (cont)			
3.3 mA	500 Hz to 5 kHz	0.17 mA/A	Fluke 5790A characterized w/ 5790A and AC shunts
(1.25 to 6) A	(5 to 20) kHz (20 to 50) kHz	73 µA/A 0.13 mA/A	
(3.3 to 10.9999) A	(10 to 500) Hz (0.5 to 1) kHz (1 to 5) kHz	0.13 mA/A 0.16 mA/A 0.37 mA/A	
(2.5 to 13) A	(5 to 20) kHz (20 to 50) kHz	82 µA/A 0.15 mA/A	
(10.9999 to 20.5) A	(10 to 500) Hz (0.5 to 1) kHz (1 to 5) kHz	0.19 mA/A 0.20 mA/A 0.49 mA/A	
(5 to 20) A	(5 to 20) kHz (20 to 50) kHz	0.18 mA/A 0.24 mA/A	
(20 to 30) A (30 to 50) A (50 to 80) A	60 Hz 60 Hz 60 Hz	0.32 mA/A 0.25 mA/A 0.25 mA/A	Holt HCS-1 w/ Fluke 5790A

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
AC Resistance – Measure[3]	10 Ω to 100 kΩ, 12 Hz to 100 kHz	0.027 %	GenRad 1689M

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
AC Power – Generate[3] @ (45 to 65) Hz: PF=1			
(33 to 330) mV	Up to 0.003 W (0.0003 to 0.01) W (0.001 to 0.03) W (0.003 to 0.10) W (0.010 to 0.30) W (0.030 to 0.7) W (0.07 to 1.5) W (0.15 to 6.7) W	0.11 % 0.14 % 0.11 % 0.15 % 0.10 % 0.11 % 0.11 % 0.10 %	Fluke 5520A
(0.33 to 1020) V	(0.001 to 9.2) W (0.003 to 33.7) W (0.01 to 91.8) W (0.3 to 336.7) W (0.1 to 918) W 0.3 W to 2.2 kW 0.7 W to 4.6 kW 1.5 W to 20.9 kW	0.93 % 0.62 % 0.93 % 0.65 % 0.86 % 0.83 % 0.98 % 0.78 %	
Inductance – Generate[3]			
100 µH 1 mH 10 mH 100 mH, 500 mH 1 H 5 H 10 H	(0.1 & 1) kHz (0.1 & 1) kHz (0.1 & 1) kHz (0.1 & 1) kHz (0.1 & 1) kHz (0.1 & 1) kHz 100 Hz	0.1 µH 0.32 µH 4.6 µH 0.1 mH 0.6 mH 5.2 mH 7.6 mH	GenRad 1482 Series
Inductance – Measure[3]			
100 µH to 10 H	12 Hz to 100 kHz	0.27 mH/H	Gen Rad 1689M

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance – Measure[3]			
0.1 pF to 1 pF	12 Hz to 100 kHz	0.63 mF/F	Gen Rad 1689M,
1 pF to 1 mF	12 Hz to 100 kHz	0.22 mF/F	
Up to 10 pF	1 kHz	6.9 µF/F	Andeen Hagerling 2500A
(10 to 100) pF	1 kHz	6.0 µF/F	
100 pF to 1 nF	1 kHz	7.1 µF/F	
Up to 329.999 µF	DC	0.24 mF/F	Fluke 8508A w/ 5720A
(0.33 to 1.09999) mF	DC	0.14 mF/F	
(1.1 to 3.29999) mF	DC	0.12 mF/F	
(3.3 to 10.9999) mF	DC	0.13 mF/F	
(11 to 32.9999) mF	DC	0.16 mF/F	
(33 to 110) mF	DC	0.32 mF/F	
Capacitance – Generate[3]			
(190 to 400) pF	10 Hz to 10 kHz	4.0 mF/F + 7.8 pF	Fluke 5520A
400 pF to 1.1 nF	10 Hz to 10 kHz	4.0 mF/F + 7.8 pF	
(1.1 to 3.3) nF	10 Hz to 3 kHz	4.0 mF/F + 7.8 pF	
(3.3 to 11) nF	10 Hz to 1 kHz	2.3 mF/F + 7.8 pF	
(11 to 33) nF	10 Hz to 1 kHz	2.3 mF/F + 78 pF	
(33 to 110) nF	10 Hz to 1 kHz	2.3 mF/F + 78 pF	
(110 to 330) nF	10 Hz to 1 kHz	2.3 mF/F + 230 pF	
330 nF to 1.1 µF	(10 to 600) Hz	2.3 mF/F + 0.78 nF	
(1.1 to 3.3) µF	(10 to 300) Hz	2.3 mF/F + 2.3 nF	
(3.3 to 11) µF	(10 to 150) Hz	2.3 mF/F + 7.8 nF	
(11 to 33) µF	(10 to 120) Hz	3.2 mF/F + 23 nF	
(33 to 110) µF	(10 to 80) Hz	3.7 mF/F + 77 nF	
(110 to 330) µF	Up to 50 Hz	3.7 mF/F + 0.23 µF	
330 µF to 1.1 mF	Up to 20 Hz	3.5 mF/F + 0.78 µF	
(1.1 to 3.3) mF	Up to 6 Hz	3.5 mF/F + 2.3 µF	
(3.3 to 11) mF	Up to 2 Hz	3.5 mF/F + 7.7 µF	
(11 to 33) mF	Up to 0.6 Hz	5.8 mF/F + 23 µF	
(33 to 110) mF	Up to 0.2 Hz	8.5 mF/F + 77 µF	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance – Generate[3] Fixed Points			
1 pF	(0.1 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	0.072 % 0.071 % 0.074 % 0.082 % 0.095 % 0.11 % 0.26 % 0.38 %	HP 1638XX capacitance set
10 pF	(0.1 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	0.072 % 0.071 % 0.071 % 0.071 % 0.071 % 0.071 % 0.072 % 0.072 %	
100 pF	(0.1 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	0.072 % 0.071 % 0.071 % 0.071 % 0.071 % 0.072 % 0.078 % 0.078 %	
1000 pF	(0.1 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	0.072 % 0.071 % 0.072 % 0.076 % 0.083 % 0.094 % 0.20 % 0.29 %	
(10, 100) nF	(100 to 120) Hz 120 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	0.020 % 0.020 % 0.020 % 0.020 %	
1 µF	(100 to 120) Hz 120 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	0.020 % 0.020 % 0.020 % 0.020 %	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
Capacitance – Generate[3] (cont), Fixed Points			
10 pF	(0.1 to 1) kHz	0.072 %	HP 1638XX capacitance set
	1 kHz to 1 MHz	0.071 %	
	(1 to 2) MHz	0.071 %	
	(2 to 3) MHz	0.071 %	
	(3 to 4) MHz	0.071 %	
	(4 to 5) MHz	0.071 %	
	(5 to 10) MHz	0.072 %	
	(10 to 13) MHz	0.072 %	
100 pF	(0.1 to 1) kHz	0.072 %	
	1 kHz to 1 MHz	0.071 %	
	(1 to 2) MHz	0.071 %	
	(2 to 3) MHz	0.071 %	
	(3 to 4) MHz	0.071 %	
	(4 to 5) MHz	0.072 %	
	(5 to 10) MHz	0.078 %	
	(10 to 13) MHz	0.078 %	
1000 pF	(0.1 to 1) kHz	0.072 %	
	1 kHz to 1 MHz	0.071 %	
	(1 to 2) MHz	0.072 %	
	(2 to 3) MHz	0.076 %	
	(3 to 4) MHz	0.083 %	
	(4 to 5) MHz	0.094 %	
	(5 to 10) MHz	0.20 %	
	(10 to 13) MHz	0.29 %	
(10, 100) nF	(100 to 120) Hz	0.020 %	
	120 Hz to 1 kHz	0.020 %	
	(1 to 10) kHz	0.020 %	
	(10 to 100) kHz	0.020 %	
1 µF	(100 to 120) Hz	0.020 %	
	120 Hz to 1 kHz	0.020 %	
	(1 to 10) kHz	0.020 %	
	(10 to 100) kHz	0.020 %	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Simulation and Measurement of Thermocouple[3] –			
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 5520A
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	
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	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of Thermocouple Indicators[3] – (cont)			
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	Fluke 5520A
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	
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 5520A
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 0.089 °C 0.095 °C 0.17 °C 0.21 °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 (600 to 630) °C	0.060 °C 0.068 °C 0.070 °C 0.077 °C 0.077 °C 0.084 °C 0.090 °C 0.13 °C 0.19 °C	

Parameter/Equipment	Range	CMC[2, 4, 6] (±)	Comments
Electrical Calibration of RTDs[3] – (cont)			
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.044 °C 0.051 °C 0.098 °C 0.11 °C 0.11 °C 0.13 °C	Fluke 5520A
Pt 385, 500 Ω	(-200 to 80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C	0.036 °C 0.044 °C 0.051 °C 0.066 °C 0.073 °C 0.088 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.029 °C 0.036 °C 0.042 °C 0.050 °C 0.18 °C 0.057 °C 0.18 °C	
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.081 °C 0.11 °C 0.11 °C	
Cu 427, 10 Ω	(100 to 260) °C	0.69 °C	
Oscilloscopes –			
Amplitude DC Signal[3] –			
50 Ω Load	(-6.6 to 6.6) V	1.9 mV/V + 31 µV	Fluke 5520A/SC1100
1 MΩ Load	(-130 to 130) V	0.39 mV/V + 31 µV	
Amplitude Square wave[3] –			
50 Ω Load	±1 mV to ±6.6 V $_{p-p}$ 10 Hz to 10 kHz	2 mV/V + 31 µV	
1 MΩ Load	±1 mV to ±130 V $_{p-p}$ 10 Hz to 1 kHz	0.78 mV/V + 31 µV	

Parameter/Equipment	Range	CMC[2, 4, 6] (±)	Comments
Oscilloscopes – (cont)			
Edge/Rise Time[3]	1 kHz to 2 MHz (200 to 300) ps	19 ps	Fluke 5520A/SC1100
	(2 to 10) MHz (200 to 350) ps	16 ps	
Time Marker Into 50 Ω Load-Source[3]	1 ns to 20 ms 50 ms to 5 s	2.1 µs/s (19 + 39*t*) µs/s	*t* = time
	Non-Cardinal Points Any 20 ms or less	39 µs/s	
Leveled Sine Wave[3] Relative to 50 kHz [5 mV to 5.5 V] $_{p\text{-}p}$	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	17 mV/V + 100 µV 20 mV/V + 100 µV 34 mV/V + 100 µV 41 mV/V + 100 µV	
Sine Wave Flatness[3] Absolute Power			
(10 to 100) mV 100 mV to 5.5 V	50 kHz to 6 GHz 50 kHz to 6 GHz	4.2 % 2.6 %	Agilent E4418B and E9304A, Fluke 5790A
Sine Wave Flatness[3] Relative Power			
(5 to 40) mV (5 to 40) mV 40 mV to 5.5 V 40 mV to 5.5 V	(50 to 100) MHz 100 MHz to 1 GHz (50 to 100) MHz 100 MHz to 1 GHz	2.6 % 4.2 % 2.5 % 4.2 %	
Rise Time – Measure	16.8 ps to 1.2 ns Positive/Negative	5.2 ps	Tek TDS 8200 w/80E03
Leveled Sine Wave – Harmonic Amplitude	(-30 to -80) dBm 100 kHz to 5 GHz	2.3 dB	HP 8563E

Parameter/Equipment	Range	CMC[2, 4, 6] (±)	Comments
AC Level Flatness[3] –			
Up to 3 V	Up to 100 Hz 100 Hz 10 kHz (0.1 to 30) kHz 100 kHz 300 kHz (0.03 to 1) MHz 3 MHz 8 MHz (1 to 10) MHz 20 MHz (10 to 30) MHz (30 to 50) MHz 70 MHz 80 MHz (50 to 100) MHz	0.063 % 0.052 % 0.049 % 0.052 % 0.083 % 0.081 % 0.084 % 0.2 % 0.21 % 0.21 % 0.58 % 0.59 % 1.3 % 2.9 % 2.9 % 2.9 %	Thermal converters w/HP 3458A opt 002 w/Fluke 5720A
Up to 1 V	Up to 100 Hz 100 Hz (0.1 to 10) kHz 30 kHz (10 to 100) kHz 300 kHz (0.1 to 1) MHz 3 MHz 8 MHz 10 MHz 20 MHz 30 MHz (1 to 50) MHz 70 MHz (50 to 80) MHz (80 to 100) MHz	0.2 % 0.057 % 0.055 % 0.073 % 0.073 % 0.11 % 0.11 % 0.21 % 0.22 % 0.22 % 0.22 % 0.23 % 0.29 % 0.45 % 0.49 % 0.61 %	

Parameter/Equipment	Range	CMC[2, 4, 6] (±)	Comments
AC Level Flatness[3] – (cont)			
Up to 0.5 V	Up to 100 Hz 100 Hz (0.1 to 10) kHz 30 kHz (10 to 100) kHz 300 kHz (0.1 to 1) MHz 3 MHz 8 MHz 10 MHz 20 MHz (1 to 30) MHz (30 to 50) MHz 70 MHz 80 MHz (50 to 100) MHz	0.2 % 0.057 % 0.054 % 0.073 % 0.073 % 0.11 % 0.11 % 0.21 % 0.22 % 0.22 % 0.22 % 0.23 % 1.3 % 2.9 % 2.9 % 2.9 %	Thermal converters w/HP 3458A opt 002 w/Fluke 5720A
Phase – Measure			
(0 to 360)° (10 to 20) mV	(5 to 10) Hz 10 Hz to 50 kHz (50 to 100) kHz	0.46° 0.12° 2.1 m° / kHz + 0.12°	Clarke-Hess 6000
>20 mV to 350 V	(5 to 10) Hz 10 Hz to 50 kHz (50 to 100) kHz	0.23° 63 m° 1.2 m° / kHz + 58 m°	
± 180 ° (10 to 20) mV	(5 to 10) Hz 10 Hz to 50 kHz (50 to 100) kHz	0.46° 0.23° 2.1 m° / kHz + 0.12°	
>20 mV to 350 V	(5 to 10) Hz 10 Hz to 50 kHz (50 to 100) kHz	0.23° 61 m° 1.2 m° / kHz + 58 m°	

V. Electrical – RF / Microwave

Parameter/Range	Frequency	CMC[2, 9] (±)	Comments
RF Attenuation – Tuned RF Power Measure[3]			
(0.0 to -10) dBm	100 kHz to 26.5 GHz	0.020 dB	HP 8902A,
(-10 to -20) dBm		0.050 dB	HP 11722A,
(-20 to -30) dBm		0.070 dB	HP 11792A,
(-30 to -40) dBm		0.11 dB	HP 11793A
(-40 to -50) dBm		0.13 dB	
(-50 to -60) dBm		0.15 dB	
(-60 to -70) dBm		0.19 dB	
(-70 to -80) dBm		0.22 dB	
(-80 to -90) dBm		0.24 dB	
(-90 to -100) dBm		0.26 dB	
(-100 to -110) dBm		0.31 dB	
(-110 to -120) dBm		0.37 dB	
RF Power – Generate[3]			
(13.52 to 23.98) dBm	0.001 Hz to 20 MHz	0.37 dB	HP 3325AB
(-56 to +13.52) dBm	0.001 Hz to 100 kHz	0.39 dB	
(-56 to +13.52) dBm	100 kHz to 10 MHz	0.43 dB	
(-16.02 to +13.52) dBm	(10 to 20) MHz	0.43 dB	
(-56 to -16.02) dBm	(10 to 20) MHz	0.68 dB	
(13 to -120) dBm	100 kHz to 1.28 GHz	1.1 dB	HP 8663A
(-120 to -130) dBm		5.1 dB	
(10 to -20) dBm	(0.01 to 26.5) GHz	1.1 dB	HP 83640B
Distortion – Measure[3]			
(-80 to 0) dB	20 Hz to 20 kHz	1.2 dB	HP 8903B
(-65 to 0) dB	(20 to 100) kHz	2.4 dB	
(-73 + 20 log) N	100 Hz ≤f<10 MHz from carrier	1.8 dB	Keysight E4440A
(-80 + 20 log) N	f≥10 MHz from carrier	2.1 dB	

Parameter/Range	Frequency	CMC[2, 6, 9] (±)	Comments
RF Power – Measure[3]			
(+30 to -20) dBm	100 kHz to 2 GHz	0.083 dB	HP 8902A w/ HP 11722A and HP 11792A
	(2 to 26.5) GHz	0.14 dB	HP 8902A w/ HP 11792A and HP 11793A
Power Reference Out 1 mW	50 MHz	0.33 %	HP 478A opt H75 H77, Tegam 1830A
(+20 to -30) dBm	(0.1 to 4.2) GHz (0.05 to 26.5) GHz	2.5 % 3.8 %	HP 438A w/ HP 8482A HP 438A w/ HP 8485A
(+35 to -10) dBm	(0.01 to 18) GHz	3.9 %	HP 438A w/ HP 8481H
(-20 to -70) dBm	(0.01 to 18) GHz	4.4 %	HP 438A w/ HP 8484A
RF Attenuation – Measure[3]			
(10 to 50) dB in 10 dB steps	30 MHz	0.034 dB	HP 11812A
Phase Modulation – Measure[3]			
150 kHz to 10 MHz	200 Hz to 10 kHz	5.1 % + 1 digit	HP 8902A w/ HP 11722A
10 MHz to 26.5 GHz	200 Hz to 20 kHz	4.3 % + 1 digit	HP 8902A w/ HP 11793A

Parameter/Range	Frequency	CMC[2, 6, 9] (±)	Comments
Amplitude Modulation – Generate[3]			
Rate: 20 Hz to 100 kHz Depths: 0 % to 95 %	(11 to 13.5) MHz	0.20 %	HP 11715A
Rate: 20 Hz to 100 kHz Depths: 95 % to 99 %	(11 to 13.5) MHz	0.33 %	
Amplitude Modulation – Measure[3]			
Rate: 50 Hz to 10 kHz Depths: 5 % to 99 %	150 kHz to 10 MHz	1.6 % + 1 digit	HP 8902A w/ HP 11722A
Rate: 20 Hz to 10 kHz Depths: to 99 %	150 kHz to 10 MHz	2.4 % + 1 digit	
Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	10 MHz to 1.3 GHz	0.89 % + 1 digit	HP 8902A w/ HP 11722A w/ HP 11793A, HP 11792A
Rate: 20 Hz to 100 kHz Depths: to 99 %	10 MHz to 1.3 GHz	2.4 % + 1 digit	
Rate: 20 Hz to 100 kHz Depths: 5 % to 99 %	(1.3 to 26.5) GHz	1.3 % + 1 digit	
Rate: 20 Hz to 100 kHz Depths: to 99 %	(1.3 to 26.5) GHz	2.4 % + 1 digit	
Frequency Modulation – Generate[3]			
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	10 kHz to 432 MHz	0.39 %	HP 11715A

Parameter/Range	Frequency	CMC[2, 6, 9] (±)	Comments
Frequency Modulation – Measure[3]			
Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak	250 kHz to 10 MHz	1.6 % + 1 digit	HP 8902A w/ HP 11722A
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	10 MHz to 1.3 GHz	0.8 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	10 MHz to 1.3 GHz	3.9 % + 1 digit	
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	(1.3 to 26.5) GHz	0.79 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	(1.3 to 26.5) GHz	3.9 % + 1 digit	HP 8902A w/ HP 11792A, HP11793A
Power Sensor – Calibration Factor[3, 7]			
100 kHz to 18 GHz Power Sensor Calibration Factor – Type N	100 kHz 300 kHz 500 kHz 1 MHz 3 MHz 5 MHz 10 MHz, 30 MHz 50 MHz (100, 300, 500) MHz	0.92 % 0.89 % 0.87 % 0.86 % 0.86 % 0.86 % 0.85 % 0.86 % 0.86 %	Tegam F1130B, Tegam 1830A

Parameter/Range	Frequency	CMC[2] (±)	Comments
Power Sensor – Calibration Factor[3, 7] (cont)			
100 kHz to 18 GHz Power Sensor Calibration Factor – Type N	1 GHz 1.5 GHz (2, 3, 4) GHz (5, 6) GHz (7, 8, 9) GHz 10 GHz (11, 12, 12.4) GHz 13 GHz 14 GHz 15 GHz 16 GHz 17 GHz 18 GHz	0.86 % 0.87 % 0.86 % 0.87 % 0.93 % 0.93 % 0.95 % 0.95 % 0.94 % 0.94 % 0.95 % 0.99 % 1.1 %	Tegam F1130B, Tegam 1830A
10 MHz to 18 GHz Low Power Sensor– Type N	10 MHz 30 MHz (50, 100, 300, 500) MHz 1 GHz 1.5 GHz (2, 3, 4, 5, 6) GHz (7, 8, 9) GHz 10 GHz (11, 12, 12.4) GHz (13 to 18) GHz	1.4 % 1.4 % 1.6 % 1.6 % 1.6 % 1.6 % 1.6 % 1.6 % 1.6 % 1.8 %	Agilent E4419B, Tegam F1130B, Tegam 1830A, Weinschel 44-30, HP 8484A

Parameter/Range	Frequency	CMC[2, 9] (±)	Comments
Power Sensor- Calibration Factor[3, 7] (cont)			
10 MHz to 26.5 GHz – 3.5 mm	10 MHz 50 MHz 100 MHz (300, 500) MHz (1, 1.5, 2, 3) GHz (4, 5) GHz (6, 7, 8, 9) GHz (10, 11, 12, 12.4) GHz 13 GHz 14 GHz 15 GHz (16, 17) GHz (18, 19) GHz (20, 21) GHz 22 GHz (23, 24, 25, 26) GHz 26.5 GHz	1.8 % 1.6 % 1.6 % 1.6 % 1.6 % 1.7 % 1.8 % 2.0 % 1.9 % 2.3 % 2.2 % 2.1 % 2.6 % 2.2 % 2.1 % 2.8 % 3.2 %	Agilent E4419B, HP 8485A, Tegam 1830A, Tegam F1135B
Reflection Coefficient[3]			
$0.0 < \rho < 0.2$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.010 ρ 0.016 ρ 0.016 ρ	HP 8753D
$0.2 < \rho < 0.4$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.011 ρ 0.017 ρ 0.017 ρ	
$0.4 < \rho < 0.6$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.012 ρ 0.018 ρ 0.019 ρ	
$0.6 < \rho < 0.8$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.014 ρ 0.022 ρ 0.023 ρ	
$0.8 < \rho < 1.0$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.017 ρ 0.029 ρ 0.029 ρ	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Reflection Coefficient[3] (cont)			
0 < ρ < 0.05	(0.01 to < 8.4) GHz (8.4 to < 12.4) GHz (12.4 to < 18) GHz (18 to < 20) GHz (20 to 26.5) GHz	0.0066 ρ 0.016 ρ 0.016 ρ 0.016 ρ 0.017 ρ	HP 8757D w/85027B
0.05 < ρ < 0.1	(0.01 to < 8.4) GHz (8.4 to < 12.4) GHz (12.4 to < 18) GHz (18 to < 20) GHz (20 to 26.5) GHz	0.0049 ρ 0.015 ρ 0.015 ρ 0.015 ρ 0.016 ρ	
0.1 < ρ < 0.3	(0.01 to < 8.4) GHz (8.4 to < 12.4) GHz (12.4 to < 18) GHz (18 to < 20) GHz (20 to 26.5) GHz	0.0070 ρ 0.016 ρ 0.016 ρ 0.016 ρ 0.018 ρ	
0.3 < ρ < 0.5	(0.01 to < 8.4) GHz (8.4 to < 12.4) GHz (12.4 to < 18) GHz (18 to < 20) GHz (20 to 26.5) GHz	0.016 ρ 0.016 ρ 0.016 ρ 0.016 ρ 0.018 ρ	
0.5 < ρ < 0.75	(0.01 to < 8.4) GHz (8.4 to < 12.4) GHz (12.4 to < 18) GHz (18 to < 20) GHz (20 to 26.5) GHz	0.017 ρ 0.017 ρ 0.017 ρ 0.017 ρ 0.020 ρ	
0.75 < ρ < 1	(0.01 to < 8.4) GHz (8.4 to < 12.4) GHz (12.4 to < 18) GHz (18 to < 20) GHz (20 to 26.5) GHz	0.38 ρ 0.38 ρ 0.38 ρ 0.38 ρ 0.59 ρ	
Reflection Phase[3]			
0.0 < ρ < 1.0	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	1.4° 1.9° 1.7°	HP 8753E HP 8753D

Parameter/Range	Frequency	CMC[2] (±)	Comments
Transmission Phase[3]			
(-15 to 10) dBm	30 kHz to 1.3 GHz	(0.81 to 3.6)°	HP 8753E
(-25 to 0) dBm		(0.81 to 3.5)°	HP 8753D
(-35 to -10) dBm		(1.9 to 3.5)°	
(-45 to -20) dBm		(1.9 to 3.0)°	
(-55 to -30) dBm		(1.9 to 3.0)°	
(-65 to -40) dBm		(1.9 to 2.7)°	
(-15 to 10) dBm	(1.3 to 3) GHz	(0.5 to 3.5)°	
(-25 to 0) dBm		(0.5 to 1.5)°	
(-35 to -10) dBm		(0.74 to 2.1)°	
(-45 to -20) dBm		(0.88 to 3.2)°	
(-55 to -30) dBm		(1.5 to 3.3)°	
(-65 to -40) dBm		(2.1 to 3.3)°	
(-15 to 10) dBm	(3 to 6) GHz	(0.57 to 4.1)°	
(-25 to 0) dBm		(0.57 to 1.5)°	
(-35 to -10) dBm		(0.85 to 2.1)°	
(-45 to -20) dBm		(0.96 to 3.2)°	
(-55 to -30) dBm		(1.5 to 3.6)°	
(-65 to -40) dBm		(2.1 to 3.6)°	
Transmission Magnitude[3]			
(-15 to 10) dBm	30 kHz to 1.3 GHz	(0.18 to 0.84) dB	HP 8753E,
(-25 to 0) dBm		(0.18 to 0.84) dB	HP 8753D
(-35 to -10) dBm		(0.18 to 0.84) dB	
(-45 to -20) dBm		(0.30 to 0.84) dB	
(-55 to -30) dBm		(0.3 to 1.1) dB	
(-65 to -40) dBm		(0.4 to 1.1) dB	
(-15 to 10) dBm	(1.3 to 3) GHz	(0.075 to 0.27) dB	
(-25 to 0) dBm		(0.075 to 0.15) dB	
(-35 to -10) dBm		(0.87 to 0.37) dB	
(-45 to -20) dBm		(0.10 to 0.72) dB	
(-55 to -30) dBm		(0.15 to 0.77) dB	
(-65 to -40) dBm		(0.37 to 0.77) dB	

Parameter/Range	Frequency	CMC[2] (±)	Comments
Transmission Magnitude[3] (cont)			
(-15 to 10) dBm	(3 to 6) GHz	(0.085 to 0.45) dB	HP 8753E, HP 8753D
(-25 to 0) dBm		(0.085 to 0.16) dB	
(-35 to -10) dBm		(0.11 to 0.37) dB	
(-45 to -20) dBm		(0.12 to 0.73) dB	
(-55 to -30) dBm		(0.16 to 0.79) dB	
(-65 to -40) dBm		(0.37 to 0.79) dB	
Return Loss – Measure[3] Into 50 Ω			
(0 to 5) dB	10 MHz to 8.4 GHz	2.5 dB	HP 8757D w/85027B
	(8.4 to 12.4) GHz	2.4 dB	
	(12.4 to 18) GHz	2.5 dB	
	(18 to 20) GHz	2.5 dB	
	(20 to 26.5) GHz	2.5 dB	
(5 to 10) dB	10 MHz to 8.4 GHz	2.5 dB	
	(8.4 to 12.4) GHz	2.4 dB	
	(12.4 to 18) GHz	2.5 dB	
	(18 to 20) GHz	2.5 dB	
	(20 to 26.5) GHz	2.5 dB	
(10 to 20) dB	10 MHz to 8.4 GHz	2.5 dB	
	(8.4 to 12.4) GHz	2.5 dB	
	(12.4 to 18) GHz	2.5 dB	
	(18 to 20) GHz	2.5 dB	
	(20 to 26.5) GHz	2.6 dB	
(20 to 30) dB	10 MHz to 8.4 GHz	2.7 dB	
	(8.4 to 12.4) GHz	3.0 dB	
	(12.4 to 18) GHz	2.9 dB	
	(18 to 20) GHz	2.8 dB	
	(20 to 26.5) GHz	3.5 dB	
(30 to 40) dB	10 MHz to 8.4 GHz	4.5 dB	
	(8.4 to 12.4) GHz	7.5 dB	
	(12.4 to 18) GHz	6.3 dB	
	(18 to 20) GHz	5.4 dB	
	(20 to 26.5) GHz	12 dB	

VI. Fluid Quantities

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Gas Flow – Measuring Equipment	(1 to 100 000) sccm (100 000 to 300 000) sccm (0 to 120) SLM (120 to 600) SLM (600 to 3000) SLM	0.19 % 0.19 % 0.19 % 0.17 % 0.21 %	DHI Molblocs w/ Molbox DHI Molblocs S w/ Molbox
Liquid Flow – Measuring Equipment	(0.04 to 400) gpm	0.13 %	Flow calibrator
Air Velocity – Measuring Equipment	Up to 200 ft/min (>200 to 300) ft/min (>300 to 400) ft/min (>400 to 1000) ft/min (>1000 to 3000) ft/min (>3000 to 4000) ft/min (>4000 to 5000) ft/min (>5000 to 9000) ft/min	2.1 % 1.7 % 1.4 % 1.3 % 1.8 % 2.3 % 2.1 % 2.0 %	Wind Tunnel w/ flow measurement system

VII. Mechanical

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Pressure – Measure and Measuring Equipment			
Pneumatic Absolute	(0.2 to 25) psia (1.7 to 100) psia (2 to 1000) psia (0 to 15) psia (15 to 30) psia (0 to 50) psia (50 to 100) psia (0 to 600) psia (600 to 1200) psia (0 to 1500) psia (1500 to 3000) psia	0.0018 % 0.0020 % 0.0033 % 0.012 % of FS 0.012 % 0.012 % of FS 0.013 % 0.013 % of FS 0.013 % 0.013 % of FS 0.013 %	Ruska 2465 Mensor CPR6050 Mensor CPR6050 Mensor CPR6050 Mensor CPR6050

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Pressure – Measure and Measuring Equipment (cont)			
Pneumatic Gage and Transducers	(0.2 to 25) psig (1.7 to 100) psig (2 to 1000) psig (0 to 15) psig (15 to 30) psig (0 to 50) psig (50 to 100) psig (0 to 600) psig (600 to 1200) psig (0 to 1500) psig (1500 to 3000) psig (0 to 10) inH_2O (0 to 3) in·H_2O (3 to 30) in·H_2O	0.0018 % 0.0020 % 0.0033 % 0.012 % of FS 0.012 % 0.012 % of FS 0.013 % 0.013 % of FS 0.013 % 0.013 % of FS 0.013 % 0.012 % of FS 0.012 % 0.010 %	Ruska 2465 Mensor CPR6050 Mensor CPR6050 Mensor CPR6050 Mensor CPR6050 Mensor 2100 Fluke 7250LP
Hydraulic Gage	Up to 30 000 psig (30 000 to 75 000) psig	0.0031 % 0.0043 %	Fluke PG7302-2 Fluke PG7302-5
Differential	(-10 to 10) psid	0.0012 psid	Mensor 5014
Torque – Measuring Equipment[3]	(2 to 220) in·ozf (4 to 110) in·lbf (9 to 275) ft·lbf (275 to 2000) ft·lbf	0.013 % 0.015 % 0.029 % 0.044 %	Class 6 & F weights w/ torque arms
Torque – Measure[3]	(5 to 50) in·lbf (50 to 250) in·lbf (250 to 1000) in·lbf (25 to 250) ft·lbf (60 to 600) ft·lbf	0.32 % 0.32 % 0.32 % 0.32 % 0.32 %	CDI 950-DT w/ TTPM-41

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Force – Measuring Equipment [3]	(0 to 1) lbf (1 to 10) lbf (10 to 50) lbf (50 to 100) lbf (100 to 500) lbf	0.0006 lbf 0.003 lbf 0.018 lbf 0.055 lbf 0.11 lbf	Class F weights
Direct Verification of Durometer Spring Force[3] Types A, C and D	 (10 to 90) duros	 0.61 duros	 Pan balance w/ Class 1 weights
Scales and Balances[3]	Up to 2 mg (2 to 10) mg (10 to 20) mg (20 to 30) mg (30 to 50) mg (50 to 300) mg (300 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 20) g (20 to 30) g (30 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 5) kg (5 to 10) kg (10 to 26) kg (0 to 0.5) lb (>0.5 to 10) lb (>10 to 25) lb (>25 to 50) lb (>50 to 100) lb (>100 to 250) lb (>250 to 500) lb (>500 to 1000) lb	1.7 µg 1.8 µg 1.9 µg 1.8 µg 1.7 µg 1.8 µg 1.9 µg 2.9 µg 3.3 µg 3.0 µg 3.8 µg 12 µg 17 µg 18 µg 16 µg 30 µg 71 µg 89 µg 0.10 mg 0.19 mg 0.91 mg 6.6 mg 3.0 mg 3.8 mg 13 mg 0.13 g (0.00029 lb) 0.54 g (0.0012 lb) 1.1 g (0.0023 lb) 2.7 g (0.0059 lb) 5.5 g (0.012 lb) 13 g (0.029 lb) 27 g (0.059 lb) 110 g (0.1 lb)	Master weights Class F weights

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Mass	Up to 1 mg	1.1 µg	UMX5
	(1 to 2) mg	1.1 µg	UMX5
	(2 to 5) mg	1.2 µg	UMX5
	(5 to 10) mg	1.4 µg	UMX5
	(10 to 20) mg	1.4 µg	UMX5
	(20 to 50) mg	1.5 µg	UMX5
	(50 to 100) mg	1.8 µg	UMX5
	(100 to 200) mg	1.5 µg	UMX5
	(200 to 500) mg	2.1 µg	UMX5
	(0.5 to 1) g	2.2 µg	UMX5
	(1 to 2) g	2.5 µg	UMX5
	(2 to 3) g	2.9 µg	UMX5
	(3 to 5) g	4.0 µg	UMX5
	(5 to 10) g	10 µg	AX106
	(10 to 50) g	19 µg	AX106
	(50 to 100) g	36 µg	AX106
	(100 to 200) g	50 µg	AT1005
	(200 to 300) g	58 µg	AT1005
	(300 to 500) g	73 µg	AT1005
	(0.5 to 1) kg	0.12 mg	AT1005
	(1 to 2) kg	0.47 mg	PR2004
	(2 to 3) kg	1.8 mg	XPE26003LC
	(3 to 5) kg	1.0 mg	XPE26003LC
	(5 to 10) kg	1.7 mg	XPE26003LC
	(10 to 20) kg	8.7 mg	XPE26003LC
	(20 to 26) kg	13 mg	XPE26003LC
Fixed Points	1 mg	1.1 µg	Master weights
	2 mg	1.1 µg	
	3 mg	1.1 µg	
	5 mg	1.2 µg	
	10 mg	1.4 µg	
	20 mg	1.4 µg	
	30 mg	1.5 µg	
	50 mg	1.5 µg	
	100 mg	1.8 µg	
	200 mg	1.5 µg	
	300 mg	1.7 µg	
	500 mg	2.1 µg	
	1 g	2.2 µg	
	2 g	2.5 µg	
	3 g	2.9 µg	
	5 g	4.0 µg	

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Mass (cont)			
Fixed Points	10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 20 kg	10 µg 15 µg 12 µg 19 µg 36 µg 50 µg 58 µg 73 µg 0.12 mg 0.47 mg 1.8 mg 1.0 mg 1.7 mg 8.7 mg	Master weights

VIII. Thermodynamics

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Temperature – Measure[3]	(-196 to 0.01) °C (0.01 to 660) °C (660 to 950) °C	0.0099 °C 0.013 °C 0.042 °C	Hart 1502 w/ SPRT Hart 1590 w/ 5624 Hart 1590 w/ 5624
Temperature – Measuring Equipment[3]	(-196 to 0.01) °C (0.01 to 660) °C (660 to 950) °C	0.013 °C 0.059 °C 0.35 °C	Bath w/1502 w/ SPRT Bath w/1590 w/ 5624 Bath w/1590 w/ 5624
Relative Humidity[3]	(5 to 95) % RH	0.31 % RH	Thunder scientific 9000

VIII. Time & Frequency

Parameter/Equipment	Frequency	CMC[2, 5, 6, 9] (±)	Comments
Frequency – Measuring Equipment[3]	10 MHz 0.01 Hz to 2 MHz (0.001 to 1000) Hz 1000 Hz to 20 MHz 10 MHz to 26.5 GHz	5.2 pHz/Hz 2.3 µHz/Hz + 5.0 µHz 0.12 mHz 0.12 nHz/Hz 64 pHz/Hz	Datum 9390 Fluke 5520A Datum GPS w/ HP 3325B Datum GPS w/ HP 8340 or 836xA
Frequency – Measure[3]	150 kHz to 1.3 GHz Up to 200 MHz 40 Hz to 10 MHz 10 MHz (100 to 500) MHz (0.5 to 26.5) GHz	0.62 µHz/Hz + 0.6*R* 0.060 µHz/Hz + 0.6*R* 120 µHz/Hz 40 pHz/Hz 2.9 nHz/Hz + 0.6*R* 53 pHz/Hz + 0.6*R*	HP 8902A HP 5335A Agilent 3458A Agilent 53132A Agilent 53151A
Optical Tachometers and Stroboscopes	(0.01 to 5) RPM (5 to 200 000) RPM	0.00058 RPM 0.0012 RPM	Datum GPS w/ HP 3325B, Agilent 53132A

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I. Mechanical

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Pressure – Pneumatic Effective Area of a Piston	(0.2 to 1000) psi (100 to 4000) psi (100 to 14 000) psi (400 to 40 000) psi	0.0040 % 0.0060 % 0.0080 % 0.0080 %	By comparison with Ruska 2465 w/cross float system
Pressure – Hydraulic Effective Area of a Piston	(0.2 to 1000) psi (100 to 4000) psi (100 to 14 000) psi (400 to 40 000) psi	0.0040 % 0.0060 % 0.0080 % 0.0080 %	By comparison with Ruska 2465 w/cross float system
Absolute Pressure[3] – Pneumatic	(0.2 to 25) psia (1.7 to 100) psia (2 to 1000) psia (100 to 4000) psia (100 to 14 000) psia (400 to 40 000) psia (0 to 25) psia (0 to 30) psia (0 to 100) psia (0 to 500) psia (0 to 1000) psia	0.0015% 0.0015 % 0.0030% 0.0060 % 0.0080 % 0.0080 % 0.013 % F.S. 0.012 % F.S. 0.013 % F.S. 0.012 % F.S. 0.013 % F.S.	Mensor 5014 Mensor IS50 Mensor 5014 Mensor 5014 Mensor 5014
Gage Pressure[3] – Pneumatic	(0.2 to 25) psig (1.7 to 100) psig (2 to 1000) psig (100 to 4000) psig (100 to 14 000) psig (400 to 40 000) psig (0 to 1500) psig (0 to 250) psig (0 to 200) psig (0 to 100) psig (0 to 60) psig (0 to 50) psig (0 to 25) psig (0 to 15) psig (0 to 3) psig	0.0015 % 0.0015 % 0.0030 % 0.0060 % 0.0080 % 0.0080 % 0.016 % F.S. 0.013 % F.S. 0.013 % F.S. 0.013 % F.S. 0.012 % F.S. 0.012 % F.S 0.012 % F.S 0.013 % F.S. 0.012 % F.S.	Ruska 2465 Ruska 2452 w/ 2413 separator Mensor CPC6000 Mensor CPC6000 Mensor 5014 Mensor 5014 Mensor CPC6000 Mensor 5014 Mensor 5014 Mensor 5014 Mensor CPC6000

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Differential Pressure – Pneumatic	(±10) psid	0.015 % F.S.	Mensor 5014
Absolute Pressure[3] – Hydraulic	(0.2 to 25) psia (1.7 to 100) psia (2 to 1000) psia (100 to 4000) psia (100 to 14 000) psia (400 to 40 000) psia (0 to 25) psia (0 to 30) psia (0 to 100) psia (0 to 500) psia (0 to 1000) psia	0.0015% 0.0015% 0.0030 % 0.0060 % 0.0080 % 0.0080 % 0.013 % F.S. 0.012 % F.S. 0.013 % F.S. 0.012 % F.S. 0.013 % F.S.	Ruska 2465 Ruska 2452 w/ 2413 Separator Mensor 5014 Mensor IS50 Mensor 5014 Mensor 5014 Mensor 5014
Gage Pressure[3] – Hydraulic	(0.2 to 25) psig (1.7 to 100) psig (2 to 1000) psig (100 to 4000) psig (100 to 14 000) psig (400 to 40 000) psig (0 to 200) psig (0 to 100) psig (0 to 50) psig (0 to 25) psig (0 to 15) psig	0.0015% 0.0015% 0.0030% 0.0060 % 0.0080 % 0.0080 % 0.013 % F.S. 0.013 % F.S. 0.012 % F.S 0.012 % F.S 0.013 % F.S.	Ruska 2465 Ruska 2452 w/ 2413 Separator Mensor 5014 Mensor 5014 Mensor 5014 Mensor 5014 Mensor 5014
Differential Pressure[3] – Hydraulic	(±10) psid	0.015 % F.S.	Mensor 5014
Accelerometer Sensitivity, Voltage and Charge Sensitivity	(2 to 10) Hz (10 to 50) Hz (50 to 160) Hz (160 to 920) Hz 920 Hz to 5 kHz (5 to 10) kHz	1.4 % 0.80 % 0.70 % 0.80 % 2.1 % 3.3 %	Standard accelerometers

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Mass – Fixed Points	(1, 2, 5, 10, 20, 50, 100, 200) mg 500 mg 1 g (2, 5) g 10 g 20 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 10 kg 20 kg 50 lb (1 to 500) mg >500 mg to 5 g (>5 to 20) g (>20 to 50) g (>50 to 100) g (>100 to 200) g (>200 to 500) g >500 g to 1 kg (>1 to 2) kg (>2 to 5) kg (>5 to 10) kg (>10 to 20) kg 50 lb	0.012 mg 0.013 mg 0.043 mg 0.13 mg 0.13 mg 0.14 mg 0.22 mg 0.33 mg 2.0 mg 2.5 mg 3.7 mg 7.1 mg 15 mg 31 mg 59 mg 72 mg 0.013 mg 0.13 mg 0.14 mg 0.22 mg 0.33 mg 2.0 mg 2.5 mg 3.7 mg 7.1 mg 15 mg 31 mg 59 mg 72 mg	Class 1 weights using comparison method
Torque – Measuring Equipment	(2 to 220) ozf·in (4 to 110) lbf·in (9 to 275) lbf·ft (275 to 2000) lbf·ft	0.043 % 0.044 % 0.050 % 0.044 %	Class F weights w/ torque arms
Force – Measuring Equipment	(0.0 to 1000) lbf	0.01 %	Class S weights

II. Thermodynamics

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Temperature – Measuring Equipment	(0 to 300) °C	0.031 °C	Hart Scientific 5681, 1502A w/ temperature baths
Temperature – Measure	(0 to 420) °C	0.029 °C	Hart Scientific 5681, 1502A

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I. Mechanical

Parameter/Equipment	Range	CMC[2, 6, 9] (±)	Comments
Torque – Measure[3]	(5 to 50) lbf·in (50 to 250) lbf·in (250 to 1000) lbf·in (25 to 250) lbf·ft	0.45 % 0.30 % 0.29 % 0.30 %	CDI 5000ST w/ 4 in 1transducer model CDI 2000-12-02

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I. Dimensional

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Calipers[3]	Up to 12 in	(68 + 4.8*L*) µin	Gage blocks
Indicators[3]	Up to 0.5 in Up to 0.5 in	64 µin 33 µin	Universal calibrator Gage blocks
Extrusion Plastometers[3]	Up to 2.0 in	1.4 mils	Caliper

II. Mechanical

Parameter/Equipment	Range	CMC[2] (±)	Comments
Balances	(1 to 500) mg (1 to 5) g (10 to 20) g 50 g 100 g (200 to 1000) g 2 kg 5 kg	120 µg 130 µg 190 µg 190 µg 320 µg 3.2 mg 6.0 mg 19 mg	Class S weights

III. Thermodynamics

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Temperature – Measure	(-40 to 420) °C	0.13 °C	Instrulab RTD and display unit
Temperature – Measure	(0 to 280) °C	1.3 °C	Altek 322-1 and Type K TC probe
Temperature – Measure	(30 to 300) °C	2.3 °C	Fluke 2635A and Type K TC probe (sheath)

IV. Time & Frequency

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
Timer & Stopwatches	(0 to 300) sec	0.26 s	Stopwatch

[1] This laboratory offers commercial calibration service 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 uncertainty 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 uncertainty 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 uncertainty.

[4] The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMC uncertainties are expressed as either a specific value that covers the full range or as a fraction/percentage of the reading plus a fixed floor specification.

[5] In the statement of CMC, *L* is the numerical value of the nominal length of the device measured in inches; *R* is the resolution of the unit under test in inches.

[6] All CMCs listed in % are percent of reading of input unless otherwise stated.

[7] In the statement of CMC, percent is expressed as linear error of reported Cal Factor, where the ideal Cal Factor is 100 %. Number given is the CMC of the highest uncertainty test in the frequency range.

[8] This scope meets A2LA's *P112 Flexible Scope Policy*.

[9] 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.

Cincinnati, OH

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, ANSI/NCSL 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 27th of April 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.22
Valid to June 30, 2023

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