



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

WESCAN CALIBRATION  
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CALIBRATION

Valid To: January 31, 2027

Certificate Number: 1500.02

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with R205 – A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations<sup>1,9</sup>:

I. Dimensional

| Parameter/Equipment    | Range                            | CMC <sup>2,4</sup> (±)                  | Comments                                                                                    |
|------------------------|----------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------|
| Angle Blocks           | Up to 30°                        | 3.1"                                    | Gauge blocks, sine bar, gauging head & amplifier                                            |
| Length Standards       | (1 to 40) in                     | (13 + 4.0L) µin                         | Gauge blocks, gauging head & amplifier                                                      |
| Diameter –<br>External | Up to 10 in<br><br>(10 to 24) in | (3.8 + 4.3D) µin<br><br>(13 + 4.0D) µin | Supermicrometer <sup>TM6</sup> & gauge blocks<br><br>Gauge blocks, gauging head & amplifier |
| Internal               | Up to 24 in                      | (13 + 3.4D) µin                         | Linear height gage                                                                          |

| Parameter/Equipment                                                                       | Range                                           | CMC <sup>2, 4</sup> ( $\pm$ )                 | Comments                                          |
|-------------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------|---------------------------------------------------|
| Flatness                                                                                  | Up to 3 in                                      | 4.1 $\mu$ in                                  | Optical flat                                      |
| Surface Plates <sup>3</sup>                                                               |                                                 |                                               |                                                   |
| Overall Flatness                                                                          | 12 in $\times$ 18 in to<br>12 ft $\times$ 12 ft | 35 $\mu$ in                                   | Electronic leveling<br>system                     |
| Repeatability                                                                             | 12 in $\times$ 18 in to<br>12 ft $\times$ 12 ft | 26 $\mu$ in                                   | Repeat meter                                      |
| Height Gauges <sup>3, 5</sup>                                                             | Up to 24 in<br>(24 to 40) in                    | (1.0 + 3.7L) $\mu$ in<br>(13 + 3.5L) $\mu$ in | Gauge blocks                                      |
| Calipers <sup>3, 5</sup>                                                                  | Up to 40 in                                     | (5.6 + 4.1L) $\mu$ in                         | Gauge blocks                                      |
| Micrometers <sup>3, 5</sup>                                                               |                                                 |                                               |                                                   |
| OD                                                                                        | Up to 60 in                                     | (8.2 + 3.8L) $\mu$ in                         | Gauge blocks                                      |
| ID                                                                                        | Up to 24 in                                     | (5.5 + 4.0L) $\mu$ in                         |                                                   |
| Depth                                                                                     | Up to 12 in                                     | (2.9 + 3.4L) $\mu$ in                         |                                                   |
| Indicators <sup>3, 5</sup>                                                                | Up to 3 in                                      | (7.0 + 2.8L) $\mu$ in                         | Gauge blocks                                      |
| Indicator Calibrators <sup>5</sup>                                                        | Up to 2 in                                      | 12 $\mu$ in                                   | Gauge blocks                                      |
| Gauge Head/Amplifier                                                                      | (0.0001 to 0.2) in                              | 5.4 $\mu$ in                                  | Gauge blocks                                      |
| ID Instruments <sup>3, 5</sup> – Bore<br>Gages, ID Micrometers,<br>& Similar <sup>3</sup> | Up to 24 in                                     | (5.5 + 4.0L) $\mu$ in                         | Gauge blocks, rings,<br>gauging<br>head/amplifier |
| Thickness Gauges <sup>5</sup>                                                             | (0.001 to 0.6) in<br>(> 0.6 to 1) in            | 4.7 $\mu$ in<br>11 $\mu$ in                   | Shims & gauge<br>blocks                           |

| Parameter/Equipment                                                         | Range                                         | CMC <sup>2, 4</sup> ( $\pm$ )                  | Comments                                                                                                |
|-----------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Rules/Tapes <sup>5</sup>                                                    | Up to 30 in increments                        | 0.0018 in                                      | Ruler/tape calibrator                                                                                   |
| Sine Bars –<br><br>Parallelism<br><br>Angle (5 in Bar)<br>Angle (10 in Bar) | 5 in<br>10 in<br><br>(0 to 45)°<br>(0 to 45)° | 37 $\mu$ in<br>39 $\mu$ in<br><br>5.5"<br>3.0" | Gauging head & amplifier<br><br>Gauge blocks, Supermicrometer <sup>TM6</sup> , gauging head & amplifier |
| Squares                                                                     | Up to 18 in                                   | 11 $\mu$ in/in                                 | Master square, gauge blocks                                                                             |
| Precision Levels <sup>5</sup>                                               | Up to 12 in                                   | 15 $\mu$ in/in                                 | Sine bar, gauge blocks, surface plate                                                                   |
| Protractors <sup>5</sup>                                                    | At 0° & 90°<br><br>(> 0 to < 90)°             | 0.000 56°<br><br>0.014°                        | Master square<br><br>Sine bar, gauge blocks, master square                                              |
| Thread Plugs – Major & Pitch Diameter                                       | (0.07 to 10) in                               | 98 $\mu$ in                                    | Thread wires & Supermicrometer <sup>TM6</sup>                                                           |
| Linear Dimension –<br><br>X-Axis<br>Y-Axis<br><br>Angle                     | 8 in<br>4 in<br><br>Up to 360°                | 0.000 075 in<br>0.000 075 in<br><br>0.017°     | Optical comparator                                                                                      |

## II. Electrical – DC/Low Frequency

| Parameter/Equipment                                    | Range                                                                                                                                                                                                                 | CMC <sup>2, 11</sup> (±)                                                                                                                                                                                                                                                | Comments                                                                                                                             |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| DC Voltage <sup>3</sup> – Generate                     | (0 to 220) mV<br>(0.2 to 2.2) V<br>(2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(200 to 1100) V<br><br>0 to 329.9999) mV<br>(0.33 to 3.299 999) V<br>(3.3 to 32.999 99) V<br>(33 to 329.9999) V<br>(330 to 1000) V | 0.000 96 % + 0.0011 mV<br>0.000 92 % + 0.0015 mV<br>0.000 91 % + 0.000 005 6 V<br>0.000 92 % + 0.000 010 V<br>0.0010 % + 0.000 12 V<br>0.0013 % + 0.000 82 V<br><br>16 µV/V + 0.78 µV<br>8.6 µV/V + 1.6 µV<br>9.4 µV/V + 16 µV<br>14 µV/V + 120 µV<br>14 µV/V + 1200 µV | Fluke 5700A<br><br><br><br><br><br><br>552X series calibrator                                                                        |
| DC Voltage – Measure – Generate (Monitor)              | (0 to 100) mV<br>100 mV to 1 V<br>(1 to 10) V<br>(10 to 100) V<br>(100 to 1000) V<br><br>(1 to 10) kV<br>(1 to 35) kV<br>(10 to 140) kV                                                                               | 5.7 µV/V + 0.34 µV<br>4.5 µV/V + 0.35 µV<br>4.5 µV/V + 0.57 µV<br>6.8 µV/V + 0.035 mV<br>(20 + (12·V / 1000) <sup>2</sup> ) µV/V + 0.19 mV<br><br>0.035 % + 0.15 V<br>0.030 % + 0.14 V<br>0.091 % + 0.8 V                                                               | HP 3458A opt 002<br><br><i>V</i> is the voltage in V<br><br><br>Vitrek 4700<br><br>Vitrek 4700 & HVL-35<br><br>Vitrek 4700 & HVL-150 |
| DC Current <sup>3</sup> – Measure – Generate (Monitor) | (0 to 120) nA<br>100 nA to 1.2 µA<br>(1 to 12) µA<br>(10 to 120) µA<br>100 µA to 1.2 mA<br>(1 to 12) mA<br>(10 to 120) mA<br>100 mA to 1.05 A<br><br>(1 to 3) A<br>(3 to 10) A<br>(10 to 20) A                        | 34 µA/A + 45 pA<br>23 µA/A + 45 pA<br>23 µA/A + 0.11 nA<br>23 µA/A + 0.91 nA<br>23 µA/A + 5.7 pA<br>23 µA/A + 57 pA<br>40 µA/A + 0.57 µA<br>120 µA/A + 11 µA<br><br>0.016 % + 48 µA<br>0.017 % + 18 µA<br>0.022 % - 10 µA                                               | HP 3458A opt 002<br><br><br><br><br><br><br>Fluke Y5020 & HP 3458A opt 002                                                           |

| Parameter/Equipment                                                             | Range                                                                                                                                                                                                                                                                                    | CMC <sup>2, 8, 11</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                   | Comments                                                                     |
|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| DC Current <sup>3</sup> – Generate                                              | (0 to 329.999) $\mu$ A<br>(0.330 to 3.299 99) mA<br>(3.3 to 32.9999) mA<br>(33 to 329.999) mA<br>(0.33 to 1.099 99) A<br>(1.1 to 2.999 99) A<br>(3 to 10.9999) A<br>(11 to 20.5) A                                                                                                       | 0.012 % + 0.016 $\mu$ A<br>78 $\mu$ A/A + 0.039 $\mu$ A<br>78 $\mu$ A/A + 0.20 $\mu$ A<br>78 $\mu$ A/A + 2.0 $\mu$ A<br>0.016 % + 32 $\mu$ A<br>0.03 % + 32 $\mu$ A<br>0.039 % + 390 $\mu$ A<br>0.078 % + 580 $\mu$ A                                                                                                                                               | 552X series calibrator                                                       |
| Clamp-On Meters                                                                 | (20 to 149.999) A<br>(150 to 549.999) A<br>(550 to 1025) A                                                                                                                                                                                                                               | 0.58 % + 0.17 A<br>0.58 % + 0.58 A<br>0.59 % + 0.58 A                                                                                                                                                                                                                                                                                                               | 552X series w/<br>5500A/coil                                                 |
| DC Current – Generate                                                           | (0 to 220) $\mu$ A<br>(0.2 to 2.2) mA<br>(2 to 22) mA<br>(22 to 22) mA<br>(0.2 to 2.2) A<br><br>(2 to 11) A<br>(11 to 20) A                                                                                                                                                              | 0.0069 % + 0.012 $\mu$ A<br>0.0069 % + 0.000 013 mA<br>0.0069 % + 0.0012 mA<br>0.0079 % + 0.0015 mA<br>0.010 % + 0.000 056 A<br><br>0.018 % + 0.0029 A<br>0.038 % + 0.000 62 A                                                                                                                                                                                      | Fluke 5700A<br><br><br><br><br>5700A with<br>Fluke 5220A                     |
| Resistance <sup>3</sup> – Measure –<br>Generate (Monitor)                       | (1 to 11) m $\Omega$<br><br>11 m $\Omega$ to 10 $\Omega$<br>(10 to 100) $\Omega$<br>100 $\Omega$ to 1 k $\Omega$<br>(1 to 10) k $\Omega$<br>(10 to 100) k $\Omega$<br>100 k $\Omega$ to 1 M $\Omega$<br>(1 to 10) M $\Omega$<br>(10 to 100) M $\Omega$<br>100 M $\Omega$ to 1 G $\Omega$ | 0.052 %<br><br>18 $\mu\Omega/\Omega$ + 58 $\mu\Omega$<br>15 $\mu\Omega/\Omega$ + 0.58 m $\Omega$<br>13 $\mu\Omega/\Omega$ + 0.57 m $\Omega$<br>13 $\mu\Omega/\Omega$ + 5.7 m $\Omega$<br>13 $\mu\Omega/\Omega$ + 56 m $\Omega$<br>18 $\mu\Omega/\Omega$ + 2.3 $\Omega$<br>58 $\mu\Omega/\Omega$ + 120 $\Omega$<br>0.058 % + 1200 $\Omega$<br>0.58 % + 12 k $\Omega$ | Leeds &<br>Northrup 4300<br>w/HP 3458A opt<br>002<br><br>HP 3458A opt<br>002 |
| AC Resistance <sup>12</sup> Measure –<br>Generate (Monitor)<br>12 Hz to 100 kHz | 0.1 $\Omega$<br>1 $\Omega$<br>6.25 $\Omega$ to 410 k $\Omega$<br>1 M $\Omega$<br>10 M $\Omega$<br>100 M $\Omega$                                                                                                                                                                         | 0.72 %<br>0.083 %<br>0.024 %<br>0.04 %<br>0.29 %<br>2.8 %                                                                                                                                                                                                                                                                                                           | Genrad 1689<br>CMC is stated at<br>1 kHz                                     |

| Parameter/Equipment                                | Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Comments                  |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Resistance <sup>3</sup> – Generate<br>Fixed Points | 0 $\Omega$<br>1 $\Omega$<br>1.9 $\Omega$<br>10 $\Omega$<br>19 $\Omega$<br>100 $\Omega$<br>190 $\Omega$<br>1 k $\Omega$<br>1.9 k $\Omega$<br>10 k $\Omega$<br>19 k $\Omega$<br>100 k $\Omega$<br>190 k $\Omega$<br>1 M $\Omega$<br>1.9 M $\Omega$<br>10 M $\Omega$<br>19 M $\Omega$<br>100 M $\Omega$                                                                                                                                                                                                                                                    | 0.11 m $\Omega$<br>0.14 m $\Omega$<br>0.25 m $\Omega$<br>0.40 m $\Omega$<br>0.71 m $\Omega$<br>2.4 m $\Omega$<br>4.5 m $\Omega$<br>34 m $\Omega$<br>34 m $\Omega$<br>0.17 $\Omega$<br>0.32 $\Omega$<br>1.9 $\Omega$<br>2.0 $\Omega$<br>28 $\Omega$<br>56 $\Omega$<br>0.57 k $\Omega$<br>1.4 k $\Omega$<br>17 k $\Omega$                                                                                                                                                                                                                                                                                                                                                                 | Fluke 5700A               |
| Resistance <sup>3</sup> – Generate                 | (0 to 10.9999) $\Omega$<br>(11 to 32.9999) $\Omega$<br>(33 to 109.9999) $\Omega$<br>(110 to 329.9999) $\Omega$<br>(330 to 1.099 999) k $\Omega$<br>(1.1 to 3.299 999) k $\Omega$<br>(3.3 to 10.999 99) k $\Omega$<br>(11 to 32.999 99) k $\Omega$<br>(33 to 109.9999) k $\Omega$<br>(110 to 329.9999) k $\Omega$<br>330 k $\Omega$ to 1.099 999 M $\Omega$<br>(1.1 to 3.299 999) M $\Omega$<br>(3.3 to 10.999 99) M $\Omega$<br>(11 to 32.999 99) M $\Omega$<br>(33 to 109.9999) M $\Omega$<br>(110 to 329.9999) M $\Omega$<br>(330 to 1100) M $\Omega$ | 32 $\mu\Omega/\Omega$ + 0.78 m $\Omega$<br>24 $\mu\Omega/\Omega$ + 1.2 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 1.1 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 1.6 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 1.6 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 16 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 16 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 16 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 0.16 $\Omega$<br>22 $\mu\Omega/\Omega$ + 0.16 $\Omega$<br>25 $\mu\Omega/\Omega$ + 1.6 $\Omega$<br>25 $\mu\Omega/\Omega$ + 1.6 $\Omega$<br>47 $\mu\Omega/\Omega$ + 24 $\Omega$<br>0.011 % + 36 $\Omega$<br>0.02 % + 2.0 k $\Omega$<br>0.039 % + 2.4 k $\Omega$<br>0.24 % + 78 k $\Omega$<br>1.2 % + 390 k $\Omega$ | 552X series<br>calibrator |

| Parameter/Range                     | Frequency       | CMC <sup>2, 11</sup> (±) | Comments               |
|-------------------------------------|-----------------|--------------------------|------------------------|
| Capacitance <sup>3</sup> – Generate |                 |                          | 552X series calibrator |
| (0.22 to 0.399 99) nF               | 10 Hz to 10 kHz | 0.39 % + 0.0078 nF       |                        |
| (0.4 to 1.0999) nF                  | 10 Hz to 10 kHz | 0.39 % + 0.0078 nF       |                        |
| (1.1 to 3.2999) nF                  | 10 Hz to 3 kHz  | 0.39 % + 0.0078 nF       |                        |
| (3.3 to 10.999) nF                  | 10 Hz to 1 kHz  | 0.20 % + 0.0078 nF       |                        |
| (11 to 32.9999) nF                  | 10 Hz to 1 kHz  | 0.20 % + 0.078 nF        |                        |
| (33 to 109.999) nF                  | 10 Hz to 1 kHz  | 0.20 % + 0.078 nF        |                        |
| (110 to 329.999) nF                 | 10 Hz to 1 kHz  | 0.20 % + 0.24 nF         |                        |
| (0.33 to 1.099 99) µF               | (10 to 600) Hz  | 0.20 % + 0.78 nF         |                        |
| (1.1 to 3.299 99) µF                | (10 to 300) Hz  | 0.20 % + 2.4 nF          |                        |
| (3.3 to 10.9999) µF                 | (10 to 150) Hz  | 0.20 % + 7.8 nF          |                        |
| (11 to 32.9999) µF                  | (10 to 120) Hz  | 0.32 % + 24 nF           |                        |
| (33 to 109.999) µF                  | (10 to 80) Hz   | 0.35 % + 78 nF           |                        |
| (110 to 329.999) µF                 | (0 to 50) Hz    | 0.35 % + 240 nF          |                        |
| (0.33 to 1.099 99) mF               | (0 to 20) Hz    | 0.35 % + 0.78 µF         |                        |
| (1.1 to 3.2999) mF                  | (0 to 6) Hz     | 0.35 % + 2.4 µF          |                        |
| (3.3 to 10.9999) mF                 | (0 to 2) Hz     | 0.35 % + 7.8 µF          |                        |
| (11 to 32.9999) mF                  | (0 to 0.6) Hz   | 0.59 % + 24 µF           |                        |
| (33 to 110) mF                      | (0 to 0.2) Hz   | 0.86 % + 78 µF           |                        |

| Parameter/Equipment                                                             | Range                                                                               | CMC <sup>2, 8 11</sup> (±)                                                                                                                                                                                               | Comments                                             |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Capacitance <sup>12</sup> – Measure<br>– Generate (Monitor)<br>12 Hz to 100 kHz | 1 pF<br>10 pF<br>100 pF<br>400 pF to 25 µF<br>100 µF<br>1000 µF                     | 4.6 %<br>0.47 %<br>0.057 %<br>0.024 %<br>0.057 %<br>0.47 %                                                                                                                                                               | Genrad 1689<br>CMC is stated at 1<br>kHz             |
| Capacitance – Generate,<br>Cardinal Points Only                                 | Nominal<br>1 pF<br>10 pF<br>100 pF<br>1000 pF<br>1 nF<br>10 nF<br>100 nF<br>1000 nF | 0.14 % of charted value<br>0.12 % of charted value<br>0.12 % of charted value<br>0.12 % of charted value<br>0.058 % of charted value<br>0.058 % of charted value<br>0.058 % of charted value<br>0.058 % of charted value | HP 16380A & GR<br>1409 series standard<br>capacitors |
| Inductance <sup>12</sup> – Measure –<br>Generate (Monitor)<br>100 Hz to 10 kHz  | 100 µH<br>1 mH to 10 H                                                              | 0.13 %<br>0.024 %                                                                                                                                                                                                        | Genrad 1689<br>CMC is stated at 1<br>kHz             |

| Parameter/Equipment                                                                                               | Range                                                                     | CMC <sup>2, 8, 11</sup> ( $\pm$ )                                      | Comments                                |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------|
| DC Power <sup>3</sup> – Generate<br><br>33 mV to 1020 V (@)<br>(0.33 to 330) mA<br>(0.33 to 3) A<br>(3 to 20.5) A | <br><br>(0.000 011 to 336.6) W<br>(0.011 to 3060) W<br>(0.99 to 20 910) W | <br><br>0.022 % + 48 $\mu$ W<br>0.020 % + 0.18 mW<br>0.063 % - 0.24 mW | <br><br>Fluke 552X series<br>calibrator |

| Parameter/Range                                                                                                                                                                                                                                                                                                                                                                | Frequency                                                                                                                                                                                                                                                                                | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                                               | Comments                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| AC Power <sup>3</sup> – Generate<br><br>(33 to 330) mV @<br>(3.3 to 9) mA<br>(9 to 33) mA<br>(33 to 90) mA<br>(90 to 330) mA<br>(330 to 900) mA<br>(0.9 to 2.2) A<br>(2.2 to 4.5) A<br>(4.5 to 20.5) A<br><br>330 mV to 1020 V @<br>(3.3 to 9) mA<br>(9 to 33) mA<br>(33 to 90) mA<br>(90 to 330) mA<br>(330 to 900) mA<br>(0.9 to 2.2) A<br>(2.2 to 4.5) A<br>(4.5 to 20.5) A | <br><br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br><br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz<br>(45 to 65) Hz | <br><br>0.27 % - 0.024 $\mu$ W<br>0.11 % + 0.18 $\mu$ W<br>0.13 % + 0.028 $\mu$ W<br>0.091 % + 0.032 $\mu$ W<br>0.12 % - 0.42 $\mu$ W<br>0.10 % + 2.3 $\mu$ W<br>0.12 % - 1.2 $\mu$ W<br>0.10 % + 7.0 $\mu$ W<br><br>0.11 % + 0.29 $\mu$ W<br>0.10 % - 0.27 mW<br>0.11 % - 0.035 $\mu$ W<br>0.073 % - 0.65 mW<br>0.11 % - 0.59 mW<br>0.084 % - 0.18 mW<br>0.11 % + 21 mW<br>0.091 % + 1.1 mW | <br><br>Fluke 552X series<br>calibrator |



| Parameter/Equipment                                                                                                                                                    | Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CMC <sup>2</sup> (±)                                                                                                                                                                                                                                                                 | Comments                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Electrical Simulation of<br>RTD Indicators &<br>Indicating Systems <sup>3</sup> –<br><br>Pt 385, 100 Ω                                                                 | (-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 300) °C<br>(300 to 400) °C<br>(400 to 630) °C<br>(630 to 800) °C                                                                                                                                                                                                                                                                                                                                                                              | 0.039 °C<br>0.039 °C<br>0.055 °C<br>0.07 °C<br>0.078 °C<br>0.094 °C<br>0.18 °C                                                                                                                                                                                                       | 552X series<br>calibrator |
| Electrical Simulation of<br>Thermocouples &<br>Thermocouple Indicating<br>Devices <sup>3</sup> –<br><br>Type B<br><br>Type E<br><br>Type J<br><br>Type K<br><br>Type N | (600 to 800) °C<br>(800 to 1000) °C<br>(1000 to 1550) °C<br>(1550 to 1820) °C<br><br>(-250 to -100) °C<br>(-100 to -25) °C<br>(-25 to 350) °C<br>(350 to 650) °C<br>(650 to 1000) °C<br><br>(-210 to -100) °C<br>(-100 to -30) °C<br>(-30 to 150) °C<br>(150 to 760) °C<br>(760 to 1200) °C<br><br>(-200 to -100) °C<br>(-100 to -25) °C<br>(-25 to 120) °C<br>(120 to 1000) °C<br>(1000 to 1372) °C<br><br>(-200 to -100) °C<br>(-100 to -25) °C<br>(-25 to 120) °C<br>(120 to 410) °C<br>(410 to 1300) °C | 0.35 °C<br>0.27 °C<br>0.24 °C<br>0.26 °C<br><br>0.39 °C<br>0.13 °C<br>0.11 °C<br>0.13 °C<br>0.17 °C<br><br>0.21 °C<br>0.13 °C<br>0.11 °C<br>0.14 °C<br>0.18 °C<br><br>0.26 °C<br>0.14 °C<br>0.13 °C<br>0.21 °C<br>0.32 °C<br><br>0.32 °C<br>0.18 °C<br>0.15 °C<br>0.14 °C<br>0.21 °C | 552X series<br>calibrator |

| Parameter/Equipment                                                                            | Range                                                                      | CMC <sup>2</sup> (±)                     | Comments                                      |
|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------|-----------------------------------------------|
| Electrical Simulation of Thermocouples & Thermocouple Indicating Devices <sup>3</sup> – (cont) |                                                                            |                                          |                                               |
| Type R                                                                                         | (0 to 250) °C<br>(250 to 400) °C<br>(400 to 1000) °C<br>(1000 to 1767) °C  | 0.45 °C<br>0.28 °C<br>0.26 °C<br>0.32 °C | 552X series calibrator                        |
| Type S                                                                                         | (0 to 250) °C<br>(250 to 1000) °C<br>(1000 to 1400) °C<br>(140 to 1767) °C | 0.37 °C<br>0.28 °C<br>0.29 °C<br>0.36 °C |                                               |
| Type T                                                                                         | (-250 to -150) °C<br>(-150 to 0) °C<br>(0 to 120) °C<br>(120 to 400) °C    | 0.49 °C<br>0.19 °C<br>0.13 °C<br>0.11 °C |                                               |
| Thermistors                                                                                    | (-80 to -40) °C<br>(-40 to 100) °C<br>(100 to 150) °C                      | 0.084 °C<br>0.0063 °C<br>0.0095 °C       | Decade resistance boxes w/HP<br>3458A opt 002 |

| Parameter/Range                    | Frequency                                                                                                                                          | CMC <sup>2, 11</sup> (±)                                                                                                                                                           | Comments    |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| AC Voltage <sup>3</sup> – Generate |                                                                                                                                                    |                                                                                                                                                                                    |             |
| (0.3 to 2.2) mV                    | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 0.020 % + 0.0080 mV<br>0.0055 % + 0.0075 mV<br>0.0014 % + 0.0075 mV<br>0.0094 % + 0.0085 mV<br>0.045 % + 0.013 mV<br>0.038 % + 0.024 mV<br>0.050 % + 0.044 mV<br>0.15 % + 0.046 mV | Fluke 5700A |
| (2 to 22) mV                       | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 0.053 % + 0.011 mV<br>0.016 % + 0.011 mV<br>0.0067 % + 0.0095 mV<br>0.033 % + 0.011 mV<br>0.090 % + 0.014 mV<br>0.10 % + 0.031 mV<br>0.15 % + 0.052 mV<br>0.32 % + 0.062 mV        |             |

| Parameter/Range                              | Frequency                                                                                                                                          | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                                                                              | Comments    |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| AC Voltage <sup>3</sup> – Generate<br>(cont) |                                                                                                                                                    |                                                                                                                                                                                             |             |
| (22 to 220) mV                               | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 0.060 % + 0.011 mV<br>0.024 % + 0.011 mV<br>0.011 % + 0.011 mV<br>0.039 % + 0.011 mV<br>0.098 % + 0.014 mV<br>0.12 % + 0.031 mV<br>0.19 % + 0.052 mV<br>0.38 % + 0.062 mV                   | Fluke 5700A |
| (0.2 to 2) V                                 | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 0.061 % + 0.000 32 V<br>0.018 % + 0.000 10 V<br>0.0089 % + 0.000 031 V<br>0.014 % + 0.000 070 V<br>0.030 % + 0.000 16 V<br>0.049 % + 0.000 34 V<br>0.13 % + 0.000 82 V<br>0.24 % + 0.0021 V |             |
| (2 to 22) V                                  | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 0.061 % + 0.0032 V<br>0.018 % + 0.0010 V<br>0.0087 % + 0.000 35 V<br>0.014 % + 0.000 73 V<br>0.029 % + 0.0013 V<br>0.062 % + 0.0038 V<br>0.15 % + 0.0096 V<br>0.29 % + 0.024 V              |             |
| (20 to 220) V                                | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                             | 0.061 % + 0.032 V<br>0.018 % + 0.011 V<br>0.0091 % + 0.0040 V<br>0.026 % + 0.011 V<br>0.067 % + 0.018 V                                                                                     |             |
| (200 to 1100) V                              | 50 Hz to 1 kHz                                                                                                                                     | 0.0092 % + 0.021 V                                                                                                                                                                          |             |

| Parameter/Range                              | Frequency                                                                                                   | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                                  | Comments                  |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| AC Voltage <sup>3</sup> – Generate<br>(cont) |                                                                                                             |                                                                                                                                                 |                           |
| (1 to 32.999) mV                             | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 0.063 % + 4.7 $\mu$ V<br>0.012 % + 4.7 $\mu$ V<br>0.016 % + 4.7 $\mu$ V<br>0.078 % + 4.7 $\mu$ V<br>0.28 % + 9.4 $\mu$ V<br>0.63 % + 39 $\mu$ V | 552X series<br>calibrator |
| (33 to 329.999) mV                           | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 0.024 % + 6.3 $\mu$ V<br>0.012 % + 6.3 $\mu$ V<br>0.013 % + 6.3 $\mu$ V<br>0.028 % + 6.3 $\mu$ V<br>0.063 % + 25 $\mu$ V<br>0.16 % + 55 $\mu$ V |                           |
| 330 mV to 3.299 99 V                         | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 0.024 % + 39 $\mu$ V<br>0.012 % + 47 $\mu$ V<br>0.015 % + 47 $\mu$ V<br>0.024 % + 39 $\mu$ V<br>0.055 % + 97 $\mu$ V<br>0.19 % + 470 $\mu$ V    |                           |
| (3.3 to 32.9999) V                           | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                     | 0.024 % + 510 $\mu$ V<br>0.012 % + 470 $\mu$ V<br>0.019 % + 470 $\mu$ V<br>0.028 % + 470 $\mu$ V<br>0.07 % + 1300 $\mu$ V                       |                           |
| (33 to 329.999) V                            | 45 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                      | 0.015 % + 1600 $\mu$ V<br>0.016 % + 4700 $\mu$ V<br>0.02 % + 4700 $\mu$ V<br>0.024 % + 4700 $\mu$ V<br>0.16 % + 39 000 $\mu$ V                  |                           |
| (330 to 1020) V                              | 45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                             | 0.024 % + 7800 $\mu$ V<br>0.02 % + 7800 $\mu$ V<br>0.024 % + 7800 $\mu$ V                                                                       |                           |

| Parameter/Range                    | Frequency                                                                         | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                | Comments                        |
|------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| AC Current <sup>3</sup> – Generate |                                                                                   |                                                                                                                               |                                 |
| (20 to 220 $\mu$ A                 | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.086 % + 0.36 $\mu$ A<br>0.042 % + 0.045 $\mu$ A<br>0.012 % + 0.044 $\mu$ A<br>0.075 % + 1.2 $\mu$ A<br>0.20 % + 4.6 $\mu$ A | Fluke 5700A                     |
| (0.2 to 2.2) mA                    | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.090 % + 0.000 12 mA<br>0.015 % + 0.000 094 mA<br>0.015 % + 0.000 13 mA<br>0.078 % + 0.0024 mA<br>0.20 % + 0.0047 mA         |                                 |
| (2 to 22) mA                       | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.090 % + 0.0015 mA<br>0.047 % + 0.000 53 mA<br>0.015 % + 0.000 86 mA<br>0.078 % + 0.012 mA<br>0.20 % + 0.024 mA              |                                 |
| (20 to 220) mA                     | 10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.089 % + 0.013 mA<br>0.046 % + 0.011 mA<br>0.015 % + 0.015 mA<br>0.078 % + 0.064 mA<br>0.20 % + 0.13 mA                      |                                 |
| (0.2 to 2.2) A                     | 40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                   | 0.083 % + 0.000 13 A<br>0.095 % + 0.000 20 A<br>1.1 % + 0.000 55 A                                                            |                                 |
| (2 to 20) A                        | 30 Hz to 1 kHz<br>(1 to 5) kHz                                                    | 0.053 % + 0.0022 A<br>0.42 % + 0.000 20 A                                                                                     | Fluke 5700A with<br>Fluke 5220A |

| Parameter/Range                    | Frequency                                                                                        | CMC <sup>2, 5, 11</sup> ( $\pm$ )                                                                                                                     | Comments               |
|------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| AC Current <sup>3</sup> – Generate |                                                                                                  |                                                                                                                                                       |                        |
| (29 to 329.99) $\mu$ A             | (10 to 20) Hz<br>(20 to 45) Hz<br>45 to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz | 0.16 % + 0.078 $\mu$ A<br>0.12 % + 0.078 $\mu$ A<br>0.097 % + 0.078 $\mu$ A<br>0.24 % + 0.12 $\mu$ A<br>0.63 % + 0.16 $\mu$ A<br>1.3 % + 0.32 $\mu$ A | 552X series calibrator |
| (0.33 to 3.2999) mA                | 10 to 20) Hz<br>(20 to 45) Hz<br>45 to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz  | 0.16 % + 0.12 $\mu$ A<br>0.097 % + 0.12 $\mu$ A<br>0.078 % + 0.12 $\mu$ A<br>0.16 % + 0.16 $\mu$ A<br>0.39 % + 0.24 $\mu$ A<br>0.78 % + 0.47 $\mu$ A  |                        |
| (3.3 to 32.999) mA                 | (10 to 20) Hz<br>(20 to 45) Hz<br>45 to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz | 0.14 % + 1.6 $\mu$ A<br>0.07 % + 1.6 $\mu$ A<br>0.032 % + 1.6 $\mu$ A<br>0.063 % + 1.6 $\mu$ A<br>0.16 % + 2.4 $\mu$ A<br>0.32 % + 3.2 $\mu$ A        |                        |
| (33 to 329.99) mA                  | (10 to 20) Hz<br>(20 to 45) Hz<br>45 to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz | 0.14 % + 16 $\mu$ A<br>0.070 % + 16 $\mu$ A<br>0.032 % + 16 $\mu$ A<br>0.078 % + 39 $\mu$ A<br>0.16 % + 78 $\mu$ A<br>0.32 % + 160 $\mu$ A            |                        |
| (0.33 to 1.099 99) A               | (10 to 45) Hz<br>45 to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                    | 0.14 % + 78 $\mu$ A<br>0.039 % + 78 $\mu$ A<br>0.47 % + 780 $\mu$ A<br>2.0 % + 3900 $\mu$ A                                                           |                        |
| (1.1 to 2.999 99) A                | (10 to 45) Hz<br>45 to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                    | 0.14 % + 78 $\mu$ A<br>0.047 % + 78 $\mu$ A<br>0.47 % + 780 $\mu$ A<br>2.0 % + 3900 $\mu$ A                                                           |                        |
| (2 to 10.9999) A                   | 45 to 100) Hz<br>100 to 1 kHz<br>(1 to 5) kHz                                                    | 0.047 % + 1600 $\mu$ A<br>0.078 % + 1600 $\mu$ A<br>2.4 % + 1600 $\mu$ A                                                                              |                        |

| Parameter/Range                                            | Frequency                                                                                                                                    | CMC <sup>2, 5, 11</sup> ( $\pm$ )                                                                                                                                                              | Comments                     |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| AC Current <sup>3</sup> – Generate<br>(cont)               |                                                                                                                                              |                                                                                                                                                                                                |                              |
| (11 to 20) A                                               | (45 to 100) Hz<br>(100 to 1000) Hz<br>(1 to 5) kHz                                                                                           | 0.11 % + 4.4 mA<br>0.14 % + 4.4 mA<br>2.7 % + 4.5 mA                                                                                                                                           | 552X series calibrator       |
| Clamp-On Meters:                                           |                                                                                                                                              |                                                                                                                                                                                                |                              |
| Toroidal Type:                                             |                                                                                                                                              |                                                                                                                                                                                                |                              |
| (20 to 54.999) A<br>(55 to 149.999) A<br>(150 to 1025) A   | (45 to 65) Hz                                                                                                                                | 0.31 % + 0.054 A<br>0.34 % + 0.042 A<br>0.34 % + 0.13 A                                                                                                                                        | 552X series w/<br>5500A/coil |
| (20 to 54.999) A<br>(55 to 149.999) A<br>(150 to 400) A    | (65 to 440) Hz                                                                                                                               | 0.93 % + 0.054 A<br>0.94 % + 0.046 A<br>1.2 % + 0.22 A                                                                                                                                         |                              |
| Non-Toroidal Type:                                         |                                                                                                                                              |                                                                                                                                                                                                |                              |
| (20 to 149.999) A<br>(150 to 549.999) A<br>(550 to 1025) A | (45 to 65) Hz                                                                                                                                | 0.65 % + 0.30 A<br>0.66 % + 1.1 A<br>0.65 % + 1.1 A                                                                                                                                            |                              |
| (20 to 149.999) A<br>(150 to 400) A                        | (65 to 440) Hz                                                                                                                               | 1.2 % + 0.30 A<br>1.4 % + 1.1 A                                                                                                                                                                |                              |
| AC Voltage <sup>3</sup> – Measure<br>– Generate (Monitor)  |                                                                                                                                              |                                                                                                                                                                                                |                              |
| Up to 10 mV                                                | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz                                     | 0.035 % + 3.5 $\mu$ V<br>0.024 % + 1.3 $\mu$ V<br>0.035 % + 1.3 $\mu$ V<br>0.12 % + 1.3 $\mu$ V<br>0.58 % + 1.3 $\mu$ V<br>4.7 % + 2.4 $\mu$ V                                                 | HP 3458A opt 002             |
| (10 to 100) mV                                             | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz | 0.0081 % + 4.7 $\mu$ V<br>0.0081 % + 2.4 $\mu$ V<br>0.017 % + 2.4 $\mu$ V<br>0.035 % + 2.4 $\mu$ V<br>0.093 % + 2.4 $\mu$ V<br>0.35 % + 12 $\mu$ V<br>1.2 % + 12 $\mu$ V<br>1.8 % + 12 $\mu$ V |                              |

| Parameter/Range                                                  | Frequency                                                                                                                                    | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                                                                               | Comments                  |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| AC Voltage <sup>3</sup> – Measure –<br>Generate (Monitor) (cont) |                                                                                                                                              |                                                                                                                                                                                              |                           |
| (100 mV to 1) V                                                  | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz | 0.0081 % + 47 $\mu$ V<br>0.0081 % + 24 $\mu$ V<br>0.017 % + 24 $\mu$ V<br>0.035 % + 24 $\mu$ V<br>0.093 % + 24 $\mu$ V<br>0.35 % + 120 $\mu$ V<br>1.2 % + 120 $\mu$ V<br>1.8 % + 120 $\mu$ V | HP 3458A opt 002          |
| (1 to 10) V                                                      | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz | 0.0081 % + 0.47 mV<br>0.0081 % + 0.24 mV<br>0.017 % + 0.24 mV<br>0.035 % + 0.24 mV<br>0.093 % + 0.24 mV<br>0.35 % + 1.2 mV<br>1.2 % + 1.2 mV<br>1.8 % + 1.2 mV                               |                           |
| (10 to 100) V                                                    | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz                 | 0.024 % + 4.7 mV<br>0.024 % + 2.4 mV<br>0.024 % + 2.4 mV<br>0.041 % + 2.4 mV<br>0.14 % + 2.4 mV<br>0.47 % + 12 mV<br>1.8 % + 12 mV                                                           |                           |
| (100 to 750) V                                                   | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                         | 0.047 % + 47 mV<br>0.047 % + 24 mV<br>0.07 % + 24 mV<br>0.14 % + 24 mV<br>0.35 % + 24 mV                                                                                                     | HP 3458A opt 002          |
| (1 to 10) kV                                                     | (30 to 200) Hz<br>(200 to 450) Hz<br>(450 to 600) Hz                                                                                         | 0.14 % + 0.14 V<br>0.46 % + 0.16 V<br>0.87 % - 0.47 V                                                                                                                                        | Vitrek 4700               |
| (1 to 35) kV                                                     | (30 to 200) Hz<br>(200 to 450) Hz<br>(450 to 600) Hz                                                                                         | 0.064 % + 0.24 V<br>0.69 % + 0.28 V<br>1.5 % - 7.4 V                                                                                                                                         | Vitrek 4700 &<br>HVL-35   |
| (35 to 100) kV                                                   | 60 Hz                                                                                                                                        | 0.57 % + 1.1 V                                                                                                                                                                               | Vitrek 4700 & HVL-<br>150 |



| Parameter/Range                                           | Frequency                                                                                              | CMC <sup>2, 11</sup> ( $\pm$ )                                                                                                                      | Comments         |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| AC Current <sup>3</sup> – Measure –<br>Generate (Monitor) |                                                                                                        |                                                                                                                                                     |                  |
| (0 to 100) $\mu$ A                                        | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz                                    | 0.46 % + 23 nA<br>0.17 % + 23 nA<br>0.070 % + 23 nA<br>0.070 % + 23 nA                                                                              | HP 3458A opt 002 |
| 100 $\mu$ A to 1 mA                                       | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz | 0.17 % + 23 $\mu$ A<br>0.17 % + 0.23 $\mu$ A<br>0.070 % + 0.23 $\mu$ A<br>0.035 % + 0.23 $\mu$ A<br>0.068 % + 0.25 $\mu$ A<br>0.46 % + 0.46 $\mu$ A |                  |
| (1 to 10) mA                                              | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz | 0.46 % + 2.3 $\mu$ A<br>0.17 % + 2.3 $\mu$ A<br>0.070 % + 2.3 $\mu$ A<br>0.035 % + 2.3 $\mu$ A<br>0.070 % + 2.3 $\mu$ A<br>0.46 % + 4.6 $\mu$ A     |                  |
| (10 to 100) mA                                            | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz | 0.46 % + 23 $\mu$ A<br>0.17 % + 23 $\mu$ A<br>0.070 % + 23 $\mu$ A<br>0.035 % + 23 $\mu$ A<br>0.070 % + 23 $\mu$ A<br>0.46 % + 46 $\mu$ A           |                  |
| 100 mA to 1 A                                             | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz                   | 0.46 % + 0.23 mA<br>0.46 % + 0.23 mA<br>0.093 % + 0.23 mA<br>0.12 % + 0.23 mA<br>0.35 % + 0.23 mA                                                   |                  |
| (1 to 20) A                                               | 45 Hz to 1 kHz<br>(1 to 5) kHz                                                                         | 0.031 % + 65 $\mu$ A<br>0.046 % + 0.21 mA                                                                                                           |                  |
| Distortion (THD) –<br>Measure                             | 20 Hz to 20 kHz<br><br>(20 to 100) kHz                                                                 | 14 % of Indicated<br>THD<br><br>30 % of Indicated<br>THD                                                                                            | HP 8903A         |

| Parameter/Equipment          | Range                                                                          | CMC <sup>2, 8, 11</sup> ( $\pm$ )                                                    | Comments              |
|------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------|
| Oscilloscopes <sup>3</sup> – |                                                                                |                                                                                      |                       |
| Amplitude – DC Signal:       |                                                                                |                                                                                      |                       |
| 50 $\Omega$ Load             | 1 mV to 6.6 V                                                                  | 0.20 % + 32 $\mu$ V                                                                  | 552X/SC1100           |
| 1 M $\Omega$ Load            | 1 mV to 130 V                                                                  | 0.039 % + 32 $\mu$ V                                                                 |                       |
| Amplitude – Square Wave:     |                                                                                |                                                                                      |                       |
| 50 $\Omega$ Load             | 1 mV to 6.6 Vp-p<br>10 Hz to 100 kHz                                           | 0.20 % + 32 $\mu$ V                                                                  |                       |
| 1 M $\Omega$ Load            | 1 mV to 130 Vp-p<br>10 Hz to 100 kHz                                           | 0.078 % + 32 $\mu$ V                                                                 |                       |
| Bandwidth Flatness           | 50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 600) MHz<br>(600 to 1100) MHz | 1.2 % + 78 $\mu$ V<br>1.6 % + 78 $\mu$ V<br>3.2 % + 78 $\mu$ V<br>3.9 % + 78 $\mu$ V |                       |
| Time Marker                  | 50 ms to 5 s<br>2 ns to 20 ms                                                  | (20 + ( $t$ 1000)) $\mu$ s/s<br>1.9 $\mu$ s/s                                        | $t$ = time in seconds |
| Resistance – Measure         | (40 to 60) $\Omega$<br>(0.5 to 1.5) M $\Omega$                                 | 0.079 %<br>0.078 %                                                                   |                       |

### III. Electrical – RF/Microwave

| Parameter/Range                       | Frequency           | CMC <sup>2, 8, 11</sup> ( $\pm$ ) | Comments           |
|---------------------------------------|---------------------|-----------------------------------|--------------------|
| Relative Power – Measure, Attenuation |                     |                                   |                    |
| (0 to -10) dBm                        | 2.5 MHz to 26.5 GHz | 0.026 dB                          | HP 8902A w/ 11793A |
| (-10 to -20) dBm                      | 2.5 MHz to 26.5 GHz | 0.038 dB                          |                    |
| (-20 to -30) dBm                      | 2.5 MHz to 26.5 GHz | 0.046 dB                          |                    |
| (-30 to -40) dBm                      | 2.5 MHz to 26.5 GHz | 0.063 dB                          |                    |
| (-40 to -50) dBm                      | 2.5 MHz to 26.5 GHz | 0.082 dB                          |                    |
| (-50 to -60) dBm                      | 2.5 MHz to 26.5 GHz | 0.084 dB                          |                    |
| (-60 to -70) dBm                      | 2.5 MHz to 26.5 GHz | 0.10 dB                           |                    |
| (-70 to -80) dBm                      | 2.5 MHz to 26.5 GHz | 0.12 dB                           |                    |
| (-80 to -90) dBm                      | 2.5 MHz to 26.5 GHz | 0.13 dB                           |                    |
| (-90 to -100) dBm                     | 2.5 MHz to 26.5 GHz | 0.14 dB                           |                    |
| (-100 to -110) dBm                    | (2.5 to 1300) MHz   | 0.15 dB                           |                    |
| (-110 to -120) dBm                    | (2.5 to 1300) MHz   | 0.17 dB                           |                    |

| Parameter/Range                                 | Frequency         | CMC <sup>2, 8, 11</sup> ( $\pm$ ) | Comments                   |
|-------------------------------------------------|-------------------|-----------------------------------|----------------------------|
| Relative Power – Measure,<br>Attenuation (cont) |                   |                                   |                            |
| (0 to -10) dBm                                  | 100 kHz to 10 MHz | 0.020 dB                          | Rohde & Schwarz<br>FSMR-26 |
| (-10 to -20) dBm                                | 100 kHz to 10 MHz | 0.024 dB                          |                            |
| (-20 to -30) dBm                                | 100 kHz to 10 MHz | 0.029 dB                          |                            |
| (-30 to -40) dBm                                | 100 kHz to 10 MHz | 0.041 dB                          |                            |
| (-40 to -50) dBm                                | 100 kHz to 10 MHz | 0.047 dB                          |                            |
| (-50 to -60) dBm                                | 100 kHz to 10 MHz | 0.052 dB                          |                            |
| (-60 to -70) dBm                                | 100 kHz to 10 MHz | 0.058 dB                          |                            |
| (-70 to -80) dBm                                | 100 kHz to 10 MHz | 0.064 dB                          |                            |
| (-80 to -90) dBm                                | 100 kHz to 10 MHz | 0.070 dB                          |                            |
| (-90 to -100) dBm                               | 100 kHz to 10 MHz | 0.076 dB                          |                            |
| (-100 to -110) dBm                              | 100 kHz to 10 MHz | 0.083 dB                          |                            |
| (-110 to -120) dBm                              | 100 kHz to 10 MHz | 0.090 dB                          |                            |
| (0 to -10) dBm                                  | 10 MHz to 22 GHz  | 0.018 dB                          |                            |
| (-10 to -20) dBm                                | 10 MHz to 22 GHz  | 0.024 dB                          |                            |
| (-20 to -30) dBm                                | 10 MHz to 22 GHz  | 0.029 dB                          |                            |
| (-30 to -40) dBm                                | 10 MHz to 22 GHz  | 0.041 dB                          |                            |
| (-40 to -50) dBm                                | 10 MHz to 22 GHz  | 0.047 dB                          |                            |
| (-50 to -60) dBm                                | 10 MHz to 22 GHz  | 0.053 dB                          |                            |
| (-60 to -70) dBm                                | 10 MHz to 22 GHz  | 0.058 dB                          |                            |
| (-70 to -80) dBm                                | 10 MHz to 22 GHz  | 0.064 dB                          |                            |
| (-80 to -90) dBm                                | 10 MHz to 22 GHz  | 0.070 dB                          |                            |
| (-90 to -100) dBm                               | 10 MHz to 22 GHz  | 0.076 dB                          |                            |
| (-100 to -110) dBm                              | 10 MHz to 22 GHz  | 0.084 dB                          |                            |
| (-110 to -120) dBm                              | 10 MHz to 22 GHz  | 0.089 dB                          |                            |
| (-120 to -130) dBm                              | 10 MHz to 22 GHz  | 0.12 dB                           |                            |
| (0 to -10) dBm                                  | (22 to 26.5) GHz  | 0.065 dB                          |                            |
| (-10 to -20) dBm                                | (22 to 26.5) GHz  | 0.070 dB                          |                            |
| (-20 to -30) dBm                                | (22 to 26.5) GHz  | 0.081 dB                          |                            |
| (-30 to -40) dBm                                | (22 to 26.5) GHz  | 0.090 dB                          |                            |
| (-40 to -50) dBm                                | (22 to 26.5) GHz  | 0.12 dB                           |                            |
| (-50 to -60) dBm                                | (22 to 26.5) GHz  | 0.14 dB                           |                            |
| (-60 to -70) dBm                                | (22 to 26.5) GHz  | 0.13 dB                           |                            |
| (-70 to -80) dBm                                | (22 to 26.5) GHz  | 0.11 dB                           |                            |
| (-80 to -90) dBm                                | (22 to 26.5) GHz  | 0.11 dB                           |                            |
| (-90 to -100) dBm                               | (22 to 26.5) GHz  | 0.11 dB                           |                            |
| (-100 to -110) dBm                              | (22 to 26.5) GHz  | 0.11 dB                           |                            |
| (-110 to -120) dBm                              | (22 to 26.5) GHz  | 0.12 dB                           |                            |
| (-120 to -130) dBm                              | (22 to 26.5) GHz  | 0.13 dB                           |                            |

| Parameter/Range                                                     | Frequency                                                                    | CMC <sup>2, 8, 11</sup> ( $\pm$ )        | Comments                                       |
|---------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------|
| Absolute Power – Measure                                            |                                                                              |                                          |                                                |
| (20 to 30) dBm                                                      | 100 kHz to 2.6 GHz<br>(2.6 to 12) GHz<br>(12 to 26.5) GHz                    | 0.26 dB<br>0.28 dB<br>0.32 dB            | HP 8902A,<br>HP 11722A,<br>HP 11792A           |
| (10 to 20) dBm                                                      | 100 kHz to 2.6 GHz<br>(2.6 to 12) GHz<br>(12 to 26.5) GHz                    | 0.23 dB<br>0.25 dB<br>0.30 dB            |                                                |
| (0 to 10) dBm                                                       | 100 kHz to 2.6 GHz<br>(2.6 to 12) GHz<br>(12 to 26.5) GHz                    | 0.21 dB<br>0.23 dB<br>0.28 dB            |                                                |
| (-10 to 0) dBm                                                      | 100 kHz to 2.6 GHz<br>(2.6 to 12) GHz<br>(12 to 26.5) GHz                    | 0.34 dB<br>0.24 dB<br>0.30 dB            |                                                |
| (-20 to -10) dBm                                                    | 100 kHz to 2.6 GHz<br>(2.6 to 12) GHz<br>(12 to 26.5) GHz                    | 0.27 dB<br>0.29 dB<br>0.34 dB            |                                                |
| (-10 to 0) dBm<br>(0 to 10) dBm<br>(10 to 20) dBm<br>(20 to 24) dBm | DC to 4.2 GHz<br>DC to 4.2 GHz<br>DC to 4.2 GHz<br>DC to 4.2 GHz             | 0.12 dB<br>0.11 dB<br>0.11 dB<br>0.11 dB | Rohde & Schwarz<br>FSMR-26 & NRP-Z37<br>sensor |
| (-10 to 0) dBm<br>(0 to 10) dBm<br>(10 to 20) dBm<br>(20 to 24) dBm | (4.2 to 8) GHz<br>(4.2 to 8) GHz<br>(4.2 to 8) GHz<br>(4.2 to 8) GHz         | 0.14 dB<br>0.12 dB<br>0.12 dB<br>0.12 dB |                                                |
| (-10 to 0) dBm<br>(0 to 10) dBm<br>(10 to 20) dBm<br>(20 to 24) dBm | (12.4 to 18) GHz<br>(12.4 to 18) GHz<br>(12.4 to 18) GHz<br>(12.4 to 18) GHz | 0.20 dB<br>0.17 dB<br>0.17 dB<br>0.22 dB |                                                |
| (-10 to 0) dBm<br>(0 to 10) dBm<br>(10 to 20) dBm<br>(20 to 24) dBm | (18 to 26.5) GHz<br>(18 to 26.5) GHz<br>(18 to 26.5) GHz<br>(18 to 26.5) GHz | 0.22 dB<br>0.20 dB<br>0.20 dB<br>0.20 dB |                                                |

| Parameter/Range                                                                                                                                                                                                                                                                                            | Frequency                                                                                                                               | CMC <sup>2, 8, 11</sup> ( $\pm$ )                                                                             | Comments                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| High RF Power – Measure<br><br>(0.3 to 100) W                                                                                                                                                                                                                                                              | (25 to 1000) MHz                                                                                                                        | 3.6 %                                                                                                         | Bird 4421A w/ 4022A                                |
| Amplitude Modulation – Measure<br><br>Carrier: 150 kHz to 10 MHz<br>Depth: Up to 99 %<br><br>Carrier: (0.1 to 1.3) GHz<br>Depth: Up to 99 %<br><br>Carrier: 100 kHz to 10 MHz<br>Depth: (5 to 95) % AM<br><br>Carrier: (0.01 to 26.5) GHz<br>Depth: (5 to 95) % AM                                         | (20 to 50) Hz<br>(0.05 to 100) kHz<br><br>(20 to 50) Hz<br>(0.05 to 100) kHz<br><br>10 Hz to 10 kHz<br><br>10 Hz to 50 kHz              | 3.0 %<br>2.0 %<br><br>1.1 %<br>3.0 %<br><br>1.8 % AM<br><br>1.2 % AM                                          | HP 8902A<br><br><br><br>Rohde & Schwarz<br>FSMR-26 |
| Frequency Modulation – Measure<br><br>Carrier: (0.3 to 10) MHz<br>Dev: Up to 40 kHz<br><br>Carrier: (0.01 to 1.3) GHz<br>Dev: Up to 400 kHz<br><br>Carrier: (0.25 to 10) MHz<br>Dev: Up to 50 kHz<br><br>Carrier: (0.01 to 1) GHz<br>Dev: Up to 100 kHz<br><br>Carrier: (1 to 6) GHz<br>Dev: Up to 100 kHz | (0.02 to 10) kHz<br><br>(0.05 to 100) kHz<br>(100 to 200) kHz<br><br>(0.01 to 10) kHz<br><br>(0.01 to 100) kHz<br><br>(0.01 to 100) kHz | 2.3 % + 12 Hz<br><br>1.2 % + 0.12 kHz<br>5.8 % + 0.12 kHz<br><br>1.3 %<br><br>1.4 %<br><br>1.4 % + 0.0067 kHz | HP 8902A<br><br><br><br>Rohde & Schwarz<br>FSMR-26 |
| Phase Modulation – Measure<br><br>Carrier: (0.15 to 10) MHz<br>Carrier: (0.01 to 1.3) GHz<br><br>Carrier: (0.2 to 10) MHz<br>Carrier: (0.01 to 18) GHz                                                                                                                                                     | (0.2 to 10) kHz<br>(0.2 to 20) kHz<br><br>50 Hz to 10 kHz<br>50 Hz to 100 kHz                                                           | 4.8 % + 0.012 rad<br>3.7 % + 0.012 rad<br><br>1.2 % + 0.0040 rad<br>1.2 % + 0.0040 rad                        | HP 8902A<br><br><br>Rohde & Schwarz<br>FSMR-26     |

#### IV. Fluid Quantities

| Parameter/Equipment                                          | Range                                                                                              | CMC <sup>2</sup> (±)                                                                                       | Comments                              |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Piston Operated Volumetric Apparatus (Pipettes) <sup>3</sup> | (0.5 to 2) µL<br>(2 to 20) µL<br>(20 to 200) µL<br><br>(200 to 1000) µL<br><br>(1000 to 25 000) µL | 0.040 µL<br>0.052 µL<br>(0.037 + 0.0033 · V) µL<br><br>(0.26 + 0.0020 · V) µL<br><br>(2.1 + 0.0011 · V) µL | Balances<br><br>V is the volume in µL |

#### V. Mechanical

| Parameter/Equipment                        | Range                                                                       | CMC <sup>2, 8, 10</sup> (±)                                                         | Comments                                                      |
|--------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Force –Measuring Equipment <sup>3, 5</sup> | Up to 500 lbf                                                               | 0.038 %                                                                             | Dead weight                                                   |
| Load Cells / Force Gauges                  |                                                                             |                                                                                     |                                                               |
| Compression                                | Up to 5000 lbf<br>Up to 25 000 lbf<br>Up to 60 000 lbf                      | 0.12 % + 0.28 lbf<br>0.1 % + 0.4 lbf<br>0.069 % + 3 lbf                             | Load cells with digital display                               |
| Tension                                    | Up to 5000 lbf<br>Up to 25 000 lbf<br>Up to 60 000 lbf                      | 0.07 % + 0.03 lbf<br>0.23 % + 0.07 lbf<br>0.18 % - 0.7 lbf                          | Load cells with digital display                               |
| Mass <sup>3</sup>                          | 1 mg to 1 g<br><br>( > 1 to 10) g<br>( > 10 to 210) g<br>( > 210 to 6.1) kg | 0.0080 mg<br><br>(0.0021 - 0.000 18X) %<br>0.000 090 %<br>(0.000 66 - 0.000 083Y) % | Troemner weights & comparators<br><br>X: in g<br><br>Y: in kg |

| Parameter/Equipment                                                                              | Range                                                                                                                                                                                                                                                   | CMC <sup>2, 8, 10</sup> ( $\pm$ )                                                                                                                                                            | Comments                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mass <sup>3</sup> , Class F Weights or lower                                                     | (6 to 9.999) kg<br>(10 to 14.999) kg<br>(15 to 17) kg<br>(17.001 to 20) kg<br>(20.001 to 24) kg<br>(24.001 to 30) kg                                                                                                                                    | 130 mg<br>160 mg<br>180 mg<br>210 mg<br>230 mg<br>300 mg                                                                                                                                     | Ultra & Class 1 weights with SAW-PC scale comparator                                                                                                      |
| Scales & Balances <sup>3, 5</sup>                                                                | 1 mg to 1 g<br><br>(1 to 10) g<br><br>10 g to 11 kg<br><br>(11 to 200) kg                                                                                                                                                                               | 0.0050 mg<br><br>(0.000 48 – 0.000 038X) %<br><br>0.000 060 %<br><br>0.012 %                                                                                                                 | Troemner weights<br><br>X: in g<br><br><br>Class F weights                                                                                                |
| Torque – Measure & Measuring Equipment <sup>3</sup><br><br>Measuring Equipment Only <sup>5</sup> | (0.4 to 20) lb·in<br>(12.5 to 250) lb·in<br>(5 to 100) lb·ft<br>(20 to 1000) lb·ft<br><br>(1 to 200) lbf·in                                                                                                                                             | 0.52 %<br>0.57 %<br>0.54 %<br>0.53 %<br><br>0.13 %                                                                                                                                           | Norbar torque transducers & display<br><br><br><br>Torque arm & weights                                                                                   |
| Pressure/Vacuum – Measure & Measuring Equipment <sup>3, 5</sup>                                  | (-2 to 2) in H <sub>2</sub> O<br><br>(-5 to 5) in H <sub>2</sub> O<br><br>(0 to 8.5) psia<br>(8.5 to 17) psia<br><br>(-12.5 to 30) psia<br>(30 to 3000) psi<br><br>(3000 to 15 000) psi<br><br>Up to -14.2 psi<br>(0 to 10) psi<br>(> 10 to 15 000) psi | 0.000 57 in H <sub>2</sub> O<br><br>0.006 in H <sub>2</sub> O<br><br>0.0011 psia<br>0.0019 psia<br><br>0.0034 psi<br>0.01 %<br><br>0.000 80 % + 1.4 psi<br><br>0.44 %<br>0.027 psi<br>0.12 % | Dwyer 1430 Microtector hook gauge<br><br>Additel ADT681-DP5<br><br>Mensor CPG2500<br><br>Fluke 6270A<br><br>Mensor CPT9000<br><br>Digital pressure gauges |

## VI. Thermodynamics

| Parameter/Equipment                                               | Range                                                                                                                                                                                                                               | CMC <sup>2, 10</sup> (±)                                                                                  | Comments                                                                                                                                                                                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature <sup>3</sup> – Measure                                | (-196 to -20) °C                                                                                                                                                                                                                    | 0.033 °C                                                                                                  | Fluke 5609, Hart 1529                                                                                                                                                                                                                   |
| Thermocouples                                                     | (-196 to 600) °C                                                                                                                                                                                                                    | 0.059 °C                                                                                                  | HP3458A, Ice Bath, Fluke 5609/1529                                                                                                                                                                                                      |
| Temperature – Measure & Measuring Equipment <sup>3</sup>          | -196 °C (Measuring Equipment Only)<br><br>(-80 to -40) °C (Measuring Equipment Only)<br><br>Ice Point (Measuring Equipment Only)<br><br>(-95 to -20) °C<br>(-20 to 150) °C<br>(150 to 200) °C<br>(200 to 425) °C<br>(425 to 600) °C | 0.029 °C<br><br>0.027 °C<br><br>0.0027 °C<br><br>0.080 °C<br>0.033 °C<br>0.044 °C<br>0.053 °C<br>0.089 °C | Liquid N <sub>2</sub> , Fluke 5609, Hart 1529<br><br>Fluke 5609, Hart 1529 with Isopropol alcohol & subzero freezer<br><br>ASTM E563 ice point<br><br>w/ Fluke 9190A<br>w/ Fluke 7320<br>w/ Fluke 6102<br>w/ Fluke 9172<br>w/ Hart 9127 |
| Infrared Temperature – Measure & Measuring Equipment <sup>3</sup> | (35 to 500) °C                                                                                                                                                                                                                      | (0.30 + 0.0040 rdg) °C                                                                                    | Fluke 4181<br>Emissivity = 0.95<br>where wavelength = (8 to 14) μm                                                                                                                                                                      |
| Relative Humidity – Measure & Measuring Equipment <sup>3, 5</sup> | (10 to 95) % RH                                                                                                                                                                                                                     | 0.58 % rdg + 0.026 % RH                                                                                   | Thunder Scientific 1200                                                                                                                                                                                                                 |

## VI. Time & Frequency

| Parameter/Equipment              | Range             | CMC <sup>2, 7, 10</sup> (±)              | Comments                                    |
|----------------------------------|-------------------|------------------------------------------|---------------------------------------------|
| Frequency – Measure <sup>5</sup> | 1 mHz to 26.5 GHz | 3.5 parts in 10 <sup>12</sup> + 0.6RE Hz | HP Z3801A GPS locked with frequency counter |



| Parameter/Equipment                                    | Range                                                   | CMC <sup>2, 7, 10</sup> ( $\pm$ )                                       | Comments                                                    |
|--------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------|
| Frequency – Measuring Equipment <sup>5</sup>           | 10 MHz Reference<br>1 mHz to 26.5 GHz                   | 3.5 parts in $10^{12}$ Hz<br>3.5 parts in $10^{12} + 0.6RE$ Hz          | HP Z3801A GPS<br>HP Z3801A GPS locked with signal generator |
| Frequency – Measure & Measuring Equipment <sup>3</sup> | (0.01 to 10) Hz<br>(10 to 100) Hz<br>100 Hz to 26.5 GHz | 1.1 part in $10^3$ Hz<br>4.1 part in $10^6$ Hz<br>1.1 part in $10^7$ Hz | HP 5345A<br>HP5350A,<br>Anritsu 68377B                      |

<sup>1</sup> This laboratory offers commercial calibration service and field and mobile calibration service, where noted.

<sup>2</sup> 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.

<sup>3</sup> Field and mobile calibration service is available for this calibration except pipettes as a mobile laboratory activity. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the Calibration and Measurement Capability Uncertainty (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 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.

<sup>4</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches.  $D$  is the numerical value of the nominal diameter of the device measured in inches except where noted.  $R$  is the resolution of the unit under test.

<sup>5</sup> The contributions from the "best existing device" are not included in the CMC claim.

<sup>6</sup> "Supermicrometer" is a registered trademark with a last listed owner of Pratt & Whitney Measurement Systems, Inc., Connecticut U.S.A.

<sup>7</sup>  $RE$  is the resolution of the signal generator or counter.

<sup>8</sup> Unless otherwise indicated all units listed in % means % of reading.

<sup>9</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>10</sup> 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.

<sup>11</sup> 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. CMCs are expressed as either a specific value that covers the full range or as a percentage or fraction of the reading plus a fixed floor specification.

<sup>12</sup> Measurement uncertainty at intermediate values is calculated using the Manufacturers Limits of Error Calculator.



# Accredited Laboratory

A2LA has accredited

**WESCAN CALIBRATION**

*Richmond, British Columbia, CANADA*

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 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 20<sup>th</sup> day of January 2025.

A blue ink signature of Mr. Trace McInturff, written over a horizontal line.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 1500.02  
Valid to January 31, 2027

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