



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

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CALIBRATION

Valid To: January 31, 2025

Certificate Number: 2348.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 7</sup>:

I. Acoustical

| Parameter/Equipment               | Range                         | CMC <sup>2, 8</sup> (±) | Comments           |
|-----------------------------------|-------------------------------|-------------------------|--------------------|
| Sound Level Meters <sup>3</sup> – |                               |                         |                    |
| 94 dB                             | 31.5 Hz to 12.5 kHz<br>16 kHz | 0.30 dB<br>0.64 dB      | Briel & Kjaer 4226 |
| 104 dB                            | 31.5 Hz to 12.5 kHz<br>16 kHz | 0.30 dB<br>1.0 dB       |                    |
| 114 dB                            | 31.5 Hz to 12.5 kHz<br>16 kHz | 0.30 dB<br>1.1 dB       |                    |

II. Chemical

| Parameter/Equipment                   | Range                          | CMC <sup>2, 8</sup> (±)          | Comments                        |
|---------------------------------------|--------------------------------|----------------------------------|---------------------------------|
| pH – Measuring Equipment <sup>3</sup> | 4.00 pH<br>7.00 pH<br>10.00 pH | 0.012 pH<br>0.012 pH<br>0.012 pH | Buffer solutions<br>Fluke 5522A |

| Parameter/Equipment                             | Range   | CMC <sup>2, 8</sup> (±)                          | Comments  |
|---|---|--|---|
| Conductivity – Measuring Equipment <sup>3</sup> | 10 µS/cm<br>100 µS/cm<br>1410 µS/cm<br>10 000 µS/cm | 0.56 µS/cm<br>2.2 µS/cm<br>4.7 µS/cm<br>41 µS/cm | Laboratory standard conductivity solution                                   |
| Aerosol Particle Counters                       | (0.3 to 1.0) µm                                     | 2.9 %  | TSI electrostatic classifier 3082<br>TSI condensation particle counter 3772 |

### III. Dimensional

| Parameter/Equipment                         | Range                          | CMC <sup>2, 6</sup> (±)              | Comments  |
|---|--------------------------------|--------------------------------------|---|
| Gage Blocks                                 | Up to 4 in<br>(> 4 to 20) in   | (2.4 + 1.6L) µin<br>(3.1 + 1.6L) µin | Electronic comparator, master steel gage blocks |
| Caliper <sup>3</sup>                        | Up to 20 in<br>(> 20 to 40) in | (4.8L + 0.6R) µin<br>(370 + 6L) µin  | Gage blocks                                     |
| Micrometer <sup>3</sup>                     | Up to 12 in<br>(> 12 to 36) in | (4.8L + 0.6R) µin<br>(43 + 8.8L) µin | Gage blocks                                     |
| Bench Micrometers                           | Up to 10 in                    | (12 + 1.3L) µin                      | Gage blocks                                     |
| Dial, Digital & Test Indicator <sup>3</sup> | Up to 4 in                     | (4.8L + 0.6R) µin                    | Gage blocks                                     |
| Height Gages <sup>3</sup>                   | Up to 40 in                    | (4.8L + 0.6R) µin                    | Gage blocks                                     |
| Optical Flats                               | (1 to 8) in                    | 6.0 µin                              | Standard optical flat                           |

| Parameter/Equipment   | Range  | CMC <sup>2, 6</sup> (±)  | Comments   |
|---|--|--|--|
| Measuring Microscopes <sup>3</sup>  | Up to 12 in  | (95 + 3.0L) μin  | Glass scale  |
| Cylindrical Gages –<br><br>Plug & Pin Gages<br><br>Plain Ring Gages             | Up to 1 in<br>(> 1 to 4) in<br>(> 4 to 16) in<br><br>Up to 1 in<br>(> 1 to 4) in<br>(> 4 to 16) in | (6.8 + 0.7D) μin<br>(5.4 + 2.2D) μin<br>(10 + 1.7D) μin<br><br>(13 + 0.9D) μin<br>(13 + 1.2D) μin<br>(12 + 2.2D) μin | Universal measuring standard-Supra-500<br><br>Universal measuring standard-Supra-500 w/ID probes                         |
| Thread Wires  | (4 to 20) TPI<br>(> 20 to 80) TPI  | 17 μin<br>12 μin   | Supermicrometer™<br>Universal measuring standard-Supra-500   |
| Thread Plug Gage –<br><br>Pitch Diameter<br><br>Major Diameter                  | (4 to 20) TPI<br>(> 20 to 80) TPI<br><br>Up to 16 in   | (28 + 1.5D) μin<br>(24 + 0.5D) μin<br><br>(11 + 1.5D) μin  | Supermicrometer™<br>Universal measuring standard-Supra-500 w/ thread wires<br><br>Universal measuring standard-Supra-500 |
| Thread Plug Gage –<br><br>Minor Lead Angle<br><br>Major Minor Pitch Flank Angle | (4 to 80) TPI<br><br>Up to 6 in  | (95 + 5.4D) μin<br>(31 + 2.6D) μin<br>0.054°<br><br>(80 + 4.5L) μin<br>(84 + 3.8L) μin<br>(50 + 5.5L) μin<br>0°6'32' | Quest thread view machine<br><br>MicroScanner™   |
| Thread Ring Gage –<br><br>Major Minor Pitch Flank Angle                         | (80 to 4.5) TPI<br><br>Up to 6 in  | (67 + 0.5D) μin<br><br>(83 + 4.2L) μin<br>(81 + 4.9L) μin<br>(51 + 7.7L) μin<br>0°6'23'                              | Universal measuring standard-Supra-500 w/ probe<br><br>MicroScanner™   |

| Parameter/Equipment  | Range   | CMC <sup>2,6</sup> ( $\pm$ )                        | Comments                                       |
|--|---|---|--|
| Surface Plate <sup>3</sup> –<br>Flatness<br>Repeatability      | (18 x 18) in to (36 x 72) in                        | 13 $\mu$ in<br>28 $\mu$ in                          | Autocollimator<br>Repeat-o-meter               |
| Optical Comparator <sup>3</sup> –<br>X axis<br>Y axis<br>Angle | Up to 12 in<br>Up to 12 in<br>Up to 360°            | (46 + 4L) $\mu$ in<br>(47 + 3L) $\mu$ in<br>2.5 min | Gage blocks<br>Angle blocks                    |
| Angle Blocks <sup>3</sup>                                      | Up to 45°   | 2.1 arc sec   | Sine plate, gage blocks & electronic indicator |
| Crimping Tools <sup>3</sup>                                    | Up to 1 in diameter                                 | 160 $\mu$ in  | Pin gages, optical comparator & pull tester    |
| Precision Levels <sup>3</sup>                                  | (2 to 15) in  | 150 $\mu$ in  | Gage blocks                                    |
| Protractors/Clinometer <sup>3</sup>                            | Up to 180°  | 1.3 arc sec + 0.6R                                  | Sine plate w/ angle blocks                     |
| Surface Roughness Specimens                                    | Up to 400 $\mu$ in                                  | 0.62 $\mu$ in                                       | SurfTest w/ reference specimen                 |
| Profilometers  | Up to 400 $\mu$ in                                  | 0.55 $\mu$ in                                       | Surface roughness specimen                     |
| Rotary Table   | (1 to 360)°   | 4.1 arc sec   | Renishaw laser                                 |
| Steel Rules & Tapes –<br>Steel Rules<br>Measuring Tapes        | Up to 72 in<br>Up to 1200 in<br>(in 40 in segments) | 0.0027 in<br>(6600 + 16L) $\mu$ in                  | Kudale TSCU                                    |

IV. Dimensional Testing<sup>1</sup>

| Parameter/Equipment      | Range        | CMC <sup>2,6</sup> (±) | Comments                         |
|--------------------------|--------------|------------------------|----------------------------------|
| Length – 1D <sup>9</sup> | Up to 40 in  | 5.2 μin/in             | Gage blocks, CMM, Supra 500, etc |
|                          | Up to 110 in | (12 + 0.8L) μin        | Renishaw laser                   |

V. Electrical – DC/Low Frequency

| Parameter/Equipment                | Range  | CMC <sup>2,4</sup> (±)  | Comments   |
|------------------------------------|--|---|--|
| DC Voltage – Generate <sup>3</sup> | Up to 220 mV<br>220 mV to 2.2 V<br>(2.2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(220 to 1100) V   | 8.5 μV/V + 0.40 μV<br>5.2 μV/V + 0.70 μV<br>3.7 μV/V + 2.5 μV<br>3.7 μV/V + 4.0 μV<br>5.2 μV/V + 40 μV<br>6.7 μV/V + 0.40 mV  | Fluke 5720A  |
| DC Voltage – Measure <sup>3</sup>  | Up to 100 mV<br>(0.1 to 1) V<br>(1 to 10) V<br>(10 to 100) V<br>(100 to 1000) V  | 7.6 μV/V + 0.2 μV<br>4.1 μV/V + 0.3 μV<br>3.3 μV/V + 0.5 μV<br>5.6 μV/V + 30 μV<br>6.1 μV/V + 0.5 mV  | Fluke 8588A  |
| High Voltage                       | (1000 to 10 000) V<br>(10 000 to 70 000) V   | 0.042 % + 0.6R<br>0.048 % + 0.6R  | Vitretek 4700/HLV-70   |
| DC Current – Generate <sup>3</sup> | 20 nA to 220 μA<br>220 μA to 2.2 mA<br>(2.2 to 22) mA<br>(22 to 220) mA<br>220 mA to 2.2 A<br><br>(2.2 to 11) A<br><br>(11 to 20) A<br>(20 to 700) A | 45 μA/A + 6.0 nA<br>53 μA/A + 7.0 nA<br>38 μA/A + 40 nA<br>48 μA/A + 0.70 μA<br>85 μA/A + 12 A<br><br>410 μA/A + 0.48 mA<br><br>1.1 mA/A + 0.75 mA<br>1.5 mA/A + 0.52 A | Fluke 5720A<br><br>Fluke 5720A, Fluke 5725A<br><br>Fluke 5522A, Keysight 6680A, HP 3458A, current shunts |
| Clamp Meters                       | (16.5 to 150) A<br>(150 to 1000) A   | 0.59 % + 0.17 A<br>0.62 % + 0.54 A  | Fluke 5522A w/<br>Fluke 5500 coils   |

| Parameter/Equipment               | Range                         | CMC <sup>2, 4, 6</sup> ( $\pm$ )       | Comments             |                       |             |
|-----------------------------------|-------------------------------|--|----------------------|-----------------------|-------------|
| DC Current – Measure <sup>3</sup> | (10 to 20) pA                 | 1.2 % + 3.5 fA                         | Keithley 6517A       |                       |             |
|                                   | (20 to 200) pA                | 1.2 % + 6 fA                           |                      |                       |             |
|                                   | (0.2 to 2) nA                 | 0.27 % + 0.32 pA                       |                      |                       |             |
|                                   | (2 to 20) nA                  | 0.24 % + 0.6 pA                        |                      |                       |             |
|                                   | (20 to 100) nA                | 0.022 % + 60 pA                        | HP 3458A, option 002 |                       |             |
|                                   | 100 nA to 1 $\mu$ A           | 36 $\mu$ A/A + 60 pA                   |                      |                       |             |
|                                   | (1 to 10) $\mu$ A             | 27 $\mu$ A/A + 0.14 nA                 |                      |                       |             |
|                                   | (10 to 100) $\mu$ A           | 33 $\mu$ A/A + 1.1 nA                  |                      |                       |             |
|                                   | 100 $\mu$ A to 1 mA           | 32 $\mu$ A/A + 7.0 nA                  |                      |                       |             |
|                                   | (1 to 10) mA                  | 31 $\mu$ A/A + 70 nA                   |                      |                       |             |
| (10 to 100) mA                    | 50 $\mu$ A/A + 0.70 nA        |  |                      |                       |             |
| 100 mA to 1A                      | 0.014 % + 13 $\mu$ A          |  |                      |                       |             |
| (1 to 10) A                       | 0.028 % + 0.43 mA             | Fluke 8588A                            |                      |                       |             |
| (10 to 30) A                      | 0.07 % + 4.4 mA               |  |                      |                       |             |
| (30 to 100) A                     | 0.026 %                       | HP 3458A, current shunts               |                      |                       |             |
| (100 to 700) A                    | 0.038 %                       |  |                      |                       |             |
| Resistance – Generate             | (0 to 10.9999) $\Omega$       | 46 $\mu\Omega/\Omega$ + 1 m $\Omega$   | Fluke 5522A          |                       |             |
|                                   | (11 to 32.9999) $\Omega$      | 32 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ |                      |                       |             |
|                                   | (33 to 109.9999) $\Omega$     | 32 $\mu\Omega/\Omega$ + 1.4 m $\Omega$ |                      |                       |             |
|                                   | (110 to 329.9999) $\Omega$    | 29 $\mu\Omega/\Omega$ + 2 m $\Omega$   |                      |                       |             |
|                                   | (0.33 to 1.099999) k $\Omega$ | 29 $\mu\Omega/\Omega$ + 2 m $\Omega$   |                      |                       |             |
|                                   | (1.1 to 3.299999) k $\Omega$  | 30 $\mu\Omega/\Omega$ + 20 m $\Omega$  |                      |                       |             |
|                                   | (3.3 to 10.99999) k $\Omega$  | 29 $\mu\Omega/\Omega$ + 20 m $\Omega$  |                      |                       |             |
|                                   | (11 to 32.99999) k $\Omega$   | 31 $\mu\Omega/\Omega$ + 0.2 $\Omega$   |                      |                       |             |
|                                   | (33 to 109.9999) k $\Omega$   | 30 $\mu\Omega/\Omega$ + 0.2 $\Omega$   |                      |                       |             |
|                                   | (110 to 329.9999) k $\Omega$  | 34 $\mu\Omega/\Omega$ + 7 $\Omega$     |                      |                       |             |
|                                   | (0.33 to 1.099999) M $\Omega$ | 33 $\mu\Omega/\Omega$ + 7 $\Omega$     |                      |                       |             |
|                                   | (1.1 to 3.299999) M $\Omega$  | 63 $\mu\Omega/\Omega$ + 50 $\Omega$    |                      |                       |             |
|                                   | (3.3 to 10.99999) M $\Omega$  | 0.016 % + 70 $\Omega$                  |                      |                       |             |
|                                   | (11 to 32.99999) M $\Omega$   | 0.027 % + 2.7 k $\Omega$               |                      |                       |             |
|                                   | (33 to 109.9999) M $\Omega$   | 0.056 % + 3.2 k $\Omega$               |                      |                       |             |
|                                   | Fixed Points <sup>3</sup>     | (1, 1.9) $\Omega$                      |                      | 0.011 %               | Fluke 5720A |
|                                   |                               | (10, 19) $\Omega$                      |                      | 37 $\mu\Omega/\Omega$ |             |
| (100, 190) $\Omega$               |                               | 12 $\mu\Omega/\Omega$                  |                      |                       |             |
| (1, 1.9) k $\Omega$               |                               | 11 $\mu\Omega/\Omega$                  |                      |                       |             |
| (10, 19) k $\Omega$               |                               | 9.5 $\mu\Omega/\Omega$                 |                      |                       |             |
| (100, 190) k $\Omega$             |                               | 24 $\mu\Omega/\Omega$                  |                      |                       |             |
| (1, 1.9) M $\Omega$               |                               | 43 $\mu\Omega/\Omega$                  |                      |                       |             |
| 10 M $\Omega$                     |                               | 43 $\mu\Omega/\Omega$                  |                      |                       |             |
| 19 M $\Omega$                     |                               | 71 $\mu\Omega/\Omega$                  |                      |                       |             |
| 100 M $\Omega$                    |                               | 0.015 %                                |                      |                       |             |



| Parameter/Equipment                 | Range  | CMC <sup>2, 4, 5</sup> (±)  | Comments    |
|-------------------------------------|--|---|-------------|
| Capacitance – Generate <sup>3</sup> | (0.22 to 0.4) nF<br>(0.40 to 1.1) nF<br>(1.1 to 3.3) nF<br>(3.3 to 11) nF<br>(11 to 33) nF<br>(33 to 110) nF<br>(0.11 to 0.33) μF<br>(0.33 to 1.1) μF<br>(1.1 to 3.3) μF<br>(3.3 to 11) μF<br>(11 to 33) μF<br>(33 to 110) μF<br>(0.11 to 0.33) mF<br>(0.33 to 1.1) mF<br>(1.1 to 3.3) mF<br>(3.3 to 11) mF<br>(11 to 33) mF<br>(33 to 110) mF | 0.54 % + 0.010 nF<br>0.54 % + 0.010 nF<br>0.51 % + 0.010 nF<br>0.26 % + 0.010 nF<br>0.26 % + 0.10 nF<br>0.26 % + 0.10 nF<br>0.26 % + 0.30 nF<br>0.26 % + 1.0 nF<br>0.26 % + 30 nF<br>0.26 % + 10 nF<br>0.41 % + 30 nF<br>0.47 % + 0.10 μF<br>0.47 % + 0.30 μF<br>0.46 % + 1.0 μF<br>0.53 % + 3.0 μF<br>0.54 % + 10 μF<br>0.88 % + 30 μF<br>1.3 % + 0.1 mF | Fluke 5522A |

| Parameter/Range                    | Frequency  | CMC <sup>2, 4</sup> (±)  | Comments                 |
|------------------------------------|--|--|--------------------------|
| AC Voltage – Generate <sup>3</sup> |  |  |                          |
| 300 μV 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>(0.5 to 1.0) MHz | 0.15 % + 4.0 μV<br>0.11 % + 4.0 μV<br>0.09 % + 4.0 μV<br>0.14 % + 4.0 μV<br>0.17 % + 5.0 μV<br>0.23 % + 10 μV<br>0.51 % + 20 μV<br>0.59 % + 20 μV      | Fluke 5720A, Fluke 5725A |
| (2.2 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>(0.5 to 1.0) MHz | 0.040 % + 4.0 μV<br>0.019 % + 4.0 μV<br>0.015 % + 4.0 μV<br>0.034 % + 4.0 μV<br>0.059 % + 5.0 μV<br>0.12 % + 10 μV<br>0.19 % + 20 μV<br>0.30 % + 20 μV |                          |



| Parameter/Range                              | Frequency  | CMC <sup>2,4</sup> ( $\pm$ )  | Comments                 |
|--|--|---|--------------------------|
| AC Voltage – Generate <sup>3</sup><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>(0.5 to 1.0) MHz | 0.026 % + 12 $\mu$ V<br>0.010 % + 7.0 $\mu$ V<br>0.016 % + 7.0 $\mu$ V<br>0.024 % + 7.0 $\mu$ V<br>0.049 % + 17 $\mu$ V<br>0.095 % + 20 $\mu$ V<br>0.14 % + 25 $\mu$ V<br>0.29 % + 45 $\mu$ V | Fluke 5720A, Fluke 5725A |
| 220 mV to 2.2 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>(0.5 to 1.0) MHz | 0.025 % + 40 $\mu$ V<br>0.010 % + 15 $\mu$ V<br>0.0051 % + 8.0 $\mu$ V<br>0.0087 % + 10 $\mu$ V<br>0.013 % + 30 $\mu$ V<br>0.043 % + 80 $\mu$ V<br>0.10 % + 0.20 mV<br>0.18 % + 0.30 mV       |                          |
| (2.2 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>(0.5 to 1.0) MHz | 0.025 % + 0.40 mV<br>0.010 % + 0.15 mV<br>0.005 % + 50 $\mu$ V<br>0.086 % + 0.10 mV<br>0.012 % + 0.20 mV<br>0.030 % + 0.60 mV<br>0.10 % + 2.0 mV<br>0.16 % + 3.2 mV                           |                          |
| (22 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   | 0.026 % + 4.0 mV<br>0.010 % + 1.5 mV<br>0.0058 % + 0.60 mV<br>0.011 % + 1.0 mV<br>0.019 % + 2.5 mV  |                          |
| (220 to 750) V                               | (15 to 50) Hz<br>50 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz  | 0.031 % + 16 mV<br>0.008 % + 3.5 mV<br>0.017 % + 6.0 mV<br>0.06% + 11 mV<br>0.23% + 45 mV   |                          |
| (750 to 1100) V                              | (15 to 50) Hz<br>50 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 30) kHz   | 0.031 % + 16 mV<br>0.008 % + 3.5 mV<br>0.017 % + 6.0 mV<br>0.06 % + 11 mV   |                          |

| Parameter/Range  | Frequency  | CMC <sup>2,4</sup> (±)  | Comments           |
|--|--|---|--------------------|
| AC Voltage – Measure <sup>3</sup>                          |  |   | Fluke 8588A        |
| Up to 10 mV  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.034 % + 1.1 μV<br>0.042 % + 1.1 μV<br>0.048 % + 1.1 μV<br>0.32 % + 1.1 μV<br>1.1 % + 4.0 μV<br>2.2 % + 4.0 μV   |                    |
| (10 to 100) mV   | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.007 % + 0.5 μV<br>0.012 % + 0.5 μV<br>0.024 % + 1 μV<br>0.055 % + 5 μV<br>0.23 % + 30 μV<br>1.2 % + 100 μV      |                    |
| 100 mV to 1 V  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.009 % + 5 μV<br>0.012 % + 5 μV<br>0.023 % + 10 μV<br>0.055 % + 50 μV<br>0.21 % + 0.3 mV<br>1.1 % + 1 mV         |                    |
| (1 to 10) V  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.007 % + 0.05 mV<br>0.012 % + 0.05 mV<br>0.022 % + 0.1 mV<br>0.055 % + 0.5 mV<br>0.23 % + 3 mV<br>0.12 % + 10 mV |                    |
| (10 to 100) V  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.01 % + 0.5 mV<br>0.012 % + 0.5 mV<br>0.025 % + 1 mV<br>0.061 % + 5 mV<br>0.39 % + 50 mV<br>0.12 % + 500 mV      |                    |
| (100 to 1000) V  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz  | 0.1 % + 25 mV<br>0.1 % + 25 mV<br>0.027 % + 25 mV<br>0.059 % + 100 mV   |                    |
| High Voltage<br>(1000 to 10 000) V<br>(10 000 to 50 000) V | 60 Hz<br>60 Hz   | 0.18 % + 0.6R<br>0.14 % + 0.6R  | Vitrek 4700/HLV-70 |

| Parameter/Range                    | Frequency   | CMC <sup>2,4,6</sup> (±)  | Comments                   |
|------------------------------------|---|---|----------------------------|
| AC Current – Generate <sup>3</sup> |   |   |                            |
| Up to 220 µA                       | (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 | 0.028 % + 16 nA<br>0.019 % + 10 nA<br>0.016 % + 8.0 nA<br>0.032 % + 12 nA<br>0.12 % + 65 nA         | Fluke 5720A, Fluke 5725A   |
| 220 µA 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 | 0.027 % + 40 nA<br>0.018 % + 35 nA<br>0.013 % + 35 nA<br>0.025 % + 0.11 µA<br>0.11 % + 0.65 µA      |                            |
| (2.2 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 | 0.028 % + 0.40 µA<br>0.018 % + 0.35 µA<br>0.015 % + 0.35 µA<br>0.024 % + 0.55 µA<br>0.11 % + 5.0 µA |                            |
| (22 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 | 0.028 % + 4.0 µA<br>0.018 % + 3.5 µA<br>0.017 % + 2.5 µA<br>0.026 % + 3.5 µA<br>0.12 % + 10 µA      | Fluke 5720A                |
| 220 mA to 2.2 A                    | 20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                   | 0.030 % + 35 µA<br>0.051 % + 80 µA<br>0.73 % + 0.16 mA  |                            |
| (2.2 to 11) A                      | 40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                   | 0.50 % + 0.17 mA<br>0.10 % + 0.38 mA<br>0.36 % + 0.75 mA  |                            |
| (11 to 20.5) A                     | (45 to 100) Hz<br>100 Hz to 1 kHz<br>(1 to 5) kHz                                 | 0.14 % + 5 mA<br>0.17 % + 5 mA<br>3.4 % + 0.75 mA   | Fluke 5522A                |
| Clamp Meters                       |   |   |                            |
| (20.5 to 150) A                    | (45 to 65) Hz<br>(65 to 400) Hz   | 0.48 % + 0.035 A<br>0.79 % + 0.077 A  | Fluke 5522A<br>w/5500 coil |
| (150 to 1025) A                    | (45 to 65) Hz<br>(65 to 400) Hz   | 0.58 % + 0.19 A<br>1.5 % + 0.35 A   |                            |

| Parameter/Range   | Frequency  | CMC <sup>2, 4</sup> (±)  | Comments              |
|---|--|--|-----------------------|
| AC Current – Measure <sup>3</sup>   |  |  |                       |
| Up to 20 µA   | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz                               | 0.21 % + 2.5 nA<br>0.21 % + 2.5 nA<br>0.23 % + 2.5 nA                    | Fluke 8588A           |
| (20 to 200) µA  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz            | 0.03 % + 5 nA<br>0.062 % + 5 nA<br>0.09 % + 5 nA<br>0.45% + 10 nA        |                       |
| 200 µA to 2 mA  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz            | 0.028 % + 50 nA<br>0.053 % + 50 nA<br>0.09 % + 50 nA<br>0.045 % + 0.1 µA |                       |
| (2 to 20) mA  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz            | 0.029 % + 0.5 µA<br>0.055 % + 0.5 µA<br>0.09 % + 0.5 µA<br>0.46 % + 1 µA |                       |
| (20 to 200) mA  | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz                               | 0.029 % + 5 µA<br>0.054 % + 5 µA<br>0.074 % + 5 µA                       |                       |
| 200 mA to 2 A   | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz                               | 0.031 % + 0.1 mA<br>0.084 % + 0.1 mA<br>0.084 % + 0.1 mA                 |                       |
| (2 to 20) A   | 1 Hz to 2 kHz<br>(2 to 10) kHz   | 0.089 % + 0.1 mA<br>0.11 % + 0.5 mA                                      |                       |
| (20 to 30) A  | 1 Hz to 2 kHz<br>(2 to 10) kHz   | 0.085 % + 12 mA<br>0.15 % + 12 mA  |                       |
| Oscilloscopes <sup>3</sup> –  |  |  |                       |
| Amplitude DC Signal<br>Into 50 Ω Load<br>Into 1 MΩ Load   | (-6.6 to 6.6) V<br>(-130 to 130) V   | 0.25 % + 40 µV<br>0.050 % + 40 µV  | Fluke<br>5522A/SC1100 |
| Rise Time   | < 300 ps   | +0 ps/-100 ps  |                       |
| Leveled Sine Wave<br>Flatness,<br>Relative to 50 kHz<br>5 mV <sub>(p-p)</sub> to 5.5 V <sub>(p-p)</sub> | 50 Hz to 100 MHz<br>(100 to 300) MHz<br>(300 to 600) MHz<br>600 MHz to 1.1 GHz | 1.5 % + 100 µV<br>2.0 % + 100 µV<br>4.0 % + 100 µV<br>5.0 % + 100 µV     |                       |
| Time Marker<br>Into 50 Ω Load   | (5 to 50) ms<br>20 ms to 2 ns  | (25 + 1000t) parts in 10 <sup>6</sup><br>2.5 parts in 10 <sup>6</sup>    |                       |
|   |  |  | t is time in seconds  |

| Parameter/Range                | Frequency  | CMC <sup>2,4</sup> (±)           | Comments                 |
|--------------------------------|--|----------------------------------|--------------------------|
| Tachometers <sup>3</sup>       | (6 to 99 999) RPM  | 0.004 %                          | Frequency standard w/LED |
| Phase – Measure<br>(0 to 360)° | 5 Hz to 2 kHz<br>(2 to 5) kHz<br>(5 to 10) kHz<br>(10 to 50) kHz | 0.03°<br>0.04°<br>0.05°<br>0.06° | Clark Hess 6000A         |

VI. Electrical – RF/Microwave

| Parameter/Range  | Frequency   | CMC <sup>2,4,5</sup> (±)                      | Comments  |
|--|---|---|---|
| Power Sensor – Calibration Factors<br><br>(-30 to 20) dBm<br>(-30 to 20) dBm   | 0.1 MHz to 4.2 GHz<br>50 MHz to 26.5 GHz  | 2.8 % <i>CF</i><br>3.5 % <i>CF</i>            | Agilent power sensors<br>8482A & 8485A<br><br><i>CF</i> is calibration factor |
| Amplitude Modulation <sup>3</sup> –<br><br>Carrier: (0.15 to 10) MHz<br>Depth: Up to 99 %<br><br>Carrier: 10 MHz to 1.3 GHz<br>Depth: Up to 99 %   | (20 to 50) Hz<br>50 Hz to 10 kHz<br><br>(20 to 50) Hz<br>50 Hz to 50 kHz<br>(50 to 100) kHz | 3.8 %<br>2.7 %<br><br>3.8 %<br>1.6 %<br>3.8 % | HP 8902A measuring receiver w/ 11722A power sensor                            |
| Frequency Modulation <sup>3</sup> –<br><br>Carrier: 250 kHz to 10 MHz<br>Dev: Up to 40 kHz<br><br>Carrier: 10 MHz to 1.3 GHz<br>Dev: Up to 400 kHz | 20 Hz to 10 kHz<br><br>(20 to 50) Hz<br>50 Hz to 100 kHz<br>(100 to 200) kHz                | 2.9 %<br><br>5.9 %<br>1.3 %<br>5.9 %          | HP 8902A measuring receiver w/ 11722A power sensor                            |

| Parameter/Range  | Frequency                            | CMC <sup>2, 4, 5</sup> (±)   | Comments   |
|--|--------------------------------------|--|--|
| Phase Modulation <sup>3</sup> –<br>Carrier: 150 kHz to 10 MHz<br>Carrier: 10 MHz to 1.3 GHz  | 200 Hz to 10 kHz<br>200 Hz to 20 kHz | 4.8 %<br>3.7 %   | HP 8902A measuring receiver w/ 11722A power sensor           |
| Absolute Power – Measure <sup>3</sup><br><br>(0 to -10) dBm<br>(-10 to -20) dBm<br>(-20 to -30) dBm<br>(-30 to -40) dBm<br>(-40 to -50) dBm<br>(-50 to -60) dBm<br>(-60 to -70) dBm<br>(-70 to -80) dBm<br>(-80 to -90) dBm<br>(-90 to -100) dBm<br>(-100 to -110) dBm<br>(-110 to -120) dBm | 10 MHz to 26.5 GHz                   | 0.08 dB<br>0.10 dB<br>0.12 dB<br>0.13 dB<br>0.15 dB<br>0.17 dB<br>0.20 dB<br>0.23 dB<br>0.28 dB<br>0.33 dB<br>0.39 dB<br>0.43 dB | HP 8902A measuring receiver w/ 11722A & 11792A power sensors |

## VII. Fluid Quantities

| Parameter/Equipment        | Range   | CMC <sup>2, 5, 8</sup> (±)  | Comments  |
|----------------------------|---|---|---|
| Flow – Gas <sup>3</sup>    | (0.5 to 5) sccm<br>(5 to 50) sccm<br>(0.05 to 0.5) lpm<br>(0.5 to 5) lpm<br>(3 to 30) lpm<br>(30 to 100) lpm<br><br>(100 to 2500) lpm | 1.2 %<br>1.2 %<br>0.28 %<br>0.26 %<br>0.42 %<br>0.65 %<br><br>1.2 % | DH instruments flow meter calibrator Molbox1<br><br><br><br><br><br>Alicat MCR2500SLM |
| Flow – Liquid <sup>3</sup> | (0.02 to 3) gpm<br>(0.5 to 60.0) gpm<br>(1.5 to 160) gpm  | 0.11 %<br>0.09 %<br>0.09 %  | Flow technology turbine meter   |

VIII. Magnetic Quantities

| Parameter/Equipment      | Range            | CMC <sup>2, 5</sup> (±) | Comments                           |
|--------------------------|------------------|-------------------------|------------------------------------|
| Gauss Meter <sup>3</sup> | (1 to 200) Gauss | 0.88 %                  | Helmholtz coil, zero gauss chamber |

IX. Optical Quantities

| Parameter/Equipment   | Range  | CMC <sup>2, 5, 8</sup> (±)  | Comments                                    |
|---|--|---|---|
| Illuminance –<br>Light meters   | (5 to 200) fc<br>(200 to 2000) fc  | 2.8 %<br>3.1 %  | Hoffman light source w/ PCS 600 light meter |
| Optical Wavelength – Measure  | (700 to 1650) nm   | 0.00048%  | Keysight 86120A                             |
| Optical Absolute Power - Measure  | -20 dBm @ 850 nm<br>-20 dBm @ 1550 nm  | 0.091 dBm<br>0.090 dBm  | Agilent 81624A                              |
| Optical Power Linearity – Measure<br><br>850 nm<br><br>1310 nm<br><br>1550 nm | 0 dBm<br>-10 dBm<br>-20 dBm<br>-30 dBm<br>-40 dBm<br>-50 dBm<br><br>0 dBm<br>-10 dBm<br>-20 dBm<br>-30 dBm<br>-40 dBm<br>-50 dBm<br><br>0 dBm<br>-10 dBm<br>-20 dBm<br>-30 dBm<br>-40 dBm<br>-50 dBm | 0.022 dBm<br>0.024 dBm<br>0.023 dBm<br>0.024 dBm<br>0.024 dBm<br>0.024 dBm<br>0.029 dBm<br><br>0.023 dBm<br>0.024 dBm<br>0.025 dBm<br>0.025 dBm<br>0.027 dBm<br>0.030 dBm<br><br>0.022 dBm<br>0.025 dBm<br>0.023 dBm<br>0.024 dBm<br>0.024 dBm<br>0.030 dBm | Agilent 81624A                              |

X. Mechanical

| Parameter/Equipment                                | Range   | CMC <sup>2, 5, 6, 8</sup> (±)   | Comments  |                      |
|--|---|---|---|----------------------|
| Pressure Gauges & Transducer / Vacuum <sup>3</sup> | Pneumatic   | (0 to 17) psia<br>Up to 600 psig<br>Up to 3000 psig<br>Up to 6000 psig  | Mensor CPC 8000   |                      |
|  |   | Up to 10 000 psig   | DH Instruments pressure calibrator, PPCH-G  |                      |
|  | Hydraulic   | (5 to 40 000) psig  | 0.030 %   | Ruska Model 2450-701 |
|  |   | (725 to 72 500) psi   | 0.030 %   | DH-Budenberg 5306    |
| Torque Analyzers <sup>3</sup>                      | (1 to 10) ozf·in<br>(10 to 100) ozf·in<br>(4 to 50) lbf·in<br>(30 to 400) lbf·in<br>(80 to 1000) lbf·in<br>(20 to 250) lbf·ft<br>(200 to 2000) lbf·ft | 0.16 %<br>0.12 %<br>0.065 %<br>0.025 %<br>0.026 %<br>0.017 %<br>0.086 % | Torque arms w/ Class F weights  |                      |
| Torque Tools <sup>3</sup>                          | (1 to 10) ozf·in<br>(10 to 100) ozf·in<br>(4 to 50) lbf·in<br>(30 to 400) lbf·in<br>(80 to 1000) lbf·in<br>(20 to 250) lbf·ft<br>(200 to 2000) lbf·ft | 0.11 %<br>0.01 %<br>0.19 %<br>0.51 %<br>0.34 %<br>0.34 %<br>0.36 %      | Mountz MTX10Z<br>AWS: QC10-100<br><br>CDI torque, force & tension calibration system, Model: 200-400-02 |                      |
| Air Velocity Instruments                           | (25 to 350) fpm<br>(350 to 1000) fpm<br>(1000 to 9000) fpm  | 2.6 %<br>2.4 %<br>1.3%  | Omega WT4401-D petit tube   |                      |
| Force Gages & Transducers <sup>3</sup>             | (1 to 100) lbf<br>(1 to 1000) lbf   | 0.049 %<br>0.037 %  | Dead weights  |                      |
|  | (350 to 1000) lbf<br>(1000 to 30 000) lbf   | 0.12 %<br>0.026 % + 1.5 lbf   | Morehouse force machine w/ load cell  |                      |
|  | (30 000 to 100 000) lbf   | 0.028 %   |   |                      |



| Parameter/Equipment   | Range   | CMC <sup>2, 5, 6, 8</sup> (±)   | Comments  |
|---|---|---|---|
| Durometer Calibrator –<br>A-Scale<br>D-Scale  | (56.08 to 820.87) g<br>(0 to 4.53) kg   | 2.6 g<br>0.012 kg   | 25 lbf load cell  |
| Pipettes  | ≤ 10 µL<br>≤ 100 µL<br>≤ 1000 µL<br>≤ 5 mL<br>≤ 10 mL   | 0.015 µL<br>0.017 µL<br>0.040 µL<br>0.045 µL<br>0.066 µL  | Sartorius CC111,<br>Sartorius WZA 225-CW<br>mass comparator |
| Durometers –<br>Type A, B, O<br>Type C, D, DO<br><br>Indentor Geometry<br>Length<br>Diameter<br>Angle<br>Radius | (0 to 100) DUROS<br>(0 to 100) DUROS<br><br>Up to 0.2 in<br>Up to 1 in<br>(0 to 90)°<br>Up to 1 in                              | 0.52 DUROS<br>0.46 DUROS<br><br>0.58 m·in<br>0.41 m·in<br>0.049°<br>0.18 m·in   | REX-1 durometer<br>calibrator<br><br>Optical comparator     |
| Indirect Verification of<br>Rockwell Hardness<br>Testers <sup>3</sup>   | HRA<br>Low<br>Mid<br>High<br><br>HRBW<br>Low<br>Mid<br>High<br><br>HRC<br>Low<br>Mid<br>High<br><br>HR15N<br>Low<br>Mid<br>High | 0.31 HRA<br>0.22 HRA<br>0.19 HRA<br><br>0.60 HRBW<br>0.50 HRBW<br>0.68 HRBW<br><br>0.56 HRC<br>0.46 HRC<br>0.40 HRC<br><br>0.54 HR15N<br>0.47 HR15N<br>0.61 HR15N | ASTM E18  |

| Parameter/Equipment  | Range  | CMC <sup>2,8</sup> (±)  | Comments                              |
|--|--|---|---------------------------------------|
| Indirect Verification of Rockwell Hardness Testers <sup>3</sup> (cont) | HR15TW<br>Low<br>Mid<br>High<br><br>HR30N<br>Low<br>Mid<br>High<br><br>HR30TW<br>Low<br>Mid<br>High<br><br>HR45N<br>Low<br>Mid<br>High<br><br>HR45TW<br>Low<br>Mid<br>High | 0.29 HR15TW<br>0.29 HR15TW<br>0.47 HR15TW<br><br>0.35 HR30N<br>0.52 HR30N<br>0.57 HR30N<br><br>0.40 HR30TW<br>0.38 HR30TW<br>0.34 HR30TW<br><br>0.56 HR45N<br>0.35 HR45N<br>0.29 HR45N<br><br>0.89 HR45TW<br>0.62 HR45TW<br>0.61 HR45TW |                                       |
| Direct Verification of Rockwell Hardness Testers <sup>3</sup>          |  |   |                                       |
| Verification of Test Force   | (15 to 150) kgf  | 0.08 % + 0.01 kgf   | Load cell                             |
| Verification of Depth-Measuring Device                                 | (0 to 260) µm  | 0.17 µm   | Digital indicator system              |
| Accelerometers –   |  |   |                                       |
| Vibration Sensitivity/Frequency Response                               | (0.5 to 10) Hz<br>(5 to 10 000) Hz<br>(10 000 to 15 000) Hz  | 1.7 %<br>1.9 %<br>2.2 %   | Modal Shop 9155 w/ PCB accelerometers |
| Shock - Linearity  | Up to 10 000 g   | 2.3 %   |                                       |
| Dynamic Pressure - Linearity   | Up to 15 000 psi   | 3.1 %   |                                       |

| Parameter/Equipment     | Range   | CMC <sup>2, 8</sup> (±)   | Comments                                       |
|-------------------------|---|---|--|
| Balances <sup>3</sup>   | Up to 310 g<br>Up to 4100 g<br>Up to 15 kg  | 0.3 mg + 0.6R<br>48 mg + 0.6R<br>0.52 g + 0.6R  | Class 1 master weights                         |
| Scales <sup>3</sup>     | Up to 100 lb<br>Up to 1000 lb<br><br>Up to 7200 lb  | 7.7 g + 0.6R<br>0.12 kg + 0.6R<br><br>0.051 % + 0.6R  | Class 4 master weights<br><br>Standard weights |
| Mass – Measure (Metric) | 30 kg<br>25 kg<br>20 kg<br>10 kg<br>5 kg<br>3 kg<br>2 kg<br>1 kg<br>500g<br>300 g<br>200 g<br>100 g<br>50 g<br>30 g<br>20 g<br>10 g<br>5 g<br>3 g<br>2 g<br>1 g<br>500 mg<br>300 mg<br>200 mg<br>100 mg<br>50 mg<br>30 mg<br>20 mg<br>10 mg<br>5 mg<br>3 mg<br>2 mg<br>1 mg | 15 mg<br>13 mg<br>10 mg<br>5.3 mg<br>2.3 mg<br>4.9 mg<br>2.3 mg<br>1.6 mg<br>0.57 mg<br>0.36 mg<br>0.19 mg<br>0.19 mg<br>73 µg<br>64 µg<br>6.8 µg<br>6.1 µg<br>4.3 µg<br>4.2 µg<br>4.5 µg<br>2.9 µg<br>2.7 µg<br>3.2 µg<br>2.5 µg<br>2.5 µg<br>2.4 µg<br>3.0 µg<br>2.4 µg<br>2.4 µg<br>2.5 µg<br>2.9 µg<br>2.5 µg<br>2.4 µg | Single substitution                            |

| Parameter/Equipment             | Range                                   | CMC <sup>2, 8</sup> (±)   | Comments            |
|---------------------------------|---|---|---------------------|
| Mass – Measure<br>(Avoirdupois) | 1 lb<br>5 lb<br>10 lb<br>25 lb<br>50 lb | 5.3 µlb (2.4 mg)<br>5.3 µlb (2.4 mg)<br>2.1 µlb (9.5 mg)<br>11 µlb (4.8 mg)<br>33 µlb (15 mg) | Single substitution |
|                                 | 500 lb<br>1000 lb                       | 0.026 lb (12 g)<br>0.068 lb (31 g)  | Load cell           |

#### XI. Thermodynamics

| Parameter/Equipment                               | Range  | CMC <sup>2, 5, 6, 8</sup> (±)   | Comments   |                               |
|---|--|---|--|-------------------------------|
| Temperature – Measure &<br>Measuring Equipment    | (-196 to -80) °C<br>(-80 to 100) °C<br>(100 to 660) °C | 0.034 °C<br>0.021 °C<br>0.039 °C  | Fluke 1560 w/SPRT,<br>TempSens cal-sys<br>-196/-80 & Fluke 7380    |                               |
|   | (400 to 1600) °C                                       | 0.27 % + 0.6R   | Type R TC w/<br>TempSens cal-sys 1700                              |                               |
| Infrared / Pyrometers <sup>3</sup>                | (50 to 500) °C   | 1.4 °C + 0.6R   | Fluke 9132<br>ε 0.95<br>λ 8 to 14 µm                               |                               |
|   | (150 to 1200) °C                                       | 0.48 % + 0.6R   | IsoTech Pegasus R970<br>ε 0.995<br>λ 9 to 14 µm                    |                               |
| Humidity – Measuring<br>Equipment                 | (10 to 30) °C  | (5 to 15) % RH<br>(5 to 25) % RH<br>(25 to 35) % RH<br>(35 to 50) % RH<br>(50 to 65) % RH<br>(65 to 80) % RH<br>(80 to 95) % RH | 0.40 %<br>0.49 %<br>0.52 %<br>0.59 %<br>0.62 %<br>0.66 %<br>0.83 % | Rotronic HC2-SH &<br>GEO 2000 |
| Temperature – Measuring<br>Equipment, Fixed Point | Triple Point of Water                                  | 8.3 mK  | Pond Engineering TPW   |                               |
|   | Liquid Nitrogen  | 7.5 mK  |  |                               |

| Parameter/Equipment  | Range            | CMC <sup>2, 5, 6, 8</sup> ( $\pm$ ) | Comments                      |
|--|------------------|-------------------------------------|-------------------------------|
| Humidity – Measure <sup>3</sup>  |                  |                                     |                               |
| (-50 to 90) °C   | (Frost Point)    | 1.1 °C                              | Chilled mirror                |
|  | (Dew Point)      | 0.14 °C                             |                               |
| (10 to 30) °C  | (5 to 15) % RH   | 0.20 %                              | Rotronic HC2-SH               |
|  | (5 to 25) % RH   | 0.35 %                              |                               |
|  | (25 to 35) % RH  | 0.40 %                              |                               |
| (10 to 30) °C  | (35 to 50) % RH  | 0.47 %                              | Rotronic HC2-SH               |
|  | (50 to 65) % RH  | 0.51 %                              |                               |
|  | (65 to 80) % RH  | 0.56 %                              |                               |
|  | (80 to 95) % RH  | 0.75 %                              |                               |
| Dew Point  | (100 to -65) °C  | 0.32 °C                             | Edge tech 1500                |
| Environmental Chambers, Ovens, Furnaces, Freezers, Temperature Baths & Dry Wells <sup>10</sup> | (-80 to 1000) °C | 2.0 °C                              | Type K TCs & Vaisala RH probe |

## XII. Time & Frequency

| Parameter/Equipment            | Range                   | CMC <sup>2, 8</sup> ( $\pm$ )    | Comments                                     |
|--------------------------------|-------------------------|----------------------------------|--|
| Frequency –Measuring Equipment | 10 MHz Reference Signal | 2.0 parts in 10 <sup>10</sup> Hz | Datum 9390-6000 w/ GPS                       |
| Frequency – Measure            |                         |                                  | 10 MHz signal from Datum 9390-6000 w/GPS to: |
|                                | 1 MHz to 40 GHz         | 9.3 parts in 10 <sup>9</sup> Hz  | 53131 counter                                |
|                                |                         | 1.4 part in 10 <sup>7</sup> Hz   | 53152A counter                               |
| Stopwatches                    | Up to 24 hrs            | 0.048 s/day                      | Timometer 4500                               |

- <sup>1</sup> This laboratory offers commercial dimensional testing and calibration service.
- <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 calibration service is available for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g., resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.
- <sup>4</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 percent or fraction of the reading plus a fixed floor specification.
- <sup>5</sup> In the statement of CMC, percentages are to be read as percent of reading, unless noted otherwise.
- <sup>6</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches,  $R$  is the numerical value of the resolution of the device under test in microinches,  $D$  is the numerical value of the nominal diameter of the device measured in inches.
- <sup>7</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.
- <sup>8</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>9</sup> This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.
- <sup>10</sup> The contributions from the “best existing device” are not included in the CMC claim.



## Accredited Laboratory

A2LA has accredited

### MICRO QUALITY CALIBRATION, INC.

Chatsworth, CA

for technical competence in the field of

### Calibration

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



Presented this 30<sup>th</sup> day of January 2023.

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 2348.01  
Valid to January 31, 2025  
Revised November 6, 2024

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