



# CERTIFICATE OF ACCREDITATION

## The ANSI National Accreditation Board

Hereby attests that

**OCS Technologies, Inc.**  
(dba: Ohio Counting Scale / Omni Calibration Services)  
14901 Emery Avenue  
Cleveland, OH 44135

Fulfills the requirements of

**ISO/IEC 17025:2017**

In the fields of

**CALIBRATION and DIMENSIONAL MEASUREMENT**

This certificate is valid only when accompanied by a current scope of accreditation document.  
The current scope of accreditation can be verified at [www.anab.org](http://www.anab.org).

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 27 November 2022

Certificate Number: L1152-1



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.  
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).

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017**

**OCS Technologies, Inc.**  
 (dba: Ohio Counting Scale / Omni Calibration Services)

14901 Emery Avenue  
 Cleveland, OH 44135  
 Joseph Gunn 216-741-0224

**CALIBRATION AND DIMENSIONAL MEASUREMENT**

Valid to: **November 27, 2022**

Certificate Number: **L1152-1**

**CALIBRATION**

**Chemical Quantities**

| Parameter / Equipment                    | Range           | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment |
|--|-----------------|---|---|
| pH Meters <sup>2</sup><br>(Fixed Points) | (4, 7, & 10) pH | 0.03 pH                                   | Comparisons to Buffer Solutions             |

**Electrical – DC/Low Frequency**

| Parameter / Equipment             | Range            | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment           |
|-----------------------------------|------------------|---|---|
| Capacitance – Source <sup>2</sup> | (0.19 to 3.3) nF | 6 mF/F + 12 pF                            | Comparisons performed with a Multifunction Calibrator |
|                                   | (3.3 to 110) nF  | 3 mF/F + 120 pF                           |   |
|                                   | (110 to 330) nF  | 3 mF/F + 350 pF                           |   |
|                                   | (0.33 to 1.1) μF | 3 mF/F + 2 nF                             |   |
|                                   | (1.1 to 3.3) μF  | 3mF/F + 4nF                               |   |
|                                   | (3.3 to 33) μF   | 5 mF/F + 35 nF                            |   |
|                                   | (33 to 330) μF   | 6 mF/F + 350 nF                           |   |
|                                   | (0.33 to 3.3) mF | 6 mF/F + 4 μF                             |   |
|                                   | (3.3 to 11) mF   | 6 mF/F + 12 μF                            |   |
|                                   | (11 to 33) mF    | 9 mF/F + 35 μF                            |   |
| (33 to 110) mF                    | 13 mF/F + 120 μF |   |   |
| DC Current – Source <sup>2</sup>  | (0 to 30) μA     | 180 μA/A + 30 nA                          | Comparisons performed with a Multifunction Calibrator |
|                                   | (0 to 3.3) mA    | 120 μA/A + 60 nA                          |   |
|                                   | (3.3 to 33) mA   | 120 μA/A + 300 nA                         |   |

**Electrical – DC/Low Frequency**

| Parameter / Equipment            | Range  | Expanded Uncertainty of Measurement (+/-)   | Reference Standard, Method and/or Equipment           |
|----------------------------------|--|---|---|
| DC Current – Source <sup>2</sup> | (33 to 330) mA<br>330 mA to 1.1 A<br>(1.1 to 3) A<br>(3 to 11) A<br>(11 to 20.5) A   | 120 $\mu$ A/A + 14 $\mu$ A<br>230 $\mu$ A/A + 48 $\mu$ A<br>440 $\mu$ A/A + 48 $\mu$ A<br>580 $\mu$ A/A + 600 $\mu$ A<br>1.2 mA/A + 880 $\mu$ A   | Comparisons performed with a Multifunction Calibrator |
|                                  | (20 to 1 000) A  | 9 mA/A + 0.6 mA   | Using 50 turn coil                                    |
| AC Current – Source <sup>2</sup> | (29 to 330) $\mu$ A<br>(10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz<br>(0.33 to 3.3) mA<br>(10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz<br>(3.3 to 33) mA<br>(10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz<br>(33 to 330) mA<br>(10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz<br>(0.33 to 3) A<br>(10 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 2.4 mA/A + 120 nA<br>1.8 mA/A + 120 nA<br>1.5 mA/A + 120 nA<br>3.5 mA/A + 170 nA<br>9.3 mA/A + 230 nA<br>19 mA/A + 460 nA<br>2.4 mA/A + 170 nA<br>1.5 mA/A + 170 nA<br>1.2 mA/A + 170 nA<br>230 nA/A + 230 nA<br>5.8 mA/A + 350 nA<br>12 mA/A + 690 nA<br>2.1 mA/A + 2.3 $\mu$ A<br>1.1 mA/A + 2.3 $\mu$ A<br>470 mA/A + 2.3 $\mu$ A<br>930 $\mu$ A/A + 2.3 $\mu$ A<br>2.4 $\mu$ A/A + 3.5 $\mu$ A<br>4.7 mA/A + 4.6 $\mu$ A<br>2.1 mA/A + 27 $\mu$ A<br>1.1 mA/A + 27 $\mu$ A<br>470 $\mu$ A/A + 27 $\mu$ A<br>1.2 mA/A + 60 $\mu$ A<br>2.4 mA/A + 120 $\mu$ A<br>4.7 mA/A + 240 $\mu$ A<br>2.1 mA/A + 120 $\mu$ A<br>700 $\mu$ A/A + 120 $\mu$ A<br>7 mA/A + 1.2 mA<br>29 mA/A + 5.8 mA | Comparisons performed with a Multifunction Calibrator |

**Electrical – DC/Low Frequency**

| Parameter / Equipment                               | Range  | Expanded Uncertainty of Measurement (+/-)   | Reference Standard, Method and/or Equipment                                   |
|---|--|---|---|
| AC Current – Source <sup>2</sup>                    | (3 to 11) A<br>(45 to 100) Hz<br>100 Hz 1 kHz<br>(1 to 5) kHz<br>(11 to 20.5) A<br>(45 to 100) Hz<br>100 Hz 1 kHz<br>(1 to 5) kHz  | 700 $\mu$ A/A + 2.4 mA<br>1.2 mA/A + 2.4 mA<br>35 mA/A + 2.4 mA<br><br>1.4 mA/A + 5.8 mA<br>1.7 mA/A + 5.8 mA<br>35 mA/A + 5.8 mA   | Comparisons performed with a Multifunction Calibrator                         |
| AC Current – Source <sup>2</sup>                    | (20 to 1 000) A<br>(45 to 65) Hz<br>(65 to 440) Hz   | 7.2 mA/A + 590 mA<br>7.8 mA/A + 590 mA  | Comparisons performed with a Multifunction Calibrator and using 50 turn coil  |
| DC Current – Measure <sup>2</sup>                   | (0 to 100) $\mu$ A<br>(0.1 to 1) mA<br>(1 to 10) mA<br>(10 to 100) mA<br>(0.1 to 1) A<br>(1 to 30) A   | 4.2 nA<br>38 nA<br>380 nA<br>6 $\mu$ A<br>0.16 mA<br>0.38 % of reading  | Comparisons performed with a 8 ½ Digit Multimeter and Current Shunt for > 1 A |
| AC Current – Measure <sup>2</sup><br>40 Hz to 1 kHz | (0 to 100) $\mu$ A<br>(0.1 to 1) mA<br>(1 to 10) mA<br>(10 to 100) mA<br>(0.1 to 1) A<br>(1 to 30) A   | 114 nA<br>1.1 $\mu$ A<br>11 $\mu$ A<br>110 $\mu$ A<br>1.3 mA<br>0.38 % of reading   | Comparisons performed with a 8 ½ Digit Multimeter and Current Shunt for > 1 A |
| Resistance – Source <sup>2</sup>                    | (0 to 33) $\Omega$<br>(33 to 330) $\Omega$<br>330 $\Omega$ to 33 k $\Omega$<br>(33 to 330) k $\Omega$<br>330 k $\Omega$ to 3.3 M $\Omega$<br>(3.3 to 33) M $\Omega$<br>(33 to 110) M $\Omega$<br>(110 to 330) M $\Omega$ | 35 $\mu\Omega/\Omega$ + 240 $\mu\Omega$<br>33 $\mu\Omega/\Omega$ + 2.4 m $\Omega$<br>33 $\mu\Omega/\Omega$ + 24 m $\Omega$<br>37 $\mu\Omega/\Omega$ + 240 m $\Omega$<br>70 $\mu\Omega/\Omega$ + 2.4 $\Omega$<br>300 $\mu\Omega/\Omega$ + 24 $\Omega$<br>600 $\mu\Omega/\Omega$ + 240 $\Omega$<br>4 m $\Omega/\Omega$ + 240 $\Omega$ | Comparisons performed with a Multifunction Calibrator                         |
| Resistance – Source <sup>2</sup>                    | 330 M $\Omega$ to 1.1 G $\Omega$<br>(1 to 10.05) G $\Omega$<br>18.24 G $\Omega$  | 18 m $\Omega/\Omega$ + 2400 $\Omega$<br>1.2 % of reading<br>0.64 G $\Omega$   | Comparisons performed with a Multifunction Calibrator                         |

**Electrical – DC/Low Frequency**

| Parameter / Equipment                            | Range   | Expanded Uncertainty of Measurement (+/-)  | Reference Standard, Method and/or Equipment                                  |
|--|---|--|--|
| Resistance – Source<br>Fixed Points <sup>2</sup> | 1.9 mΩ<br>10 mΩ<br>100 mΩ<br>1 Ω<br>15 Ω<br>100 GΩ<br>1 TΩ  | 0.84 μΩ<br>4.2 μΩ<br>37 μΩ<br>0.29 mΩ<br>2.8 mΩ<br>3.5 GΩ<br>66 GΩ   | Comparisons with Fixed Resistors   |
| Resistance – Measure <sup>2</sup>                | (0 to 10) Ω<br>(10 to 100) Ω<br>(0.1 to 1) kΩ<br>(1 to 10) kΩ<br>(10 to 100) kΩ<br>(0.1 to 1) MΩ<br>(1 to 10) MΩ<br>(10 to 100) MΩ<br>(0.1 to 1) GΩ | 23 μΩ/Ω + 71 μΩ<br>22 μΩ/Ω + 360 μΩ<br>17 μΩ/Ω + 8 μΩ<br>17 μΩ/Ω + 2.3 mΩ<br>17 μΩ/Ω + 7.8 mΩ<br>21 μΩ/Ω + 5.4 Ω<br>76 μΩ/Ω + 44 Ω<br>650 μΩ/Ω + 450 Ω<br>6.3 mΩ/Ω + 23 kΩ | Measured with a 8 ½ Digit Multimeter   |
| RTD Resistance Simulation <sup>2</sup>           | Pt 385, 100 Ω<br>(-200 to 300) °C<br>(300 to 800) °C<br>Pt 385, 1 000 Ω<br>(-200 to 300) °C<br>(100 to 600) °C                                      | 0.18 °C<br>0.46 °C<br>0.12 °C<br>0.14 °C   | Comparisons performed with Multifunction Calibrator and Electronic Indicator |
| DC Voltage – Source <sup>2</sup>                 | (0 to 330) mV<br>330 mV to 3.3 V<br>(3.3 to 33) V   | 24 μV/V + 3 μV<br>13 μV/V + 14 μV<br>14 μV/V + 140 μV  | Comparisons performed with Multifunction Calibrator                          |
| DC Voltage – Source <sup>2</sup>                 | (33 to 330) V<br>(330 to 1 000) V   | 21 μV/V + 1.3 μV<br>21 μV/V + 13 μV  |  |
| AC Voltage – Source <sup>2</sup>                 | (1 to 33) mV<br>(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                         | 930 μV/V + 8 μV<br>180 μV/V + 8 μV<br>240 μV/V + 8 μV<br>1.2 μV/V + 8 μV<br>4.1 μV/V + 15 μV<br>9.3 mV/V + 58 μV   | Comparisons performed with Multifunction Calibrator                          |

**Electrical – DC/Low Frequency**

| Parameter / Equipment                               | Range                       | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment         |
|---|-----------------------------|---|---|
| AC Voltage – Source <sup>2</sup>                    | (33 to 330) mV              |   | Comparisons performed with Multifunction Calibrator |
|   | (10 to 45) Hz               | 580 $\mu$ V/V + 10 $\mu$ V                |   |
|   | 45 Hz to 10 kHz             | 170 $\mu$ V/V + 11 $\mu$ V                |   |
|   | (10 to 20) kHz              | 190 $\mu$ V/V + 10 $\mu$ V                |   |
|   | (20 to 50) kHz              | 410 $\mu$ V/V + 13 $\mu$ V                |   |
|   | (50 to 100) kHz             | 930 $\mu$ V/V + 39 $\mu$ V                |   |
|   | (100 to 500) kHz            | 2.4 mV/V + 87 $\mu$ V                     |   |
|   | (0.33 to 3.3) V             |   |   |
|   | (10 to 45) Hz               | 350 $\mu$ V/V + 100 $\mu$ V               |   |
|   | 45 Hz to 10 kHz             | 180 $\mu$ V/V + 150 $\mu$ V               |   |
|   | (10 to 20) kHz              | 220 $\mu$ V/V + 120 $\mu$ V               |   |
|   | (20 to 50) kHz              | 350 $\mu$ V/V + 68 $\mu$ V                |   |
|   | (50 to 100) kHz             | 810 $\mu$ V/V + 180 $\mu$ V               |   |
|   | (100 to 500) kHz            | 2.8 mV/V + 840 $\mu$ V                    |   |
|   | (3.3 to 33) V               |   |   |
|   | (10 to 45) Hz               | 350 $\mu$ V/V + 890 $\mu$ V               |   |
| 45 Hz to 10 kHz                                     | 180 $\mu$ V/V + 910 $\mu$ V |   |   |
| (10 to 20) kHz                                      | 280 $\mu$ V/V + 910 $\mu$ V |   |   |
| (20 to 50) kHz                                      | 410 $\mu$ V/V + 840 $\mu$ V |   |   |
| (50 to 100) kHz                                     | 1.1 mV/V + 2.1 mV           |   |   |
| (33 to 330) V                                       |                             |   |   |
| 45 Hz to 1 kHz                                      | 220 $\mu$ V/V + 5.2 mV      |   |   |
| (1 to 10) kHz                                       | 240 $\mu$ V/V + 7.8 mV      |   |   |
| (10 to 20) kHz                                      | 290 $\mu$ V/V + 7.4 mV      |   |   |
| (20 to 50) kHz                                      | 350 $\mu$ V/V + 7.4 mV      |   |   |
| (50 to 100) kHz                                     | 2.4 mV/V + 58 mV            |   |   |
| (330 to 1 000) V                                    |                             |   |   |
| 45 Hz to 1 kHz                                      | 2.4 mV/V + 58 mV            |   |   |
| (1 to 5) kHz  | 2.4 mV/V + 58 mV            |   |   |
| (5 to 10) kHz                                       | 2.4 mV/V + 58 mV            |   |   |
| DC Voltage – Measure <sup>2</sup>                   | (0 to 1) V                  | 14 $\mu$ V                                | Measured with an 8 ½ Digit Multimeter               |
|   | (1 to 10) V                 | 130 $\mu$ V                               |   |
|   | (10 to 100) V               | 1.5 mV                                    |   |
|   | (100 to 1 000) V            | 15 mV                                     |   |
| AC Voltage – Measure <sup>2</sup><br>45 Hz to 1 kHz | (1 to 10) mV                | 4 $\mu$ V                                 | Measured with an 8 ½ Digit Multimeter               |
|   | (10 to 100) mV              | 12 $\mu$ V                                |   |
|   | 100 mV to 1 V               | 120 $\mu$ V                               |   |
|   | (1 to 10) V                 | 1.2 mV                                    |   |
|   | (10 to 100) V               | 28 mV                                     |   |
|   | (100 to 700) V              | 380 mV                                    |   |

**Electrical – DC/Low Frequency**

| Parameter / Equipment  | Range  | Expanded Uncertainty of Measurement (+/-)  | Reference Standard, Method and/or Equipment                                    |
|--|--|--|--|
| DC High Voltage – Measure <sup>2</sup>   | (0.1 to 9) kV<br>(9 to 50) kV<br>(50 to 90) kV   | 0.05% of reading<br>0.08% of reading<br>0.13% of reading   | Comparisons performed with a Precision HV Meter                                |
| AC High Voltage – Measure <sup>2</sup><br>50 Hz to 60 Hz   | (0.1 to 9) kV<br>(9 to 50) kV<br>(50 to 90) kV   | 0.16 % of reading<br>0.16 % of reading<br>0.18 % of reading  |  |
| Oscilloscopes <sup>2</sup><br>DC Voltage (50Ω)<br>DC Voltage (1MΩ)<br>AC Voltage (50Ω)<br>(Square Wave)<br>AC Voltage (1MΩ)<br>(Square Wave)<br>Leveled Sinewave<br>Time Markers<br>Edge Characteristics:<br>(1 kHz to 10 MHz into 50 Ω)<br>Amplitude<br>Rise time | 1 mV to 6.6 V<br>1 mV to 130 V<br>1 mV to 6.6 V<br>1 mV to 130 V<br>5 mV to 5.5 V<br>50 kHz to 100 MHz<br>100 MHz to 300 MHz<br>300 MHz to 600 MHz<br>600 MHz to 1.1 GHz<br>2 ns to 20 ms<br>50 ms to 5 s<br>5 mV to 2.5 V<br>1 nS to 1 μs | 2.9 mV/V + 47 μV<br>600 μV/V + 47 μV<br>2.9 mV/V + 47 μV<br>1.2 mV/V + 47 μV<br>41 mV/V + 350 μV<br>47 mV/V + 350 μV<br>70 mV/V + 350 μV<br>81 mV/V + 350 μV<br>3 μs/s<br>2 ms/s + 29 μs<br>23 mV/V + 240 μV<br>350 ps | Comparisons performed with a Multifunction Calibrator and an Oscilloscope      |
| Millivolt Simulation of Thermocouple Indicators <sup>2</sup>   | Type J<br>(-200 to -100) °C<br>(-100 to -30) °C<br>(-30 to 150) °C<br>(150 to 760) °C<br>(760 to 1 200) °C   | 0.32 °C<br>0.2 °C<br>0.17 °C<br>0.21 °C<br>0.27 °C   | Comparisons performed with Multifunction Calibrator and Thermocouple Indicator |

**Electrical – DC/Low Frequency**

| Parameter / Equipment  | Range              | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment                                    |
|--|--------------------|---|--|
| Millivolt Simulation of Thermocouple Indicators <sup>2</sup> | Type K             |   | Comparisons performed with Multifunction Calibrator and Thermocouple Indicator |
|  | (-200 to -100) °C  | 0.39 °C                                   |  |
|  | (-100 to -25) °C   | 0.22 °C                                   |  |
|  | (-25 to 120) °C    | 0.19 °C                                   |  |
|  | (120 to 1 000) °C  | 0.31 °C                                   |  |
|  | (1000 to 1 372) °C | 0.47 °C                                   |  |
|  | Type T             |   |  |
|  | (-250 to -100) °C  | 0.73 °C                                   |  |
|  | (-100 to 0) °C     | 0.28 °C                                   |  |
|  | (0 to 120) °C      | 0.19 °C                                   |  |
|  | (120 to 400) °C    | 0.17 °C                                   |  |
|  | Type E             |   |  |
|  | (-250 to -100) °C  | 0.58 °C                                   |  |
|  | (-100 to -25) °C   | 0.2 °C                                    |  |
|  | (-25 to 350) °C    | 0.17 °C                                   |  |
| (350 to 650) °C  | 0.19 °C            |   |  |
| (650 to 1 000) °C  | 0.25 °C            |   |  |
| Type R   |                    |   |  |
| (0 to 1 767) °C  | 0.88 °C            |   |  |
| Type S   |                    |   |  |
| (0 to 1 767) °C  | 0.79 °C            |   |  |

**Length – Dimensional Metrology**

| Parameter / Equipment  | Range             | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment                     |
|--|-------------------|---|---|
| Gage Blocks <sup>6</sup><br>Chrome Carbide                                   | (0.01 to 4) in    | (5 + 1.5L) μin                            | P&W LabMaster<br>Universal and Fed GGG<br>Grade 0.5 Gage Blocks |
| Gage Blocks <sup>6</sup><br>Steel, Ceramic, Tungsten<br>Carbide              | (0.01 to 4) in    | (5.6 + 3.1L) μin                          | P&W LabMaster<br>Universal and ASME<br>Grade 00 Gage Blocks     |
| Gage Blocks <sup>6</sup><br>Steel  | (5 to 12) in      | (4 + 3.1L) μin                            |   |
| Plug /Pin Gages<br>& Master Discs <sup>6</sup><br>Class XXX, XX, X, Y, Z, ZZ | (0.01 to 0.06) in | 11 μin                                    | P&W LabMaster<br>Universal and ASME<br>Grade 00 Gage Blocks     |
|  | (0.06 to 1) in    | 8 μin                                     |   |
|  | (1 to 12) in      | (3.2 + 4D) μin                            |   |



**Length – Dimensional Metrology**

| Parameter / Equipment  | Range                              | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment  |
|--|------------------------------------|---|--|
| Pin Gages <sup>2</sup><br>Class ZZ                                     | (0.01 to 2) in                     | 78 μin                                    | Comparisons with Laser Micrometer  |
| Micrometer/Length/End Standards <sup>6</sup>                           | (1 to 12) in                       | (4 + 4.2L) μin                            | P&W LabMaster Universal and ASME Grade 00 Gage Blocks  |
| Ring Gages <sup>6</sup>  | (0.04 to 1) in                     | 18 μin                                    | P&W LabMaster Universal, ASME Grade 00 Gage Blocks and Master Rings  |
|  | (1 to 12) in                       | (8.4 + 3.9D) μin                          |  |
| Spheres/Precision Balls: Diameter                                      | (0.1 to 3) in                      | 15 μin                                    | P&W LabMaster Universal and ASME Grade 00 Gage Blocks  |
| Thread Wires <sup>3</sup><br>2 TPI to 120 TPI                          | (0.004 to 0.29) in                 | 13 μin                                    | P&W LabMaster Universal and ASME Grade 00 Gage Blocks  |
| Thread Plug Gages – Straight<br>Major Diameter<br><br>Pitch Diameter   | (0.06 to 6) in<br>(4 thru 80) TPI  | 53 μin                                    | P&W LabMaster Universal and ASME Grade 00 Gage Blocks with Thread Wires  |
|  |                                    | 78 μin                                    |  |
| Thread Plug Gages<br><sup>3</sup> / <sub>4</sub> TPF<br>Pitch Diameter | (0.3 to 6) in<br>(8 thru 27) TPI   | 69 μin<br>90 μin                          | P&W LabMaster Universal and ASME Grade 00 Gage Blocks with Thread Wires  |
| Thread Ring Gages -<br>Functional Pitch Diameter                       | (0.06 to 12) in<br>(4 thru 80) TPI | 89 μin                                    | In Accordance with ASME B1.2, Paragraph 5.1.1; the Ring is Sized to a Plug with the Plug's Uncertainty Given. Class X or W Set Plugs to be Used as Available |
| Angle Blocks   | (0 to 90) °                        | 0.006 °                                   | Vision System  |
| Micrometers <sup>2,6</sup>   | (0 to 4) in<br>(4 to 80) in        | (98 + 4L) μin<br>(58 + 10L) μin           | Comparisons performed with Gage Blocks   |
| Calipers <sup>2,6</sup><br>(OD, ID, depth)                             | (0 to 4) in<br>(4 to 80) in        | (100 + 4L) μin<br>(300 + 4L) μin          |  |
| Height Gages <sup>2,6</sup>  | (0 to 4) in<br>(4 to 60) in        | (170 + 2L) μin<br>(280 + 8L) μin          |  |
| Chamfer Gages <sup>2</sup>   | (0 to 0.75) in                     | 0.001 in                                  | Sharp Edge Ring Gages / Surface Plate  |

**Length – Dimensional Metrology**

| <b>Parameter / Equipment</b>         | <b>Range</b>                                  | <b>Expanded Uncertainty of Measurement (+/-)</b> | <b>Reference Standard, Method and/or Equipment</b>                              |
|--------------------------------------|---|--|---|
| Dial/Test Indicators <sup>2</sup>    | (0 to 1) in                                   | 81 μin   | Comparisons performed with Indicator Calibrator                                 |
| Dial/Test Indicators                 | (0 to 1) in                                   | 18 μin   | P&W LabMaster Universal and ASME Grade 00 Gage Blocks                           |
|                                      | (1 to 4) in                                   | 293 μin  |   |
| Micrometer Heads                     | (0 to 1) in                                   | 18 μin   | P&W LabMaster Universal   |
| Indicating Snap Gages <sup>2,6</sup> | (0 to 4) in<br>(4 to 40) in                   | (100 + 4L) μin<br>(560 + 6L) μin                 | Comparisons performed with Gage Blocks  |
| Bore Gages – 2 Point <sup>2,6</sup>  | (0.125 to 4) in<br>(4 to 40) in               | (100 + 4L) μin<br>(260 + 8L) μin                 | Comparisons performed with Gage Blocks and End Caps                             |
| Rules & Tape Measures <sup>2</sup>   | (0 to 72) in<br>(6 to 100) ft                 | 0.02 in<br>0.026 % of reading                    | Comparisons performed with Gage Blocks  |
| Bench Micrometer <sup>2</sup>        | (0.1 to 2) in                                 | 24 μin   | Comparisons performed with ASME Grade 0 Gage Blocks                             |
| Laser Micrometers <sup>2</sup>       | (0.06 to 1) in                                | 61 μin   | Master Plug Gages   |
| Optical Comparators <sup>2</sup>     |   |  |   |
| X and Y Axis Linearity               | (0 to 12) in                                  | 190 μin  | Comparisons to Glass Scale  |
| Magnification                        | (10, 20, 31.25, 50, 62.5, & 100) x            | 190 μin  |   |
| Angle                                | (5, 10, 15, 20, 25, & 30) °                   | 0.12°  | Comparison performed with Angle Blocks  |
| Vision System <sup>2</sup>           |   |  |   |
| X-Y Linearity                        | (0 to 12) in                                  | (68 + 6.4L) μin                                  | Comparison to Grid Glass<br>Gage Blocks   |
| Z - Axis                             | (0 to 8) in                                   | (49 + 2.7L) μin                                  |   |
| Protractors                          |   |  |   |
| Angle                                | (0, 5, 10, 15, 20, 25, & 30) °<br>(0 to 90) ° | 0.12 °<br>0.27 °                                 | Comparisons performed with Angle Blocks and Surface Plate<br>Digital Protractor |
| Level                                | 0 °   | 0.27 °   |   |

**Length – Dimensional Metrology**

| Parameter / Equipment               | Range           | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment                      |
|-------------------------------------|-----------------|---|--|
| Bore Gages – 3 Point <sup>2,6</sup> | (0.125 to 7) in | (110 + 9L) μin                            | Comparisons performed with Customer Ring Gages calibrated by OCS |

**Mass and Mass Related**

| Parameter / Equipment                                       | Range  | Expanded Uncertainty of Measurement (+/-)                                   | Reference Standard, Method and/or Equipment         |
|---|--|---|---|
| Force –Tension & Compression <sup>1,2</sup>                 | (0.05 to 500) lbf<br>(501 to 6 000) lbf  | 0.045 % of reading<br>0.093 % of reading                                    | Reference Weights                                   |
| (Force Gages, Load Cells with Indicators, Testing Machines) | (17 to 200) lbf<br>(50 to 2 000) lbf<br>(46 to 1 000) lbf<br>(200 to 10 000) lbf<br>(10 000 to 20 000) lbf<br>(20 000 to 30 000) lbf<br>(30 000 to 50 000) lbf | 0.18 lbf<br>0.23 lbf<br>0.27 lbf<br>0.5 lbf<br>4.6 lbf<br>6.9 lbf<br>12 lbf | Morehouse Precision Load Cells                      |
| Force Testing Machine Crosshead Travel                      | (0.1 to 6) in  | 0.002 in  | Digital Caliper                                     |
| Force Testing Machine Crosshead Speed                       | (0.5 to 12) in/min   | 0.04 in/min   | Digital Stopwatch/Caliper                           |
| Bench Micrometer Contact Force                              | (2 to 32) ozf<br>(32 to 40) ozf  | 0.8 ozf<br>2.2 ozf  | Force Gages   |
| Direct Verification of Durometers –<br><br>Spring Force     | Type A, B, C, D, DO, O, OO   | 1.1 Duros   | ASTM D2240 with Balance / ASTM Class 6 Test Weights |
| Indenter Extension, Diameter, Tip Radius                    | (0 to 0.2) in  | 250 μin   | Vision System                                       |
| Indenter Tip Angle  | (0 to 45) °  | 0.2 °   | Vision System                                       |

**Mass and Mass Related**

| Parameter / Equipment                              | Range       | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment |
|--|-------------|---|---|
| Rockwell Hardness Testers <sup>2</sup>             | HRC         |   | Indirect Verification per ASTM E18          |
|  | Low         | 0.38 HRC                                  |   |
|  | Middle      | 0.35 HRC                                  |   |
|  | High        | 0.32 HRC                                  |   |
|  | HRBW        |   |   |
|  | Low         | 0.71 HRBW                                 |   |
|  | Middle      | 0.72 HRBW                                 |   |
|  | High        | 0.73 HRBW                                 |   |
|  | HRA         |   |   |
| Low  | 0.48 HRA    |   |   |
| Middle   | 0.39 HRA    |   |   |
| High   | 0.53 HRA    |   |   |
| Superficial Rockwell Hardness Testers <sup>2</sup> | HR15N       |   | Indirect Verification per ASTM E18          |
|  | Low         | 0.5 HR15N                                 |   |
|  | Middle      | 0.48 HR15N                                |   |
|  | High        | 0.43 HR15N                                |   |
|  | HR30N       |   |   |
|  | Low         | 0.73 HR30N                                |   |
|  | Middle      | 0.73 HR30N                                |   |
|  | High        | 0.53 HR30N                                |   |
|  | HR45N       |   |   |
|  | Low         | 0.49 HR45N                                |   |
|  | Middle      | 0.58 HR45N                                |   |
|  | High        | 0.51 HR45N                                |   |
|  | HR15TW      |   |   |
|  | Low         | 0.73 HR15TW                               |   |
|  | Middle      | 0.64 HR15TW                               |   |
|  | High        | 0.44 HR15TW                               |   |
|  | HR30TW      |   |   |
|  | Low         | 0.58 HR30TW                               |   |
|  | Middle      | 0.55 HR30TW                               |   |
|  | High        | 0.46 HR30TW                               |   |
|  | HR45TW      |   |   |
| Low  | 0.64 HR45TW |   |   |
| Middle   | 0.67 HR45TW |   |   |
| High   | 0.42 HR45TW |   |   |

**Mass and Mass Related**

| Parameter / Equipment  | Range   | Expanded Uncertainty of Measurement (+/-)   | Reference Standard, Method and/or Equipment  |
|--|---|---|--|
| Weights  | 1 mg to 160 g<br>(160 to 400) g   | 0.57 mg<br>3.2 mg   | Mass value or deviation reported using High Resolution Scales that have been Calibrated with ASTM Class 1 Test Weights |
| Weights <sup>2</sup>   | (0.8 to 10) lb<br>(10 to 27.5) lb<br>(27.5 to 70) lb  | 0.000 07 lb<br>0.000 7 lb<br>0.001 7 lb   | Mass value or deviation reported using High Resolution Scales That Have Been calibrated with ASTM Class 3 Test Weights |
| Pressure Transducers, Dial and Digital Pressure Gages, Absolute Pressure Instruments, Low Vacuum Gages <sup>2</sup><br>(Pneumatic and Hydraulic)   | (0.001 to 1) inH <sub>2</sub> O<br>(1 to 20) inH <sub>2</sub> O   | 0.006 inH <sub>2</sub> O<br>0.047 inH <sub>2</sub> O  | Comparisons to a Manometer   |
| Pressure Transducers, Dial and Digital Pressure Gages, Absolute Pressure Instruments, Low Vacuum Gages <sup>2</sup><br>(Pneumatic and Hydraulic)   | (-0.01 to -14.5) psi<br>(0.2 to 100) psia<br>(0.001 to 3) psi<br>(3 to 15) psi<br>(15 to 60) psi<br>(60 to 120) psi<br>(120 to 180) psi<br>(180 to 240) psi<br>(240 to 300) psi | 0.061 psi<br>0.06 psia<br>0.005 psi<br>0.001 4 psi + 0.11% of reading<br>0.08 psi<br>0.15 psi<br>0.22 psi<br>0.28 psi<br>0.35 psi | Comparisons to Digital Pressure Gages  |
| Pressure Transducers, Dial and Digital Pressure Gages, Absolute Pressure Instruments, Low Vacuum Gages <sup>2,4</sup><br>(Pneumatic and Hydraulic) | (300 to 1 000) psi<br>(1 000 to 2 000) psi<br>(2 000 to 4 000) psi<br>(4 000 to 6 000) psi<br>(6 000 to 8 000) psi<br>(8 000 to 10 000) psi<br>(10 000 to 30 000) psi           | 0.66 psi<br>2.5 psi<br>4.8 psi<br>7.1 psi<br>9.5 psi<br>12 psi<br>71 psi  | Comparisons to Digital Pressure Gages  |
| Weighing Systems <sup>1,2</sup>  | (0 to 500) mg   | 0.12 mg   | ASTM E617 Class 1 Weights and NIST Handbook 44 utilized for the calibration of the Weighing System                     |
|  | (1 to 20) g   | 0.005 % applied load  |  |
|  | (21 to 60 000) g  | 0.000 3 % applied load  |  |

**Mass and Mass Related**

| Parameter / Equipment   | Range   | Expanded Uncertainty of Measurement (+/-)   | Reference Standard, Method and/or Equipment   |
|---|---|---|---|
| Weighing Systems <sup>1,2</sup>   | (0.005 to 120 000) lb   | 0.013 % applied load  | NIST Class F Weights and NIST Handbook 44 utilized for the calibration of the Weighing System |
| Torque Wrenches, Drivers, Screwdrivers including Click Type             | (10 to 100) ozf-in<br>(100 to 500) ozf-in                           | 1.9 % of reading  | Torque Tester and Torque Cells  |
|   | (10 to 100) lbf-in<br>(5 to 50) lbf-ft<br>(50 to 1 000) lbf-ft      | 1.5 % of reading  |   |
| Torque Transducers, Torque Analyzers, Dial Torque Wrenches <sup>2</sup> | (3 to 640) ozf-in<br>(7.5 to 1 200) lbf-in<br>(100 to 1 000) lbf-ft | 0.13 % of reading + 0.11 ozf-in<br>0.14 % of reading + 0.05 lbf-in<br>0.14 % of reading + 0.09 lbf-ft | Torque Arms and ASTM Class 6 Weights  |

**Thermodynamic**

| Parameter / Equipment   | Range  | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method and/or Equipment   |
|---|--|---|---|
| Infrared (IR) Thermometers <sup>2</sup>   | (-15 to 100) °C<br>(100 to 200) °C<br>(200 to 350) °C<br>(350 to 500) °C | 1.7 °C<br>1.9 °C<br>2.8 °C<br>3.4 °C      | Fluke / Hart Scientific 4180 / 4181 Precision IR Calibrators<br>$\epsilon = (0.9 \text{ to } 0.99)$<br>$\lambda = (8 \text{ to } 14) \mu\text{m}$ |
| Relative Humidity Probes <sup>2</sup>   | 11.3 % RH<br>75.5 % RH<br>95 % RH  | 1.5 % RH<br>1.8 % RH<br>2.3 % RH          | Comparisons to Salt Solutions   |
| Humidity Measure  | (11 to 75) % RH<br>(75 to 95) % RH                                       | 2.5 % RH<br>3 % RH                        | Comparisons to a Humidity Indicator and Probe   |
| Temperature Chambers, Drywells, Temperature Baths <sup>2</sup>  | (-80 to 300) °C<br>(300 to 1 200) °C                                     | 0.09 °C<br>5.8 °C                         | Measurement with a Platinum Resistance Thermometer and/or Type K TC with display  |
| Temperature Devices - (Liquid in Glass Thermometers, Thermocouples, Bi-Metal Thermometers) <sup>2,7</sup> | (-80 to 300) °C  | 0.09 °C                                   | Comparisons with a Platinum Resistance Thermometer and Bath or Chamber  |
|   | (300 to 600) °C  | 2.5 °C                                    |   |
|   | (600 to 1 200) °C  | 3.1 °C                                    | Dry Block Calibrator  |

**Time and Frequency**

| Parameter / Equipment  | Range   | Expanded Uncertainty of Measurement (+/-)           | Reference Standard, Method and/or Equipment               |
|--|---|---|---|
| Tachometers – Non-Contact <sup>2</sup>                             | (0.6 to 1 000) rpm<br>(1 000 to 10 000) rpm<br>(10 000 to 100 000) rpm  | 0.06 rpm<br>0.6 rpm<br>0.65 rpm                     | Comparisons performed with a Frequency Source and LED     |
| Tachometers – Contact, Centrifuges, RPM Meters <sup>2</sup>        | (0.6 to 1 000) rpm<br>(1000 to 10 000) rpm<br>(10 000 to 100 000) rpm   | 1.2 rpm<br>1.7 rpm<br>8.2 rpm                       | Comparisons performed with a Photo/Contact Tachometer     |
| Linear Surface Speed Indicators / Conveyor Belt Speed <sup>2</sup> | (3 to 100) ft/min<br>(100 to 300) ft/min<br>(300 to 1 000) ft/min   | 0.71 ft/min<br>0.78 ft/min<br>1.3 ft/min            | Comparisons performed with a Contact Tachometer and Wheel |
| Length - Footage Counter, Yardage Counter                          | (3 to 100) ft<br>(100 to 300) ft<br>(300 to 1 000) ft   | 0.75 ft<br>0.82 ft<br>1.4 ft                        |   |
| Frequency <sup>2</sup> – Source                                    | (10 to 119.99) Hz<br>120 Hz to 1.199 9 kHz<br>(1.2 to 11.999) kHz<br>(12 to 119.99) kHz<br>120 kHz to 1.2 MHz | 380 µHz<br>3.7 mHz<br>0.037 Hz<br>0.37 Hz<br>3.7 Hz | Comparisons performed with a Multifunction Calibrator     |
| Timers / Stopwatches <sup>2</sup>                                  | 1 s to 4 h  | 0.35 s  | Comparisons performed with Reference Stopwatch            |
|  | (4 to 24) h   | 1 s   |   |

**DIMENSIONAL MEASUREMENT**

**1 Dimensional**

| Parameter/Equipment  | Range                         | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment          |
|--|-------------------------------|---|---|
| Outside Diameter Length <sup>5,6</sup>                     | (0.1 to 4) in<br>(4 to 12) in | 27 µin<br>(15 + 2.5L) µin                 | P&W LabMaster Universal and ASME Grade 00 Gage Blocks |
| Inside Diameter <sup>5,6</sup>                             | (0.1 to 4) in<br>(4 to 12) in | 27 µin<br>(15 + 2.5L) µin                 |   |
| Outside Diameter Length <sup>2</sup>                       | (0.000 5 to 1.5) in           | 59 µin                                    | Universal Measurement Machine                         |
| Outside Diameter Length <sup>2</sup>                       | (0.001 to 1) in               | 180 µin                                   | Digital Micrometer                                    |
| Outside Diameter Inside Diameter Length Depth <sup>2</sup> | (0.001 to 12) in              | 0.001 4 in                                | Digital Caliper                                       |

**1 Dimensional**

| Parameter/Equipment                     | Range   | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|--|
| Inside Diameter <sup>8</sup>            | (0.011 to 0.5) in   | 0.001 2 in                                | Plug Gages                                   |
| Vision System Measurements <sup>9</sup> | <u>Linear X and Y</u><br>(0 to 1) in<br>(1 to 6) in<br>(6 to 10) in | 250 μin<br>280 μin<br>330 μin             | Vision System                                |


**2 Dimensional**

| Parameter/Equipment                     | Range   | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---|---|---|--|
| Vision System Measurements <sup>9</sup> | <u>Linear X and Y</u><br>(0 to 1) in<br>(1 to 6) in<br>(6 to 10) in | 250 μin<br>280 μin<br>330 μin             | Vision System                                |
|   | <u>Angle</u><br>(0 to 90) °   | 0.006 °                                   |  |
| Angle                                   | (0 to 90) °   | 0.27 °                                    | Digital Protractor                           |
| Level                                   | 0 °   | 0.27 °                                    |  |

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ( $k=2$ ), corresponding to a confidence level of approximately 95%.

Notes:

1. The uncertainties for scales, balances, and force gages is highly dependent upon the resolution of the unit under test. The uncertainties presented here do not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration
2. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
3. Uncertainty shown is per wire for thread wire sets
4. Pressures from 10 000 psi to 30 000 psi can only be measured with a customer supplied pressure source
5. Micrometer Masters, Caliper Masters, Feeler Gages & shims would be included in this category.
6.  $L$  = length in inches,  $D$  = diameter in inches
7. For thermometers, measurement uncertainty may vary depend on type of thermometer, display resolution and immersion type.
8. Crimp Tools would be included in this category.
9. Radius Gages and Angle Blocks would be included in this category.
10. This scope is formatted as part of a single document including Certificate of Accreditation No. L1152-1



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