



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**ARREGA TECNOLOGÍA, SAPI, DE CV  
dba ARREGA INDUSTRIAL**

**Blvd. Tercera Oeste No. 17524, Fracc. Garita de Otay  
Tijuana, Baja California Mexico**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and national standard

**ANSI/NCSL Z540-1-1994 (R2002)**

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).

Jason Stine, Vice President

Expiry Date: 07 September 2026  
Certificate Number: ACT-2077



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

AND

ANSI/NCSL Z540-1-1994 (R2002)

**ARREGA TECNOLOGÍA, SAPI, DE CV dba ARREGA INDUSTRIAL**

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## CALIBRATION AND DIMENSIONAL MEASUREMENT

ISO/IEC 17025 Accreditation Granted: **07 September 2024**

Certificate Number: **ACT-2077** Certificate Expiry Date: **07 September 2026**

### CALIBRATION

#### Chemical Quantities

| Parameter/Equipment              | Range                                               | Expanded Uncertainty of Measurement (+/-)     | Reference Standard, Method, and/or Equipment    |
|----------------------------------|-----------------------------------------------------|-----------------------------------------------|-------------------------------------------------|
| pH Meters <sup>5</sup>           | 4 pH<br>7 pH<br>10 pH                               | 0.019 pH<br>0.028 pH<br>0.025 pH              | Comparison to Accredited Buffer Solutions       |
| Conductivity Meters <sup>5</sup> | 10 µS/cm<br>100 µS/cm<br>1 200 µS/cm<br>1 413 µS/cm | 0.34 µS/cm<br>3 µS/cm<br>31 µS/cm<br>32 µS/cm | Comparison to Accredited Conductivity Solutions |

#### Electrical – DC/Low Frequency

| Parameter/Equipment              | Range                                                                                  | Expanded Uncertainty of Measurement (+/-)                                                               | Reference Standard, Method, and/or Equipment      |
|----------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| DC Voltage – Source <sup>1</sup> | (0 to 120) mV<br>120 mV to 1.2 V<br>(1.2 to 12) V<br>(12 to 120) V<br>(120 to 1 020) V | 9.5 µV/V + 0.62 µV<br>6.7 µV/V + 0.78 µV<br>6.4 µV/V + 7.8 µV<br>8.8 µV/V + 78 µV<br>8.7 µV/V + 0.78 mV | Comparison to Fluke 55xxA Multiproduct Calibrator |

## Electrical – DC/Low Frequency

| Parameter/Equipment                              | Range                                                                                                                                                                                                                | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                                                                                                                                                                                      | Reference Standard, Method, and/or Equipment                                               |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| DC Voltage – Measure <sup>1</sup>                | (10 to 100) mV<br>(0.1 to 1) V<br>(1 to 10) V<br>(10 to 100) V<br>(100 to 1 000) V                                                                                                                                   | 9.2 $\mu\text{V/V} + 0.3 \mu\text{V}$<br>8 $\mu\text{V/V} + 0.3 \mu\text{V}$<br>8 $\mu\text{V/V} + 0.5 \mu\text{V}$<br>10 $\mu\text{V/V} + 30 \mu\text{V}$<br>10 $\mu\text{V/V} + 0.1 \text{ mV}$                                                                                                                                                                              | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter                            |
| DC High Voltage – Measure <sup>1</sup>           | Up to 5 kV<br>(5 to 10) kV<br>(10 to 20) kV<br>(20 to 30) kV<br>(30 to 40) kV<br>(40 to 50) kV                                                                                                                       | 80 $\mu\text{V/V} + 1.6 \text{ V}$<br>80 $\mu\text{V/V} + 2.5 \text{ V}$<br>80 $\mu\text{V/V} + 1.6 \text{ V}$<br>80 $\mu\text{V/V} + 5.9 \text{ V}$<br>0.1 $\text{mV/V} + 19 \text{ V}$<br>0.1 $\text{mV/V} + 30 \text{ V}$                                                                                                                                                   | Comparison to<br>Vitretek 4700<br>High Voltage Meter                                       |
| DC Current – Source <sup>1</sup>                 | (0 to 120) mA<br>(0.12 to 1.2) mA<br>(1.2 to 12) mA<br>(12 to 120) mA<br>120 mA to 1.2 A<br>(1.2 to 3.1) A<br>(3.1 to 12) A<br>(12 to 30.2) A                                                                        | 97 $\mu\text{A/A} + 4.7 \text{ nA}$<br>79 $\mu\text{A/A} + 12 \text{ nA}$<br>79 $\mu\text{A/A} + 62 \text{ nA}$<br>95 $\mu\text{A/A} + 0.62 \mu\text{A}$<br>0.13 $\text{mA/A} + 7.8 \mu\text{A}$<br>0.23 $\text{mA/A} + 7.8 \mu\text{A}$<br>0.24 $\text{mA/A} + 0.19 \text{ mA}$<br>0.78 $\text{mA/A} + 0.39 \text{ mA}$                                                       | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator                                    |
| DC Current Clamp Meters <sup>1</sup>             | (20 to 60) A<br>(60 to 1 000) A                                                                                                                                                                                      | 0.28 % of reading + 15 mA<br>0.28 % of reading + 56 mA                                                                                                                                                                                                                                                                                                                         | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator,<br>Fluke 50-turn Coil             |
| DC Current – Measure <sup>1</sup>                | (0 to 100) $\mu\text{A}$<br>(0.1 to 1) mA<br>(1 to 10) mA<br>(10 to 100) mA<br>(0.1 to 1) A                                                                                                                          | 20 $\mu\text{A/A} + 0.53 \text{ nA}$<br>19 $\mu\text{A/A} + 3.3 \text{ nA}$<br>20 $\mu\text{A/A} + 33 \text{ nA}$<br>40 $\mu\text{A/A} + 0.33 \mu\text{A}$<br>89 $\mu\text{A/A} + 6.7 \mu\text{A}$                                                                                                                                                                             | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter                            |
| DC Current – Measure <sup>1</sup>                | Up to 18 A<br>(18 to 30) A<br>(30 to 650) A                                                                                                                                                                          | 6.6 $\mu\text{A/A} + 0.36 \text{ mA}$<br>67 $\mu\text{A/A} + 0.71 \text{ mA}$<br>1.9 $\text{mA/A} + 0.21 \text{ A}$                                                                                                                                                                                                                                                            | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter,<br>Empre B-1000-100 Shunt |
| Resistance – Source <sup>1</sup><br>(Simulation) | (0 to 12) $\Omega$<br>(> 12 to 120) $\Omega$<br>(> 0.12 to 1.2) k $\Omega$<br>(> 1.2 to 12) k $\Omega$<br>(> 0.12 to 1.2) M $\Omega$<br>(1.2 to 12) M $\Omega$<br>(12 to 120) M $\Omega$<br>(0.12 to 1.2) G $\Omega$ | 23 $\mu\Omega/\Omega + 0.78 \text{ m}\Omega$<br>20 $\mu\Omega/\Omega + 0.78 \text{ m}\Omega$<br>22 $\mu\Omega/\Omega + 1.6 \text{ m}\Omega$<br>22 $\mu\Omega/\Omega + 16 \text{ m}\Omega$<br>22 $\mu\Omega/\Omega + 1.6 \Omega$<br>31 $\mu\Omega/\Omega + 23 \Omega$<br>0.34 $\text{m}\Omega/\Omega + 1.9 \text{ k}\Omega$<br>3.1 $\text{m}\Omega/\Omega + 78 \text{ k}\Omega$ | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator                                    |

## Electrical – DC/Low Frequency

| Parameter/Equipment                                     | Range                                                                                                                                                                                                                                                                                                                                                                              | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                                                                                                                                                                                                                                                                                         | Reference Standard, Method, and/or Equipment                    |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Resistance – Source <sup>1</sup><br>(Variable Artifact) | (1 to 10) $\Omega$<br>(10 to 100) $\Omega$<br>(100 to 1 000) $\Omega$<br>(1 to 10) k $\Omega$<br>(10 to 100) k $\Omega$<br>(100 to 1 000) k $\Omega$<br>(1 to 10) M $\Omega$                                                                                                                                                                                                       | 0.92 m $\Omega/\Omega$<br>0.92 m $\Omega/\Omega$<br>0.92 m $\Omega/\Omega$<br>0.92 m $\Omega/\Omega$<br>0.92 m $\Omega/\Omega$<br>0.9 m $\Omega/\Omega$<br>0.93 m $\Omega/\Omega$                                                                                                                                                                                                                                                                                                 | Comparison to<br>General Radio 1433-33<br>Decade Resistor       |
| Resistance – Measure <sup>1</sup>                       | (0 to 10) $\Omega$<br>(10 to 100) $\Omega$<br>(0.1 to 1) k $\Omega$<br>(1 to 10) k $\Omega$<br>(1 to 10) k $\Omega$<br>(10 to 100) k $\Omega$<br>(0.1 to 1) M $\Omega$<br>(1 to 10) M $\Omega$<br>(10 to 100) M $\Omega$                                                                                                                                                           | 17 $\mu\Omega/\Omega$ + 50 $\mu\Omega$<br>15 $\mu\Omega/\Omega$ + 0.5 m $\Omega$<br>12 $\mu\Omega/\Omega$ + 0.5 m $\Omega$<br>12 $\mu\Omega/\Omega$ + 5 m $\Omega$<br>13 $\mu\Omega/\Omega$ + 50 m $\Omega$<br>17 $\mu\Omega/\Omega$ + 2 $\Omega$<br>52 $\mu\Omega/\Omega$ + 0.1 k $\Omega$<br>52 $\mu\Omega/\Omega$ + 0.1 k $\Omega$<br>0.53 m $\Omega/\Omega$ + 1 k $\Omega$                                                                                                    | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter |
| AC Voltage – Source <sup>1</sup>                        | (1 to 12) mV<br>(3 to 5) Hz<br>(5 to 10) Hz<br>10 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz<br>(12 to 120) mV<br>(3 to 5) Hz<br>(5 to 10) Hz<br>10 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz<br>120 mV to 1.2 V<br>(3 to 5) Hz<br>(5 to 10) Hz<br>10 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 1.9 mV/V + 5.4 $\mu$ V<br>0.69 mV/V + 5.4 $\mu$ V<br>0.2 mV/V + 4.7 $\mu$ V<br>0.34 mV/V + 4.7 $\mu$ V<br>1.2 mV/V + 12 $\mu$ V<br>6.2 mV/V + 23 $\mu$ V<br>1.9 mV/V + 5.4 $\mu$ V<br>0.68 mV/V + 5.4 $\mu$ V<br>0.11 mV/V + 4.7 $\mu$ V<br>0.28 mV/V + 6.2 $\mu$ V<br>0.62 mV/V + 16 $\mu$ V<br>1.6 mV/V + 23 $\mu$ V<br>1.9 mV/V + 58 $\mu$ V<br>0.68 mV/V + 54 $\mu$ V<br>0.11 mV/V + 6.2 $\mu$ V<br>0.23 mV/V + 11 $\mu$ V<br>0.55 mV/V + 31 $\mu$ V<br>1.5 mV/V + 62 $\mu$ V | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator         |

## Electrical – DC/Low Frequency

| Parameter/Equipment               | Range            | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                    |
|-----------------------------------|------------------|-------------------------------------------|-----------------------------------------------------------------|
| AC Voltage – Source <sup>1</sup>  | (1.2 to 12) V    |                                           | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator         |
|                                   | (3 to 5) Hz      | 1.9 mV/V + 0.58 mV                        |                                                                 |
|                                   | (5 to 10) Hz     | 0.68 mV/V + 0.58 mV                       |                                                                 |
|                                   | 10 Hz to 20 kHz  | 0.11 mV/V + 39 $\mu$ V                    |                                                                 |
|                                   | (20 to 50) kHz   | 0.23 mV/V + 39 $\mu$ V                    |                                                                 |
|                                   | (50 to 100) kHz  | 0.55 mV/V + 97 $\mu$ V                    |                                                                 |
|                                   | (100 to 500) kHz | 1.6 mV/V + 0.47 mV                        |                                                                 |
|                                   | (12 to 120) V    |                                           |                                                                 |
|                                   | (3 to 5) Hz      | 1.9 mV/V + 5.8 mV                         |                                                                 |
|                                   | (5 to 10) Hz     | 0.68 mV/V + 5.8 mV                        |                                                                 |
|                                   | 10 Hz to 20 kHz  | 0.11 mV/V + 0.39 mV                       |                                                                 |
|                                   | (20 to 50) kHz   | 0.26 mV/V + 0.39 mV                       |                                                                 |
|                                   | (50 to 100) kHz  | 0.56 mV/V + 0.97 mV                       |                                                                 |
|                                   | (100 to 300) kHz | 1.6 mV/V + 16 mV                          |                                                                 |
|                                   | (120 to 330) V   |                                           |                                                                 |
|                                   | (3 to 5) Hz      | 1.9 mV/V + 58 mV                          |                                                                 |
|                                   | (5 to 10) Hz     | 0.68 mV/V + 58 mV                         |                                                                 |
|                                   | 10 Hz to 20 kHz  | 0.11 mV/V + 6.2 mV                        |                                                                 |
|                                   | (20 to 50) kHz   | 0.26 mV/V + 6.2 mV                        |                                                                 |
|                                   | (50 to 100) kHz  | 1.2 mV/V + 9.7 mV                         |                                                                 |
| AC Voltage – Measure <sup>1</sup> | (330 to 1 020) V |                                           | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter |
|                                   | (3 to 5) Hz      | 1.9 mV/V + 58 mV                          |                                                                 |
|                                   | (5 to 10) Hz     | 0.68 mV/V + 58 mV                         |                                                                 |
|                                   | (10 to 10) kHz   | 0.11 mV/V + 62 mV                         |                                                                 |
|                                   | Up to 10 mV      |                                           |                                                                 |
|                                   | 40 Hz to 1 kHz   | 0.34 mV/V + 1.1 $\mu$ V                   |                                                                 |
|                                   | (1 to 20) kHz    | 0.42 mV/V + 1.1 $\mu$ V                   |                                                                 |
|                                   | (20 to 100) kHz  | 5.1 mV/V + 1.1 $\mu$ V                    |                                                                 |
|                                   | (100 to 300) kHz | 41 mV/V + 2 $\mu$ V                       |                                                                 |
|                                   | (10 to 100) mV   |                                           |                                                                 |
|                                   | 40 Hz to 1 kHz   | 91 $\mu$ V/V + 2 $\mu$ V                  |                                                                 |
|                                   | (1 to 20) kHz    | 0.16 mV/V + 2 $\mu$ V                     |                                                                 |
|                                   | (20 to 100) kHz  | 0.9 mV/V + 2 $\mu$ V                      |                                                                 |
|                                   | (100 to 300) kHz | 3.1 mV/V + 10 $\mu$ V                     |                                                                 |
|                                   | (0.1 to 1) V     |                                           |                                                                 |
|                                   | 40 Hz to 1 kHz   | 86 $\mu$ V/V + 20 $\mu$ V                 |                                                                 |
|                                   | (1 to 20) kHz    | 0.16 mV/V + 20 $\mu$ V                    |                                                                 |
|                                   | (20 to 50) kHz   | 0.33 mV/V + 20 $\mu$ V                    |                                                                 |
|                                   | (50 to 100) kHz  | 0.83 mV/V + 20 $\mu$ V                    |                                                                 |
|                                   | (100 to 300) kHz | 3 mV/V + 0.1 mV                           |                                                                 |
|                                   | (300 to 500) kHz | 10 mV/V + 0.1 mV                          |                                                                 |

## Electrical – DC/Low Frequency

| Parameter/Equipment                    | Range                                                                                                                                                                                                                                                                                                                                                    | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Reference Standard, Method, and/or Equipment                    |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| AC Voltage – Measure <sup>1</sup>      | (1 to 10) V<br>(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 to 500) kHz<br>500 kHz to 1 MHz<br>(10 to 100) V<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 1 000) V<br>(50 to 60) Hz<br>(100 to 450) Hz                                         | 87 $\mu\text{V/V} + 0.4 \text{ mV}$<br>85 $\mu\text{V/V} + 0.2 \text{ mV}$<br>0.16 $\text{mV/V} + 0.2 \text{ mV}$<br>0.33 $\text{mV/V} + 0.2 \text{ mV}$<br>0.82 $\text{mV/V} + 60 \mu\text{V}$<br>3 $\text{mV/V} + 1 \text{ mV}$<br>3.4 $\text{mV/V} + 1 \text{ mV}$<br>10 $\text{mV/V} + 1 \text{ mV}$<br>0.22 $\text{mV/V} + 2 \text{ mV}$<br>0.23 $\text{mV/V} + 2 \text{ mV}$<br>0.38 $\text{mV/V} + 2 \text{ mV}$<br>1.3 $\text{mV/V} + 2 \text{ mV}$<br>1 $\text{mV/V} + 0.4 \text{ V}$<br>25 $\text{mV/V} + 0.4 \text{ V}$                                                               | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter |
| AC High Voltage – Measure <sup>1</sup> | (1 to 9) kV<br>(50 to 60) Hz                                                                                                                                                                                                                                                                                                                             | 1 $\text{mV/V} + 0.4 \text{ V}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Comparison to<br>Vitretek 4700<br>High Voltage Meter            |
| AC Current – Source <sup>1</sup>       | Up to 120 $\mu\text{A}$<br>(3 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>(> 0.12 to 1.2) mA<br>(3 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>(> 1.2 to 12) mA<br>(3 to 45) Hz<br>> 45 Hz to 1 kHz<br>(> 1 to 5) kHz<br>(> 5 to 10) kHz<br>(> 10 to 30) kHz | 0.21 $\text{mA/A} + 7.8 \text{ nA}$<br>0.21 $\text{mA/A} + 7.8 \text{ nA}$<br>0.21 $\text{mA/A} + 7.8 \text{ nA}$<br>1.17 $\text{mA/A} + 31 \text{ nA}$<br>4 $\text{mA/A} + 0.78 \mu\text{A}$<br>0.21 $\text{mA/A} + 78 \text{ nA}$<br>0.21 $\text{mA/A} + 78 \text{ nA}$<br>0.21 $\text{mA/A} + 78 \text{ nA}$<br>1.2 $\text{mA/A} + 78 \text{ nA}$<br>4 $\text{mA/A} + 3.9 \mu\text{A}$<br>0.2 $\text{mA/A} + 0.78 \mu\text{A}$<br>0.2 $\text{mA/A} + 0.78 \mu\text{A}$<br>0.2 $\text{mA/A} + 0.78 \mu\text{A}$<br>1.2 $\text{mA/A} + 0.78 \mu\text{A}$<br>3.9 $\text{mA/A} + 7.8 \mu\text{A}$ | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator         |

## Electrical – DC/Low Frequency

| Parameter/Equipment                  | Range              | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                   |
|--------------------------------------|--------------------|-------------------------------------------|--------------------------------------------------------------------------------|
| AC Current – Source <sup>1</sup>     | (> 12 to 120) mA   |                                           | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator                        |
|                                      | (3 to 45) Hz       | 0.2 mA/A + 7.8 $\mu$ A                    |                                                                                |
|                                      | > 45 Hz to 1 kHz   | 0.1 mA/A + 3.9 $\mu$ A                    |                                                                                |
|                                      | (> 1 to 5) kHz     | 0.2 mA/A + 6.2 $\mu$ A                    |                                                                                |
|                                      | (> 5 to 10) kHz    | 1.2 mA/A + 7.8 $\mu$ A                    |                                                                                |
|                                      | (> 10 to 30) kHz   | 3.9 mA/A + 78 $\mu$ A                     |                                                                                |
|                                      | (> 0.12 to 1.2) A  |                                           |                                                                                |
|                                      | (3 to 45) Hz       | 0.2 mA/A + 78 $\mu$ A                     |                                                                                |
|                                      | > 45 Hz to 1 kHz   | 0.2 mA/A + 39 $\mu$ A                     |                                                                                |
|                                      | (> 1 to 5) kHz     | 0.2 mA/A + 62 $\mu$ A                     |                                                                                |
|                                      | (> 5 to 10) kHz    | 1.9 mA/A + 0.23 mA                        |                                                                                |
|                                      | (> 10 to 30) kHz   | 3.9 mA/A + 0.23 mA                        |                                                                                |
|                                      | (> 1.2 to 3.1) A   |                                           |                                                                                |
|                                      | (3 to 45) Hz       | 0.3 mA/A + 0.39 mA                        |                                                                                |
|                                      | > 45 Hz to 1 kHz   | 0.24 mA/A + 0.23 mA                       |                                                                                |
|                                      | (> 1 to 5) kHz     | 0.3 mA/A + 0.23 mA                        |                                                                                |
|                                      | (> 5 to 10) kHz    | 1.9 mA/A + 0.39 mA                        |                                                                                |
| AC Current Clamp Meters <sup>1</sup> | (> 3.1 to 12) A    |                                           | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator,<br>Fluke 50-turn Coil |
|                                      | (3 to 45) Hz       | 0.3 mA/A + 0.78 mA                        |                                                                                |
|                                      | > 45 Hz to 1 kHz   | 0.24 mA/A + 0.39 mA                       |                                                                                |
|                                      | (> 1 to 5) kHz     | 0.31 mA/A + 0.62 mA                       |                                                                                |
|                                      | (> 5 to 10) kHz    | 1.9 mA/A + 0.78 mA                        |                                                                                |
|                                      | (> 12 to 30.2) A   |                                           |                                                                                |
|                                      | (3 to 45) Hz       | 0.78 mA/A + 7.8 mA                        |                                                                                |
|                                      | > 45 Hz to 1 kHz   | 0.55 mA/A + 6.2 mA                        |                                                                                |
|                                      | (> 1 to 5) kHz     | 3.9 mA/A + 6.2 mA                         |                                                                                |
|                                      | (20 to 50) A       |                                           |                                                                                |
|                                      | (45 to 65) Hz      | 0.3 % of reading + 20 mA                  |                                                                                |
|                                      | (65 to 440) Hz     | 0.64 % of reading + 21 mA                 |                                                                                |
|                                      | (> 50 to 500) A    |                                           |                                                                                |
|                                      | (45 to 65) Hz      | 0.28 % of reading + 72 mA                 |                                                                                |
|                                      | (65 to 440) Hz     | 0.64 % of reading + 78 mA                 |                                                                                |
|                                      | (> 500 to 1 000) A |                                           |                                                                                |
|                                      | (45 to 65) Hz      | 0.29 % of reading + 0.39 A                |                                                                                |
|                                      | (65 to 440) Hz     | 0.65 % of reading + 0.32 A                |                                                                                |

## Electrical – DC/Low Frequency

| Parameter/Equipment                                                                          | Range                           | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                                         |
|----------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------|
| AC Current – Measure <sup>1</sup>                                                            | Up to 10 $\mu$ A<br>1 kHz       | 0.95 mA/A + 3 nA                          | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter                                      |
|                                                                                              | (10 to 100) $\mu$ A<br>1 kHz    | 0.62 mA/A + 30 nA                         |                                                                                                      |
|                                                                                              | (0.1 to 1) mA<br>1 kHz          | 0.32 mA/A + 0.2 $\mu$ A                   |                                                                                                      |
|                                                                                              | (1 to 10) mA<br>1 kHz           | 0.32 mA/A + 2 $\mu$ A                     |                                                                                                      |
|                                                                                              | (10 to 100) mA<br>1 kHz         | 0.32 mA/A + 20 $\mu$ A                    |                                                                                                      |
|                                                                                              | (0.1 to 1) A<br>1 kHz           | 1 mA/A + 0.2 mA                           |                                                                                                      |
|                                                                                              |                                 |                                           |                                                                                                      |
|                                                                                              |                                 |                                           |                                                                                                      |
| AC Current – Measure <sup>1</sup>                                                            | Up to 1 000 A<br>(60 to 100) Hz | 0.62 mA/A + 0.61 A                        | Comparison to<br>Agilent 3458A Opt. 002<br>8.5 Digit Multimeter,<br>Empo B-1000-100<br>Current Shunt |
| Electrical Simulation of<br>Thermocouple Indicating<br>Devices – Source/Measure <sup>1</sup> | Type B<br>(600 to 800) °C       | 0.52 °C                                   | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator                                              |
|                                                                                              | (800 to 1 000) °C               | 0.47 °C                                   |                                                                                                      |
|                                                                                              | (1 000 to 1 550) °C             | 0.36 °C                                   |                                                                                                      |
|                                                                                              | (1 550 to 18 20) °C             | 0.37 °C                                   |                                                                                                      |
|                                                                                              | Type C<br>(0 to 150) °C         | 0.33 °C                                   |                                                                                                      |
|                                                                                              | (150 to 650) °C                 | 0.19 °C                                   |                                                                                                      |
|                                                                                              | (650 to 1 000) °C               | 0.22 °C                                   |                                                                                                      |
|                                                                                              | (1 000 to 1 800) °C             | 0.38 °C                                   |                                                                                                      |
|                                                                                              | (1 800 to 2 316) °C             | 0.63 °C                                   |                                                                                                      |
|                                                                                              | Type E<br>(-250 to -100) °C     | 0.33 °C                                   |                                                                                                      |
|                                                                                              | (-100 to -25) °C                | 0.16 °C                                   |                                                                                                      |
|                                                                                              | (-25 to 350) °C                 | 0.15 °C                                   |                                                                                                      |
|                                                                                              | (350 to 650) °C                 | 0.17 °C                                   |                                                                                                      |
|                                                                                              | (650 to 1 000) °C               | 0.2 °C                                    |                                                                                                      |
|                                                                                              |                                 |                                           |                                                                                                      |

**Electrical – DC/Low Frequency**

| Parameter/Equipment                                                                    | Range               | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment            |
|----------------------------------------------------------------------------------------|---------------------|-------------------------------------------|---------------------------------------------------------|
| Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1</sup> | Type J              |                                           | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator |
|                                                                                        | (-210 to -100) °C   | 0.22 °C                                   |                                                         |
|                                                                                        | (-100 to -30) °C    | 0.16 °C                                   |                                                         |
|                                                                                        | (-30 to 150) °C     | 0.15 °C                                   |                                                         |
|                                                                                        | (150 to 760) °C     | 0.16 °C                                   |                                                         |
|                                                                                        | (760 to 1 200) °C   | 0.2 °C                                    |                                                         |
|                                                                                        | Type K              |                                           |                                                         |
|                                                                                        | (-200 to -100) °C   | 0.26 °C                                   |                                                         |
|                                                                                        | (-100 to -25) °C    | 0.17 °C                                   |                                                         |
|                                                                                        | (-25 to 120) °C     | 0.16 °C                                   |                                                         |
|                                                                                        | (120 to 1 000) °C   | 0.21 °C                                   |                                                         |
|                                                                                        | (1 000 to 1 372) °C | 0.31 °C                                   |                                                         |
|                                                                                        | Type L              |                                           |                                                         |
|                                                                                        | (-200 to -100) °C   | 0.27 °C                                   |                                                         |
|                                                                                        | (-100 to 800) °C    | 0.2 °C                                    |                                                         |
|                                                                                        | (800 to 900) °C     | 0.15 °C                                   |                                                         |
|                                                                                        | Type N              |                                           |                                                         |
|                                                                                        | (-200 to -100) °C   | 0.35 °C                                   |                                                         |
|                                                                                        | (-100 to -25) °C    | 0.26 °C                                   |                                                         |
|                                                                                        | (-25 to 120) °C     | 0.25 °C                                   |                                                         |
|                                                                                        | (120 to 410) °C     | 0.25 °C                                   |                                                         |
|                                                                                        | (410 to 1 300) °C   | 0.28 °C                                   |                                                         |
|                                                                                        | Type R              |                                           |                                                         |
|                                                                                        | (0 to 250) °C       | 0.57 °C                                   |                                                         |
|                                                                                        | (250 to 400) °C     | 0.32 °C                                   |                                                         |
|                                                                                        | (400 to 1 000) °C   | 0.31 °C                                   |                                                         |
|                                                                                        | (1 000 to 1 767) °C | 0.35 °C                                   |                                                         |
|                                                                                        | Type S              |                                           |                                                         |
|                                                                                        | (0 to 250) °C       | 0.4 °C                                    |                                                         |
|                                                                                        | (250 to 1 000) °C   | 0.33 °C                                   |                                                         |
|                                                                                        | (1 000 to 1 400) °C | 0.34 °C                                   |                                                         |
|                                                                                        | (1 400 to 1 767) °C | 0.39 °C                                   |                                                         |
|                                                                                        | Type T              |                                           |                                                         |
|                                                                                        | (-250 to -150) °C   | 0.49 °C                                   |                                                         |
|                                                                                        | (-150 to 0) °C      | 0.23 °C                                   |                                                         |
|                                                                                        | (0 to 120) °C       | 0.13 °C                                   |                                                         |
|                                                                                        | (120 to 400) °C     | 0.12 °C                                   |                                                         |
|                                                                                        | Type U              |                                           |                                                         |
|                                                                                        | (-200 to 0) °C      | 0.35 °C                                   |                                                         |
|                                                                                        | (0 to 600) °C       | 0.12 °C                                   |                                                         |

**Electrical – DC/Low Frequency**

| Parameter/Equipment                                                   | Range                  | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment            |
|-----------------------------------------------------------------------|------------------------|-------------------------------------------|---------------------------------------------------------|
| Electrical Simulation of RTD Indicating Devices – Source <sup>1</sup> | Pt 385, 100 $\Omega$   |                                           | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator |
|                                                                       | (-200 to -80) °C       | 0.039 °C                                  |                                                         |
|                                                                       | (-80 to 0) °C          | 0.039 °C                                  |                                                         |
|                                                                       | (0 to 100) °C          | 0.056 °C                                  |                                                         |
|                                                                       | (100 to 300) °C        | 0.072 °C                                  |                                                         |
|                                                                       | (300 to 400) °C        | 0.08 °C                                   |                                                         |
|                                                                       | (400 to 630) °C        | 0.096 °C                                  |                                                         |
|                                                                       | (630 to 800) °C        | 0.18 °C                                   |                                                         |
|                                                                       | Pt 385, 1 000 $\Omega$ |                                           |                                                         |
|                                                                       | (-200 to -80) °C       | 0.049 °C                                  |                                                         |
|                                                                       | (-80 to 0) °C          | 0.066 °C                                  |                                                         |
|                                                                       | (0 to 100) °C          | 0.13 °C                                   |                                                         |
|                                                                       | (100 to 260) °C        | 0.16 °C                                   |                                                         |
|                                                                       | (260 to 300) °C        | 0.17 °C                                   |                                                         |
|                                                                       | (300 to 400) °C        | 0.19 °C                                   |                                                         |
|                                                                       | (400 to 600) °C        | 0.23 °C                                   |                                                         |
|                                                                       | (600 to 630) °C        | 0.29 °C                                   |                                                         |
|                                                                       | Pt 3916, 100 $\Omega$  |                                           |                                                         |
|                                                                       | (-200 to -190) °C      | 0.19 °C                                   |                                                         |
|                                                                       | (-190 to -80) °C       | 0.032 °C                                  |                                                         |
|                                                                       | (-80 to 0) °C          | 0.039 °C                                  |                                                         |
|                                                                       | (0 to 100) °C          | 0.048 °C                                  |                                                         |
|                                                                       | (100 to 260) °C        | 0.056 °C                                  |                                                         |
|                                                                       | (260 to 300) °C        | 0.064 °C                                  |                                                         |
|                                                                       | (300 to 400) °C        | 0.072 °C                                  |                                                         |
|                                                                       | (400 to 600) °C        | 0.081 °C                                  |                                                         |
|                                                                       | (600 to 630) °C        | 0.18 °C                                   |                                                         |
|                                                                       | Pt 3926, 100 $\Omega$  |                                           |                                                         |
|                                                                       | (-200 to -80) °C       | 0.039 °C                                  |                                                         |
|                                                                       | (-80 to 0) °C          | 0.039 °C                                  |                                                         |
|                                                                       | (0 to 100) °C          | 0.056 °C                                  |                                                         |
|                                                                       | (100 to 300) °C        | 0.072 °C                                  |                                                         |
|                                                                       | (300 to 400) °C        | 0.08 °C                                   |                                                         |
|                                                                       | (400 to 630) °C        | 0.096 °C                                  |                                                         |

## Electrical – DC/Low Frequency

| Parameter/Equipment                                                                                                                                                                                                         | Range                                                                                                                                                                               | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                                                                                              | Reference Standard, Method, and/or Equipment                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Capacitance – Source <sup>1</sup><br>(Simulation)<br>100 Hz to 10 kHz<br>150 Hz to 5 kHz<br>200 Hz to 1.3 kHz<br>(2 to 310) Hz<br>(0.5 to 110) Hz<br>(0.5 to 40) Hz<br>(0.1 to 11) Hz<br>30 mHz to 4 Hz<br>10 mHz to 1.3 Hz | (0.2 to 1.2) nF<br>(1.21 to 12) nF<br>(12 to 120) nF<br>(0.12 to 1.2) $\mu$ F<br>(1.2 to 12) $\mu$ F<br>(12 to 120) $\mu$ F<br>(0.12 to 1.2) mF<br>(1.2 to 12) mF<br>(12 to 120) mF | 0.16 % of reading + 3.1 pF<br>0.12 % of reading + 3.9 pF<br>0.12 % of reading + 23 pF<br>0.12 % of reading + 0.23 nF<br>0.12 % of reading + 2.3 nF<br>0.13 % of reading + 19 nF<br>0.2 % of reading + 0.19 $\mu$ F<br>0.21 % of reading + 2.3 $\mu$ F<br>0.4 % of reading + 23 $\mu$ F | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator           |
| Capacitance – Source <sup>1</sup><br>(Variable Artifact)                                                                                                                                                                    | (10 to 100) pF<br>(100 to 1 000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1 000) nF                                                                                          | 0.3 mF/F + 0.12 pF<br>0.9 mF/F + 0.074 pF<br>0.82 mF/F + 1.3 pF<br>0.89 mF/F + 4.9 pF<br>0.91 mF/F + 34 pf                                                                                                                                                                             | Comparison to<br>General Radio 1412-BC<br>Decade Capacitor        |
| Capacitance – Measure <sup>1</sup>                                                                                                                                                                                          | 1 kHz<br>(10 to 100) pF<br>(100 to 1 000) pF<br>(1 to 100) nF<br>(0.1 to 1) $\mu$ F                                                                                                 | 3.1 mF/F + 0.1 pF<br>3.1 mF/F + 1 pF<br>3.6 mF/F + 0.01 nF<br>2.5 mF/F + 0.1 nF                                                                                                                                                                                                        | Comparison to<br>Fluke PM6303<br>RCL Meter                        |
| Inductance – Source <sup>1</sup><br>(Simulation)<br>Up to 1 kHz<br>Up to 1 kHz<br>10 Hz to 3 kHz<br>10 Hz to 1 kHz<br>10 Hz to 1 kHz<br>10 Hz to 1 kHz<br>10 Hz to 1 kHz                                                    | (15 to 120) $\mu$ H<br>(0.12 to 1.2) mH<br>(1.2 to 12) mH<br>(12 to 120) mH<br>(0.12 to 1.2) H<br>(1.2 to 12) H<br>(12 to 120) H                                                    | 0.22 % of reading + 0.16 $\mu$ H<br>0.12 % of reading + 0.78 $\mu$ H<br>0.12 % of reading + 7.8 $\mu$ H<br>0.12 % of reading + 78 $\mu$ H<br>0.14 % of reading + 0.78 mH<br>0.19 % of reading + 7.8 mH<br>0.22 % of reading + 78 mH                                                    | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator           |
| Inductance – Source <sup>1</sup><br>(Fixed Artifacts)                                                                                                                                                                       | 100 Hz to 10 kHz<br>100 $\mu$ H<br>1 mH<br>100 mH                                                                                                                                   | 0.41 $\mu$ H<br>1.2 $\mu$ H<br>0.1 mH                                                                                                                                                                                                                                                  | Comparison to<br>GenRad 1482B, 1482E,<br>1482L Standard Inductors |
| DC Power – Source <sup>1</sup>                                                                                                                                                                                              | Up to 3.1 kW<br>(3.1 to 30) kW                                                                                                                                                      | 0.025 % of reading + 9.9 mW<br>0.083 % of reading + 0.43 W                                                                                                                                                                                                                             | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator           |

## Electrical – DC/Low Frequency

| Parameter/Equipment                                                          | Range                                                                                                          | Expanded Uncertainty of Measurement (+/-)                                                                                  | Reference Standard, Method, and/or Equipment                                              |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| AC Power – Source <sup>1</sup>                                               | 45 Hz to 1 kHz<br>Up to 120 W<br>120 W to 1.2 kW<br>(1.2 to 3.2) kW<br>(3.2 to 12) kW<br>(12 to 30.8) kW       | 0.19 mW/W + 8.4 mW<br>0.23 mW/W + 84 mW<br>0.27 mW/W + 0.31 W<br>0.27 mW/W + 0.84 W<br>0.56 mW/W + 6.6 W                   | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator                                   |
|                                                                              | (1 to 5) kHz<br>Up to 120 W<br>120 W to 1.2 kW<br>(1.2 to 3.2) kW<br>(3.2 to 12) kW<br>(12 to 30.8) kW         | 0.23 mW/W + 9.8 mW<br>0.23 mW/W + 98 mW<br>0.32 mW/W + 0.31 W<br>0.33 mW/W + 0.98 W<br>3.9 mW/W + 6.6 W                    |                                                                                           |
| Phase Angle – Source <sup>1</sup>                                            | (0 to 90)°<br>Up to 400 Hz<br>400 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz               | 0.2°<br>0.39°<br>1.9°<br>3.9°<br>7.8°                                                                                      | Comparison to<br>Fluke 55xxA<br>Multiproduct Calibrator                                   |
| Oscilloscopes <sup>1</sup><br>Amplitude Square Wave<br>into 50 $\Omega$ load | 1 kHz<br>Up to 5 mV<br>(5 to 11) mV<br>(11 to 45) mV<br>(45 to 110) mV<br>(0.11 to 0.45) V<br>(0.45 to 1.09) V | 2.3 mV/V + 25 $\mu$ V<br>2 mV/V + 55 $\mu$ V<br>2 mV/V + 0.23 mV<br>2 mV/V + 0.55 mV<br>2 mV/V + 2.3 mV<br>2 mV/V + 5.5 mV | Comparison to<br>Fluke 5502A/3<br>Multiproduct Calibrator<br>with 300 MHz Scope<br>Option |
| Leveled Sine Wave                                                            | 10 Hz<br>(1.09 to 2.2) V                                                                                       | 1.9 mV/V + 22 mV                                                                                                           |                                                                                           |
|                                                                              | 100 Hz<br>(1.09 to 2.2) V                                                                                      | 1.9 mV/V + 11 mV                                                                                                           |                                                                                           |
|                                                                              | 1 kHz<br>(1.09 to 2.2) V                                                                                       | 2 mV/V + 11 mV                                                                                                             |                                                                                           |

### Electrical – DC/Low Frequency

| Parameter/Equipment                                                           | Range                                                                                                                                                                                                                  | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                    | Reference Standard, Method, and/or Equipment                                              |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Oscilloscopes <sup>1</sup><br>Amplitude Square Wave<br>into 1 M $\Omega$ load | 1 kHz<br>Up to 5 mV<br>(5 to 20) mV<br>(20 to 89) mV<br>(89 to 219) mV<br>(219 to 890) mV<br>(0.89 to 6.5) V<br>10 Hz<br>(6.5 to 55) V<br>100 Hz<br>(6.5 to 55) V<br>1 kHz<br>(6.5 to 55) V<br>10 kHz<br>(6.5 to 55) V | 2.3 mV/V + 30 $\mu$ V<br>2 mV/V + 0.1 mV<br>2 mV/V + 0.45 mV<br>1.9 mV/V + 1.1 mV<br>1.9 mV/V + 4.5 mV<br>1.9 mV/V + 33 mV<br>2 mV/V + 0.55 V<br>1.9 mV/V + 0.28 V<br>1.9 mV/V + 0.28 V<br>3.9 mV/V + 0.28 V | Comparison to<br>Fluke 5502A/3<br>Multiproduct Calibrator<br>with 300 MHz Scope<br>Option |
| Leveled Sine Wave Flatness<br>(50 kHz Reference)                              | 10 mV to 5.5 V<br>50 kHz to 100 MHz<br>(100 to 300) MHz                                                                                                                                                                | 28 mV/V + 0.23 mV/V<br>34 mV/V + 0.23 mV/V                                                                                                                                                                   |                                                                                           |
| Time Marker<br>into 50 $\Omega$ load                                          | 2 ns to 50 ms<br>50 ms to 5 s                                                                                                                                                                                          | 20 $\mu$ s/s<br>58 $\mu$ s/s                                                                                                                                                                                 |                                                                                           |

### Length – Dimensional Metrology

| Parameter/Equipment                | Range                                         | Expanded Uncertainty of Measurement (+/-)                              | Reference Standard, Method, and/or Equipment                                      |
|------------------------------------|-----------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Calipers <sup>1,2</sup>            | Up to 12 in<br>(12 to 40) in<br>(40 to 80) in | (290 + 2.9L) $\mu$ in<br>(200 + 9.6L) $\mu$ in<br>(110 + 12L) $\mu$ in | Comparison to<br>ASME Grade 0<br>Gage Blocks,<br>Length Standards,<br>Ring Gauges |
| Outside Micrometers <sup>1,2</sup> | Up to 12 in                                   | (35 + 9.8L) $\mu$ in                                                   | Comparison to<br>ASME Grade 0<br>Gage Blocks,<br>Length Standards                 |

## Length – Dimensional Metrology

| Parameter/Equipment                | Range                                                    | Expanded Uncertainty of Measurement (+/-)                                                                             | Reference Standard, Method, and/or Equipment                                        |
|------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Inside Micrometers <sup>1,2</sup>  | Up to 12 in<br>(12 to 40) in                             | $(43 + 10L) \mu\text{in}$<br>$(170 + 8.8L) \mu\text{in}$                                                              | Comparison to<br>ASME Grade 0<br>Gage Blocks,<br>Length Standards,<br>Ring Gauges   |
| Dial Indicators <sup>1,2</sup>     | Up to 4 in                                               | $(27 + 7.4L) \mu\text{in}$                                                                                            | Comparison to<br>ASME Grade 0<br>Gage Blocks                                        |
| Test Indicators <sup>1,2</sup>     | Up to 0.05 in                                            | $(29 + 0.12L) \mu\text{in}$                                                                                           | Comparison to<br>ASME Grade 0<br>Gage Blocks                                        |
| Height Gages <sup>1,2</sup>        | Up to 12 in<br>(12 to 40) in                             | $(290 + 3.2L) \mu\text{in}$<br>$(330 + 6.5L) \mu\text{in}$                                                            | Comparison to<br>ASME Grade 0<br>Gage Blocks,<br>Length Standards,<br>Surface Plate |
| Optical Comparators <sup>1,2</sup> | Up to 50 mm<br>Up to 200 mm                              | $(0.73 + 0.25L) \mu\text{m}$<br>$(0.45 + 0.25L) \mu\text{m}$                                                          | Comparison to<br>Mitutoyo Glass Scales                                              |
| Microscopes <sup>1,2</sup>         | Up to 50 mm<br>Up to 2 in                                | $(0.73 + 0.25L) \mu\text{m}$<br>$(22 + 260L) \mu\text{in}$                                                            | Comparison to<br>Mitutoyo Glass Scales                                              |
| Protractor/Angle <sup>1,2</sup>    | (30 to 90)°                                              | 1.8'                                                                                                                  | Comparison to<br>Angle Block Set                                                    |
| Outside Diameter <sup>2</sup>      | (0.5 to 25) mm<br>(25 to 60) mm                          | $(2.6 + 0.005D) \mu\text{m}$<br>$(9.3 - 0.039D) \mu\text{m}$                                                          | Direct measure using<br>Laser Micrometer                                            |
| Laser Micrometers <sup>1,2</sup>   | (0.5 to 25) mm                                           | 0.3 $\mu\text{m}$                                                                                                     | Cylindrical Plug Gages per<br>ASME B.89.1.5-1998<br>Class XX                        |
| Laser Micrometers <sup>1,2</sup>   | 1 mm<br>60 mm                                            | 0.23 $\mu\text{m}$<br>0.5 $\mu\text{m}$                                                                               | Comparison to<br>Mitutoyo Calibration Gage,<br>Set 02AGD170                         |
| Gage Blocks <sup>2</sup>           | Up to 2 in<br>(2 to 4) in<br>(4 to 6) in<br>(6 to 12) in | $(3.4 + 1.3L) \mu\text{in}$<br>$(6 + 0.9L) \mu\text{in}$<br>$(9.6 + 0.5L) \mu\text{in}$<br>$(13 + 0.9L) \mu\text{in}$ | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 00<br>Gage Blocks       |

## Length – Dimensional Metrology

| Parameter/Equipment                                 | Range                                                       | Expanded Uncertainty of Measurement (+/-)                                                                               | Reference Standard, Method, and/or Equipment                                                    |
|-----------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Length Standards <sup>2</sup>                       | Up to 2 in<br>(2 to 4) in<br>(4 to 6) in<br>(6 to 12) in    | $(4 + 1.5L) \mu\text{in}$<br>$(7 + 0.9L) \mu\text{in}$<br>$(11 + 0.6L) \mu\text{in}$<br>$(14 + 0.9L) \mu\text{in}$      | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 00<br>Gage Blocks                   |
| Cylindrical Pin/Plug Gages <sup>2</sup>             | Up to 1 in<br>(1 to 2) in<br>(2 to 4) in                    | $(4.2 + 0.7L) \mu\text{in}$<br>$(4.9 + 0.7L) \mu\text{in}$<br>$(6.4 + 0.5L) \mu\text{in}$                               | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 00<br>Gage Blocks                   |
| Cylindrical Pin/Plug Gages <sup>2</sup>             | Up to 1 in                                                  | $(12 + 2.5L) \mu\text{in}$                                                                                              | Comparison to<br>Laser Micrometer,<br>XX Plug Gages                                             |
| Cylindrical Ring Gages<br>(Plain)                   | Up to 0.5 in<br>(0.5 to 1) in<br>(1 to 2) in<br>(2 to 4) in | $(17 + 0.15L) \mu\text{in}$<br>$(17 + 1.1L) \mu\text{in}$<br>$(17 + 1.2L) \mu\text{in}$<br>$(20 + 1.2L) \mu\text{in}$   | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 00<br>Gage Blocks,<br>XX Ring Gages |
| Thread Wires<br>(4 – 80) TPI                        | Up to 0.5 in                                                | $(3.5 + 2.7L) \mu\text{in}$                                                                                             | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 0<br>Gage Blocks                    |
| Thread Plug Gages,<br>60° Threads<br>Major Diameter | Up to 0.5 in<br>(0.5 to 1) in<br>(1 to 2) in<br>(2 to 4) in | $(20 + 0.3L) \mu\text{in}$<br>$(19 + 0.1L) \mu\text{in}$<br>$(19 + 0.21L) \mu\text{in}$<br>$(20 + 0.2L) \mu\text{in}$   | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 00<br>Gage Blocks,<br>Thread Wires  |
| Pitch Diameter                                      | Up to 0.5 in<br>(0.5 to 1) in<br>(1 to 2) in<br>(2 to 4) in | $(16 + 0.4L) \mu\text{in}$<br>$(16 + 0.12L) \mu\text{in}$<br>$(16 + 0.26L) \mu\text{in}$<br>$(17 + 0.23L) \mu\text{in}$ |                                                                                                 |

## Length – Dimensional Metrology

| Parameter/Equipment                                                                                   | Range                                                                                                                          | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                                                                | Reference Standard, Method, and/or Equipment                                                                                                                      |
|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fixed Internal Thread Ring Gages<br>Minor Diameter<br><br>Pitch Diameter                              | Up to 0.5 in<br>(0.5 to 1) in<br>(1 to 2) in<br>(2 to 4) in<br><br>Up to 0.5 in<br>(0.5 to 1) in<br>(1 to 2) in<br>(2 to 4) in | $(25 + 0.25L) \mu\text{in}$<br>$(25 + 0.08L) \mu\text{in}$<br>$(25 + 0.17L) \mu\text{in}$<br>$(25 + 0.16L) \mu\text{in}$<br><br>$(25 + 0.24L) \mu\text{in}$<br>$(25 + 0.08L) \mu\text{in}$<br>$(25 + 0.16L) \mu\text{in}$<br>$(25 + 0.15L) \mu\text{in}$ | Comparison to<br>P&W Labmaster®<br>Universal,<br>ASME Grade 00<br>Gage Blocks                                                                                     |
| Coordinate Measuring Machines (CMMs) <sup>1,2</sup><br>Linear Measurement<br>(Axis X, Axis Y, Axis Z) | Up to 2 in<br>(2 to 4) in<br>(4 to 6) in<br>(6 to 12) in<br>(12 to 20) in                                                      | $(3.7 + 6.3L) \mu\text{in}$<br>$(4.1 + 5.8L) \mu\text{in}$<br>$(19 + 4.6L) \mu\text{in}$<br>$(13 + 5.4L) \mu\text{in}$<br>$(20 + 5.4L) \mu\text{in}$                                                                                                     | Check Master<br>per ISO 10360-2.                                                                                                                                  |
| Vision Measuring System <sup>1,2</sup><br>Linear Measurement<br>(Axis X, Axis Y, Axis Z)              | Up to 2 in<br>(2 to 4) in<br>(4 to 6) in<br>(6 to 12) in<br>(12 to 20) in<br><br>Up to 50 mm<br>Up to 2 in<br>Up to 200 mm     | $(3.7 + 6.3L) \mu\text{in}$<br>$(4.1 + 5.8L) \mu\text{in}$<br>$(19.0 + 4.6L) \mu\text{in}$<br>$(13.0 + 5.4L) \mu\text{in}$<br>$(20 + 5.4L) \mu\text{in}$<br><br>$(0.4 + 0.26L) \mu\text{m}$<br>$(16 + 257L) \mu\text{in}$<br>$(0.3 + 0.26L) \mu\text{m}$ | Comparison to<br>ASME Grade 00<br>Gage Blocks,<br>Grade 0<br>Long Gage Blocks,<br>Glass Scale Up to 50 mm,<br>Glass Scale Up to 2 in,<br>Glass Scale Up to 200 mm |
| Stage Micrometer,<br>Glass Scales <sup>2</sup>                                                        | Up to 50 mm<br>(50 to 200) mm<br><br>Up to 2 in                                                                                | $(1.1 \text{ to } 0.013L) \mu\text{m}$<br>$(1.2 + 0.016L) \mu\text{m}$<br><br>$(10.1 + 42L) \mu\text{in}$                                                                                                                                                | Comparison to<br>Mitutoyo<br>QVT1-L404Z1L-D<br>Quick Vision Active                                                                                                |
| Rulers,<br>Tape Measures                                                                              | Up to 12 in<br><br>Up to 80 in                                                                                                 | $(97 + 24L) \mu\text{in}$<br><br>$(9\,000 + 3.7L) \mu\text{in}$                                                                                                                                                                                          | Comparison to<br>Mitutoyo<br>QVT1-L404Z1L-D<br>Quick Vision Active<br><br>Gage Blocks                                                                             |

## Length – Dimensional Metrology

| Parameter/Equipment                           | Range                                         | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment   |
|-----------------------------------------------|-----------------------------------------------|-------------------------------------------|------------------------------------------------|
| Roughness Testers <sup>1</sup>                | Ra 0.43 $\mu\text{m}$<br>Rz 1.6 $\mu\text{m}$ | 0.065 $\mu\text{m}$<br>0.26 $\mu\text{m}$ | Comparison to Roughness Specimens              |
|                                               | Ra 3 $\mu\text{m}$<br>Rz 11.6 $\mu\text{m}$   | 0.065 $\mu\text{m}$<br>0.34 $\mu\text{m}$ |                                                |
| Granite Surface Plates<br>Local Area Flatness | Up to 0.001 in                                | 51 $\mu\text{in}$                         | Partial verification per using Repeat-o-Meter. |

## Mass and Mass Related

| Parameter/Equipment                                              | Range                 | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                                          |
|------------------------------------------------------------------|-----------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Torque Tools <sup>1</sup>                                        | (5 to 50) ozf·in      | 0.13 % of reading                         | Comparison to CDI Torque Transducers, Readout                                                         |
|                                                                  | (5 to 50) lbf·in      | 0.12 % of reading                         |                                                                                                       |
|                                                                  | (40 to 400) lbf·in    | 0.13 % of reading                         |                                                                                                       |
|                                                                  | (100 to 1 000) lbf·in | 0.21 % of reading                         |                                                                                                       |
|                                                                  | (25 to 250) lbf·ft    | 0.14 % of reading                         |                                                                                                       |
|                                                                  | (100 to 1 000) lbf·ft | 0.13 % of reading                         |                                                                                                       |
| Torque Calibration Systems                                       | (5 to 50) ozf·in      | 0.13 % of reading                         | Comparison to CDI Torque Calibration Radius Arms, Hangers, Weights                                    |
|                                                                  | (5 to 50) lbf·in      | 0.068 % of reading                        |                                                                                                       |
|                                                                  | (40 to 400) lbf·in    | 0.049 % of reading                        |                                                                                                       |
|                                                                  | (100 to 1 000) lbf·in | 0.046 % of reading                        |                                                                                                       |
|                                                                  | (25 to 250) lbf·ft    | 0.039 % of reading                        |                                                                                                       |
|                                                                  | (100 to 1 000) lbf·ft | 0.034 % of reading                        |                                                                                                       |
| Force Gauges,<br>Load Cell Systems<br>Tension<br><br>Compression | Up to 100 lbf         | 0.13 % of reading                         | Comparison to Force Transducers, Futek Indicator, 500 lbf Load Cell using a Universal Testing Machine |
|                                                                  | (100 to 200) lbf      | 0.094 % of reading                        |                                                                                                       |
|                                                                  | (200 to 300) lbf      | 0.065 % of reading                        |                                                                                                       |
|                                                                  | (300 to 400) lbf      | 0.08 % of reading                         |                                                                                                       |
|                                                                  | (400 to 500) lbf      | 0.044 % of reading                        |                                                                                                       |
|                                                                  | Up to 100 lbf         | 0.12 % of reading                         |                                                                                                       |
|                                                                  | (100 to 200) lbf      | 0.072 % of reading                        |                                                                                                       |
|                                                                  | (200 to 300) lbf      | 0.048 % of reading                        |                                                                                                       |
|                                                                  | (300 to 400) lbf      | 0.049 % of reading                        |                                                                                                       |
|                                                                  | (400 to 500) lbf      | 0.053 % of reading                        |                                                                                                       |
|                                                                  |                       |                                           |                                                                                                       |
|                                                                  |                       |                                           |                                                                                                       |

## Mass and Mass Related

| Parameter/Equipment                           | Range                                                                                                            | Expanded Uncertainty of Measurement (+/-)                                                                 | Reference Standard, Method, and/or Equipment                                                                            |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Force Gauges,<br>Load Cell Systems<br>Tension | Up to 200 lbf<br>(200 to 400) lbf<br>(400 to 600) lbf<br>(600 to 800) lbf<br>(800 to 1 000) lbf                  | 0.22 % of reading<br>0.19 % of reading<br>0.22 % of reading<br>0.17 % of reading<br>0.1 % of reading      | Comparison to<br>Force Transducers,<br>Futek Indicator,<br>1 000 lbf Load Cell using a<br>Universal Testing Machine     |
| Compression                                   | Up to 200 lbf<br>(200 to 400) lbf<br>(400 to 600) lbf<br>(600 to 800) lbf<br>(800 to 1 000) lbf                  | 0.12 % of reading<br>0.072 % of reading<br>0.048 % of reading<br>0.049 % of reading<br>0.053 % of reading |                                                                                                                         |
| Force Gauges,<br>Load Cell Systems<br>Tension | Up to 1 000 lbf<br>(1 000 to 2 000) lbf<br>(2 000 to 3 000) lbf<br>(3 000 to 4 000) lbf<br>(4 000 to 5 000) lbf  | 0.35 % of reading<br>0.28 % of reading<br>0.24 % of reading<br>0.18 % of reading<br>0.13 % of reading     | Comparison to<br>Force Transducers,<br>Futek Indicator,<br>5 000 lbf Load Cell using a<br>Universal Testing Machine     |
| Compression                                   | Up to 1 000 lbf<br>(1 000 to 2 000) lbf<br>(2 000 to 3 000) lbf<br>(3 000 to 4 000) lbf<br>(4 000 to 5 000) lbf  | 0.1 % of reading<br>0.11 % of reading<br>0.091 % of reading<br>0.1 % of reading<br>0.11 % of reading      |                                                                                                                         |
| Force Gauges,<br>Load Cell Systems<br>Tension | Up to 2 000 lbf<br>(2 000 to 4 000) lbf<br>(4 000 to 6 000) lbf<br>(6 000 to 8 000) lbf<br>(8 000 to 10 000) lbf | 0.15 % of reading<br>0.076 % of reading<br>0.1 % of reading<br>0.16 % of reading<br>0.1 % of reading      | Comparison to<br>Force Transducers,<br>Futek Indicator,<br>10 000 lbf Load Cell<br>using a Universal<br>Testing Machine |
| Compression                                   | Up to 2 000 lbf<br>(2 000 to 4 000) lbf<br>(4 000 to 6 000) lbf<br>(6 000 to 8 000) lbf<br>(8 000 to 10 000) lbf | 0.14 % of reading<br>0.054 % of reading<br>0.033 % of reading<br>0.031 % of reading<br>0.04 % of reading  |                                                                                                                         |

## Mass and Mass Related

| Parameter/Equipment              | Range                                                                                                                                                                                                    | Expanded Uncertainty of Measurement (+/-)                                                                                                                                                                                     | Reference Standard, Method, and/or Equipment                                                                     |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Analytical Scales <sup>1,3</sup> | Up to 100 g<br>(100 to 200) g<br>(200 to 1 000) g                                                                                                                                                        | 60 µg<br>0.3 mg<br>1.4 mg                                                                                                                                                                                                     | ASTM E617 Class 1 weights and internal calibration procedure utilized in the calibration of the weighing system. |
| Scales / Balances <sup>1,3</sup> | Up to 50 g<br>(50 to 200) g<br>(200 to 500) g<br>500 g to 1 kg<br>(1 to 5) kg<br>(5 to 10) kg<br>(10 to 25) kg<br>(25 to 100) kg<br>(100 to 300) kg<br>(300 to 500) kg                                   | 1.3 mg<br>6.2 mg<br>7.1 mg<br>7.3 mg<br>1.5 g<br>3 g<br>10 g<br>35 g<br>150 g<br>270 g                                                                                                                                        | NIST Class F weights and internal calibration procedure utilized in the calibration of the weighing system.      |
| Mass Determination (SI Units)    | 1 mg<br>2 mg<br>5 mg<br>10 mg<br>20 mg<br>50 mg<br>100 mg<br>200 mg<br>500 mg<br>1 g<br>2 g<br>5 g<br>10 g<br>20 g<br>50 g<br>100 g<br>200 g<br>500 g<br>1 kg<br>2 kg<br>5 kg<br>10 kg<br>20 kg<br>25 kg | 11 µg<br>11 µg<br>11 µg<br>12 µg<br>12 µg<br>13 µg<br>15 µg<br>18 µg<br>21 µg<br>24 µg<br>30 µg<br>36 µg<br>46 µg<br>62 µg<br>78 µg<br>0.14 mg<br>0.25 mg<br>1.1 mg<br>1.5 mg<br>11 mg<br>20 mg<br>0.11 g<br>0.13 g<br>0.14 g | Double Substitution per NISTIR 5672;<br>Electronic Balances,<br>OIML Class E2 weights,<br>OIML Class F1 weights  |

## Mass and Mass Related

| Parameter/Equipment                                        | Range                                                                                                                      | Expanded Uncertainty of Measurement (+/-)                                                                                            | Reference Standard, Method, and/or Equipment                                                                |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Mass Determination (Avoirdupois)                           | 1/32 oz<br>1/16 oz<br>1/8 oz<br>1/4 oz<br>1/2 oz<br>1 oz<br>2 oz<br>4 oz<br>8 oz<br>1 lb<br>2 lb<br>5 lb<br>10 lb<br>20 lb | 1 mg<br>1.3 mg<br>1.5 mg<br>2 mg<br>3.3 mg<br>6.3 mg<br>13 mg<br>27 mg<br>52 mg<br>81 mg<br>0.11 g<br>0.27 g<br>0.52 g<br>0.6 g      | Comparison to Electronic Balances, NIST Class F Weights                                                     |
| Pneumatic Pressure Gauges <sup>1</sup><br>(Gauge Pressure) | (-12 to 0) psi<br>(0 to 300) psi                                                                                           | 0.018 psi<br>0.025 psi                                                                                                               | Comparison to Fluke 2700G-BG2M Pressure Calibrator                                                          |
| Pneumatic Pressure Gauges <sup>1</sup><br>(Gauge Pressure) | (-1 to 1) psi                                                                                                              | 0.000 5 psi                                                                                                                          | Comparison to Meriam Instruments ZM1004-DN0001 Digital Manometer                                            |
| Pneumatic Low Pressure Gauges and Measure (Gauge Pressure) | (-13.75 to 0) psi<br>Up to 36 psi                                                                                          | 0.007 5 psi<br>0.041 % of reading + 0.001 8 psi                                                                                      | Comparison to Fluke 721-3603 (PORT 1) Pressure Calibrator                                                   |
| Pneumatic/Hydraulic High Pressure Gauges (Gauge Pressure)  | Up to 3 000 psi                                                                                                            | 0.42 psi                                                                                                                             | Comparison to Fluke 2700G-G20M Pressure Gauge                                                               |
| Pneumatic/Hydraulic High Pressure Gauges (Gauge Pressure)  | Up to 10 000 psi                                                                                                           | 1.2 psi                                                                                                                              | Comparison to Dead Weight Pressure Generation (Piston Cylinder and Masses), Fluke 2700G-G70M Pressure Gauge |
| Volumetric Flow Meters <sup>2</sup>                        | (3 to 30) sccm<br>(30 to 300) sccm<br>(0.1 to 1) slpm<br>(1 to 10) slpm<br>(10 to 100) slpm                                | (0.058 + 0.001 8X) sccm<br>(0.18 + 0.002 7X) sccm<br>(0.001 2 + 0.002 5X) slpm<br>(0.007 + 0.002 6X) slpm<br>(0.022 + 0.003 7X) slpm | Comparison to CME DIVISION 60B-75-.03-1000(SP) Flowmeter                                                    |

## Mass and Mass Related

| Parameter/Equipment                             | Range                                                                   | Expanded Uncertainty of Measurement (+/-)                                                                | Reference Standard, Method, and/or Equipment                                     |
|-------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Flow/Leak Masters <sup>2</sup>                  | (3 to 30) sccm<br>(30 to 300) sccm<br>(0.1 to 1) slpm<br>(1 to 10) slpm | (0.029 + 0.008 5X) sccm<br>(0.3 + 0.008 4X) sccm<br>(0.001 1 + 0.008 1X) slpm<br>(0.011 + 0.008 6X) slpm | Comparison to<br>CME DIVISION<br>60B-75-.03-1000(SP)<br>Flowmeter                |
| Rockwell Hardness Testing Machines <sup>1</sup> | HRC<br><br>Low<br>Medium<br>High                                        | <br><br>0.42 HRC<br>0.42 HRC<br>0.36 HRC                                                                 | Indirect Verification per<br>ASTM E18 using<br>Rockwell Hardness Test<br>Blocks. |

## Thermodynamic

| Parameter/Equipment                                               | Range                                                                                    | Expanded Uncertainty of Measurement (+/-)              | Reference Standard, Method, and/or Equipment                                                                                        |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Humidity – Measuring Devices                                      | (11 to 91) %RH                                                                           | 1.5 % RH                                               | Comparison to<br>Vaisala HMP77B<br>Thermo-hygrometer                                                                                |
| Dewpoint – Measure <sup>1</sup>                                   | (-40 to -10.4) °C                                                                        | 2.5 °C                                                 | Comparison to<br>Vaisala DMP74A<br>Dewpoint/Temperature<br>Probe                                                                    |
| Temperature – Measure <sup>1</sup>                                | (-40 to 40) °C                                                                           | 0.26 °C                                                | Direct measure using<br>Vaisala HMP77B<br>Thermo-hygrometer                                                                         |
| Temperature – Radiation Thermometers                              | (35 to 100) °C<br>(100 to 200) °C<br>(200 to 350) °C<br>(350 to 500) °C                  | 1.1 °C<br>1.9 °C<br>3.1 °C<br>4.5 °C                   | Comparison to<br>Fluke 4181 IR Calibrator<br>(Flat Plate)<br>$\lambda = (8 \text{ to } 14) \mu\text{m}$ ,<br>$\epsilon = \sim 0.95$ |
| Digital Thermometers, Bimetallic Thermometers, Temperature Probes | (-45 to 100) °C<br>(100 to 300) °C<br>(300 to 420) °C<br>(429 to 650) °C                 | 0.05 °C<br>0.095 °C<br>0.15 °C<br>0.19 °C              | Comparison to<br>Fluke 5628 PRT,<br>Fluke 1523 Readout using<br>Fluke 9144 Dry Well,<br>Fluke 9170 Dry Well                         |
| Temperature – Measure                                             | (-200 to 0) °C<br>(0 to 100) °C<br>(100 to 300) °C<br>(300 to 420) °C<br>(429 to 650) °C | 0.054 °C<br>0.055 °C<br>0.065 °C<br>0.12 °C<br>0.13 °C | Comparison to<br>Fluke 5628 PRT,<br>Fluke 1523 Readout                                                                              |

### Thermodynamic

| Parameter/Equipment      | Range                                                                    | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                                                                                      |
|--------------------------|--------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Thermocouple Calibration | (-45 to 100) °C<br>(100 to 300) °C<br>(300 to 420) °C<br>(429 to 650) °C | 0.11 °C<br>0.14 °C<br>0.18 °C<br>0.22 °C  | Comparison to<br>Fluke 5628 PRT,<br>Fluke 1523 Readout;<br>Fluke 9144 Dry Well,<br>Fluke 9170 Dry Well;<br>Fluke 5522A as<br>Thermocouple Readout |

### Time and Frequency

| Parameter/Equipment                  | Range                                           | Expanded Uncertainty of Measurement (+/-)         | Reference Standard, Method, and/or Equipment                                               |
|--------------------------------------|-------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------|
| Stopwatch                            | (1 to 86 400) s                                 | 73 ms                                             | Comparison to<br>Agilent 53132A<br>Frequency Counter                                       |
| Linear Velocity Measure <sup>1</sup> | Up to 4 in/min<br>Up to 40 in/min               | 0.01 in/min<br>0.14 in/min                        | Comparison to<br>Digital Stopwatch,<br>Caliper                                             |
| Frequency – Measure <sup>2,4</sup>   | 1 Hz to 1 MHz                                   | 5.8 µHz/Hz + 31 µHz                               | Comparison to<br>Agilent 3458A<br>8.5 Digit Multimeter                                     |
| Frequency – Measure <sup>2,4</sup>   | (1 to 225) MHz<br>225 MHz to 3 GHz              | 2.6 mHz<br>61 mHz                                 | Comparison to<br>Agilent 53132A<br>Frequency Counter                                       |
| Frequency – Measure <sup>2,4</sup>   | (3 to 26.5) GHz                                 | 0.37 nHz/Hz + 8.5 Hz                              | Comparison to<br>HP 53151A<br>Microwave Frequency<br>Counter                               |
| Frequency – Source <sup>1</sup>      | 10 mHz to 2 MHz                                 | 2 µHz/Hz                                          | Comparison to<br>Fluke 55xxA<br>Multi-Product Calibrator                                   |
| Frequency – Source <sup>1</sup>      | 50 kHz<br>500 kHz<br>5 MHz<br>50 MHz<br>300 MHz | 1.3 Hz<br>13 Hz<br>0.13 kHz<br>1.3 kHz<br>7.5 kHz | Comparison to<br>Fluke 5502A/3<br>Multi-Product Calibrator<br>with 300 MHz Scope<br>Option |

## DIMENSIONAL MEASUREMENT

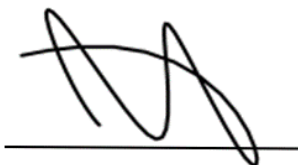
### 3 Dimensional

| Parameter/Equipment                       | Range                                                    | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                                               |
|-------------------------------------------|----------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------|
| 3D Dimensional – Measurement              | X = Up to 320 mm<br>Y = Up to 320 mm<br>Z = Up to 150 mm | 5.3 $\mu$ m                               | Mitutoyo<br>QVT1-L404Z1L-D<br>Quick Vision Active,<br>CNC Vision<br>Measuring System,<br>Customer Drawings |
| 3D Dimensional – Measurement <sup>1</sup> | Up to 1.8 m                                              | 52 $\mu$ m                                | Faro Articulated Arm<br>Coordinate Measuring<br>Machines (AACMM),<br>Customer Drawings                     |

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. 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.
2.  $D$  = diameter in millimeters,  $L$  = length in inches or millimeters,  $R$  = resolution of unit under test,  $X$  = indicated value, ' = arc-minute.
3. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
4. The Best Measurement Capability presented here does not include Resolution of the Measurand.  $0.6R$  will be added at the time of calibration, where  $R$  = resolution.
5. The value shown in the Range column is a nominal value. The actual certified value will be utilized during the calibration with the associated measurement uncertainty.
6. Unless otherwise specified in the far-right column, the calibration method/procedure utilized by the laboratory was developed and validated internally.



Jason Stine, Vice President