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The American Association for Laboratory Accreditation

# Accredited Laboratory

A2LA has accredited

## METROLOGIA MONTERREY, S.A. DE C.V.

*Nuevo Leon, Mexico*

for technical competence in the field of

### Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 8 January 2009*).

Presented this 27<sup>th</sup> day of August 2009.



A handwritten signature in black ink, reading "Peter Abney".

President & CEO  
For the Accreditation Council  
Certificate Number 1572.01  
Valid to June 30, 2011

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

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005  
& ANSI/NCSL Z540-1-1994

METROLOGIA MONTERREY, S.A. DE C.V.  
 Agua Marina #1483-4  
 La Fuente Ciudad Guadalupe  
 Nuevo León, México C.P. 67150  
 Jose Morquecho Phone: 011 52 81 1520 2180  
 Email: [jose.morquecho@metrologiamty.com](mailto:jose.morquecho@metrologiamty.com)

CALIBRATION

Valid To: June 30, 2011

Certificate Number: 1572.01

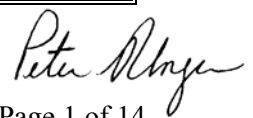
In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Chemical Quantities

| Parameter/Equipment | Range  | Best Uncertainty <sup>2</sup> (±)                   | Comments         |
|---------------------|--|---|------------------|
| pH Meter            | 4 pH unit<br>7 pH unit<br>10 pH unit                   | 0.01 pH unit<br>0.01 pH unit<br>0.01 pH unit        | Buffer standards |
| Conductivity Meter  | 1015 µS/cm<br>1408 µS/cm<br>12.85 mS/cm<br>111.3 mS/cm | 6.3 µS/cm<br>7.9 µS/cm<br>0.076 mS/cm<br>0.76 mS/cm | Buffer standards |

II. Dimensional

| Parameter/Equipment       | Range         | Best Uncertainty <sup>2,5</sup> (±) | Comments        |
|---------------------------|---------------|-------------------------------------|-----------------|
| Height Gages <sup>3</sup> | (0 to 600) mm | 8.1 µm                              | Check master    |
| Micrometers <sup>3</sup>  | Up to 100 mm  | 0.8 µm                              | Gage blocks     |
| Calipers <sup>3</sup>     | (0 to 600) mm | (8 + 2.3L/600) µm                   | Caliper checker |



| Parameter/Equipment  | Range   | Best Uncertainty <sup>2,5</sup> (±)   | Comments  |
|--|---|---|---|
| Displacement Indicators <sup>3</sup>                                     | (0 to 25) mm  | 8.2 µm  | Indicator calibrator  |
|  | (0 to 100) mm   | 0.82 µm   | Gage blocks   |
| Gage Blocks <sup>3</sup> –<br>Length<br>Flatness<br>Parallelism          | (0 to 100) mm   | (0.08 + 0.08L/100) µm<br>0.1 µm<br>0.12 µm  | By mechanical comparison with Tesa gage blocks comparator (ASME B89 1.9) optical flat |
| Metallic Rulers/Scales <sup>3</sup>                                      | Up to 900 mm  | 0.087 mm  | Optical electronic scale  |
| Pin Gages  | Up to 63 mm   | 0.57 µm   | Laser scan micrometer   |
| Thread Plug Gage <sup>3</sup> –<br>Pitch Diameter                        | Up to 50 mm   | 3.8 µm  | Three wire method and digital micrometer  |
| Optical Comparator <sup>3</sup> –<br>Magnification<br>10× only<br>Length | 10× to 50×  | 3.0 µm  | Optical scales  |
|  | 200 mm travel   | 3.0 µm  |   |
| Surface Texture (Ra)<br>Analyzers/meters <sup>3</sup>                    | 3.00 µm Ra<br>5.98 µm Ra  | 0.11 µm<br>0.16 µm  | Roughness specimen standards  |
| Indicator Calibrators <sup>3</sup>                                       | Up to 25 mm   | 0.33 µm   | Gage blocks, electronic dimensional comparator  |
| Coating Thickness<br>Gage <sup>3</sup>                                   | 0.0229 mm<br>0.0508 mm<br>0.0775 mm<br>0.0792 mm<br>0.1308 mm<br>0.2554 mm<br>0.2604 mm<br>0.5024 mm<br>0.9929 mm<br>1.4880 mm<br>1.5199 mm | 0.31 µm<br>0.33 µm<br>0.37 µm<br>0.37 µm<br>0.81 µm<br>1.1 µm<br>1.1 µm<br>1.1 µm<br>1.1 µm<br>1.1 µm<br>1.5 µm | Defelsko calibration standards  |

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| Parameter/Equipment  | Range                           | Best Uncertainty <sup>2,5</sup> (±)  | Comments   |
|--|---------------------------------|--|--|
| Height Master<br>Steel and Ceramic<br>Types  | Up to 610 mm                    | $(0.4 + L/600) \mu\text{m}$  | Gage block, step gage, electronic dimensional comparator           |
| Granite Surface Plate <sup>3</sup><br>–<br>(Local Flatness Only)                     | Up to 2500 mm x 1600 mm         | 0.7 $\mu\text{m}$  | JIS B7513, electronic dimensional, comparator, repeat reading gage |
| Laser Scan<br>Micrometer <sup>3</sup>  | 5 mm<br>15 mm<br>30 mm<br>50 mm | 0.40 $\mu\text{m}$<br>0.43 $\mu\text{m}$<br>0.47 $\mu\text{m}$<br>0.53 $\mu\text{m}$ | Cylindrical masters<br>Class XXX                                   |
| Depth Micrometer <sup>3</sup>  | 6" interchangeable rods         | 3.2 $\mu\text{m}$  | Depth micrometer calibrator  |
| CMM Performance<br>Verification <sup>3</sup><br>(Coordinate Measuring<br>Machines) – |                                 |  | Calibration per<br>ISO 10360 using:                                |
| Linear displacement<br>(x, y, and z axis)  | 900 mm                          | $(1 + 1.9L/600) \mu\text{m}$   | Step gage  |
| Volumetric<br>displacement   | 900 mm                          | $(1 + 2.1L/600) \mu\text{m}$   | Master sphere  |

### III. Electrical – DC/Low Frequency

| Parameter/Equipment                | Range  | Best Uncertainty <sup>2,4</sup> (±)   | Comments    |
|------------------------------------|--|---|-------------|
| DC Voltage – Generate <sup>3</sup> | (0 to 330) mV<br>(0 to 3.3) V<br>(0 to 33) V<br>(30 to 330) V<br>(100 to 1000) V | 0.006 % + 3 $\mu\text{V}$<br>0.005 % + 5 $\mu\text{V}$<br>0.005 % + 50 $\mu\text{V}$<br>0.0055 % + 500 $\mu\text{V}$<br>0.0055 % + 1500 $\mu\text{V}$ | Fluke 5500A |

| Parameter/Equipment                             | Range   | Best Uncertainty <sup>2,4</sup> (±)  | Comments      |
|---|---|--|---------------|
| DC Voltage – Measure, Fixed Points <sup>3</sup> | 200 mV<br>2 V<br>20 V<br>200 V<br>1000 V                                      | 19 µV<br>10 µV<br>10 µV<br>22 µV<br>22 µV  | Keithley 2002 |
|   | 100 mV<br>1000 mV<br>10 V<br>100 V<br>1000 V                                  | 0.025 % + 6 digits<br>0.025 % + 6 digits<br>0.025 % + 6 digits<br>0.025 % + 6 digits<br>0.025 % + 6 digits | Fluke 45      |
| DC Current – Generate <sup>3</sup>              | (0 to 3.3) mA<br>(0 to 33) mA<br>(0 to 330) mA<br>(0 to 2.2) A<br>(0 to 11) A | 0.013 % + 0.05 µA<br>0.01 % + 0.25 µA<br>0.01 % + 3.3 µA<br>0.03 % + 44 µA<br>0.06 % + 330 µA              | Fluke 5500A   |
| DC Current – Measure, Fixed Points <sup>3</sup> | 200 µA<br>2 mA<br>20 mA<br>200 mA<br>2 A                                      | 3.5 µA + 25 digits<br>3.5 µA + 20 digits<br>3.5 µA + 20 digits<br>3.8 µA + 20 digits<br>7.5 µA + 20 digits | Keithley 2002 |
|   | 30 mA<br>100 mA<br>10 mA<br>10 A  | 0.05 % + 3 digits<br>0.05 % + 2 digits<br>0.05 % + 5 digits<br>0.20 % + 7 digits                           | Fluke 45      |

| Parameter/Range                    | Frequency      | Best Uncertainty <sup>2,4</sup> (±)   | Comments   |             |
|------------------------------------|----------------|---|--|-------------|
| AC Voltage – Generate <sup>3</sup> | (1 to 33) mV   | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 0.35 % + 20 µV<br>0.15 % + 20 µV<br>0.2 % + 20 µV<br>0.25 % + 20 µV<br>0.35 % + 33 µV<br>1 % + 60 µV     | Fluke 5500A |
|                                    | (33 to 330) mV | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 0.25 % + 50 µV<br>0.05 % + 20 µV<br>0.1 % + 20 µV<br>0.16 % + 40 µV<br>0.24 % + 170 µV<br>0.7 % + 330 µV |             |

*Peter Abney*

| Parameter/Range                              | Frequency   | Best Uncertainty <sup>2,4</sup> (±)   | Comments    |
|--|---|---|-------------|
| AC Voltage – Generate <sup>3</sup><br>(cont) |   |   |             |
| 330 mV to 3.3 V                              | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 500) kHz | 0.15 % + 250 μV<br>0.03 % + 60 μV<br>0.08 % + 60 μV<br>0.14 % + 300 μV<br>0.24 % + 1.7 mV<br>0.5 % + 3.3 mV | Fluke 5500A |
| (3.3 to 33) V                                | (10 to 45) Hz<br>45 Hz to 10 kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                     | 0.15 % + 2.5 mV<br>0.04 % + 0.6 mV<br>0.08 % + 2.6 mV<br>0.19 % + 5 mV<br>0.24 % + 17 mV                    |             |
| (33 to 330) V                                | 45 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 20) kHz   | 0.05 % + 6.6 mV<br>0.08 % + 15 μV<br>0.09 % + 33 μV   |             |
| (330 to 1020) V                              | 45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.05 % + 80 mV<br>0.2 % + 100 μV<br>0.2 % + 500 μV  |             |
| AC Current – Generate <sup>3</sup>           |   |   |             |
| (30 to 330) μA                               | (10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                           | 0.25 % + 0.15 μA<br>0.13 % + 0.15 μA<br>0.13 % + 0.25 μA<br>0.4 % + 0.15 μA<br>1.2 % + 0.15 μA              | Fluke 5500A |
| 330 μA to 3.3 mA                             | (10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                           | 0.2 % + 0.3 μA<br>0.1 % + 0.3 μA<br>0.1 % + 0.3 μA<br>0.2 % + 0.3 μA<br>0.6 % + 0.3 μA                      |             |
| (3.3 to 33) mA                               | (10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                           | 0.2 % + 3 μA<br>0.1 % + 3 μA<br>0.09 % + 3 μA<br>0.2 % + 3 μA<br>0.6 % + 3 μA                               |             |
| (33 to 330) mA                               | (10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                           | 0.2 % + 30 μA<br>0.1 % + 30 μA<br>0.09 % + 30 μA<br>0.2 % + 30 μA<br>0.6 % + 30 μA                          |             |

| Parameter/Range                              | Frequency  | Best Uncertainty <sup>2,4</sup> ( $\pm$ )                          | Comments    |
|--|--|--|-------------|
| AC Current – Generate <sup>3</sup><br>(cont) |  |  |             |
| 330 mA to 2.2 A                              | (10 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz    | 0.2 % + 300 $\mu$ A<br>0.1 % + 300 $\mu$ A<br>0.75 % + 300 $\mu$ A | Fluke 5500A |
| (2.2 to 11) A                                | (45 to 65) Hz<br>(65 to 500) Hz<br>500 Hz to 1 kHz | 0.06 % + 2 mA<br>0.1 % + 2 mA<br>0.33 % + 2 mA                     |             |

| Parameter/Equipment   | Range  | Best Uncertainty <sup>2,4</sup> ( $\pm$ )  | Comments      |
|---|--|--|---------------|
| AC Voltage – Measure,<br>Fixed Points <sup>3</sup>          | 200 mV<br>2 V<br>20 V<br>200 V<br>750 V  | 0.3 $\mu$ V + 0.015 digits<br>0.3 $\mu$ V + 0.015 digits<br>0.3 $\mu$ V + 0.015 digits<br>0.3 $\mu$ V + 0.015 digits<br>0.3 $\mu$ V + 0.015 digits | Keithley 2002 |
|   | 300 mV<br>3 V<br>30 V<br>300 V<br>750 V  | 1 % + 10 digits<br>0.2 % + 10 digits<br>0.5 % + 10 digits<br>2.0 % + 20 digits<br>5.0 % + 50 digits  | Fluke 45      |
| AC Current – Measure,<br>Fixed Points <sup>3</sup>          | 200 $\mu$ A<br>2 mA<br>20 mA<br>2 A  | 0.5 $\mu$ A<br>0.5 $\mu$ A<br>0.5 $\mu$ A<br>3 $\mu$ A   | Keithley 2002 |
|   | 100 mA<br>1 A<br>10 A  | 2 % + 20 digits<br>1 % + 30 digits<br>1 % + 10 digits  | Fluke 45      |
| Resistance – Measure,<br>Fixed Points (4-wire) <sup>3</sup> | 10 $\Omega$<br>100 $\Omega$<br>1 k $\Omega$<br>10 k $\Omega$<br>100 k $\Omega$<br>1 M $\Omega$ | 95 $\mu\Omega$<br>0.8 m $\Omega$<br>7.3 m $\Omega$<br>72 m $\Omega$<br>1.0 $\Omega$<br>6.0 $\Omega$  | Keithley 2002 |

| Parameter/Equipment   | Range  | Best Uncertainty <sup>2, 4, 6</sup> ( $\pm$ )   | Comments   |
|---|--|---|--|
| Resistance – Generate <sup>3</sup>  | (0 to 11) $\Omega$<br>(11 to 33) $\Omega$<br>(33 to 110) $\Omega$<br>(110 to 330) $\Omega$<br>330 $\Omega$ to 1.1 k $\Omega$<br>(1.1 to 3.3) k $\Omega$<br>(3.3 to 11) k $\Omega$<br>(11 to 33) k $\Omega$<br>(33 to 110) k $\Omega$<br>(110 to 330) k $\Omega$<br>330 k $\Omega$ to 1.1 M $\Omega$<br>(1.1 to 3.3) M $\Omega$<br>(3.3 to 11) M $\Omega$<br>(11 to 33) M $\Omega$<br>(33 to 110) M $\Omega$<br>(110 to 330) M $\Omega$ | 0.012 % + 8.0 m $\Omega$<br>0.012 % + 15 m $\Omega$<br>0.009 % + 15 m $\Omega$<br>0.009 % + 15 m $\Omega$<br>0.009 % + 0.06 $\Omega$<br>0.009 % + 0.06 $\Omega$<br>0.009 % + 0.6 $\Omega$<br>0.009 % + 0.6 $\Omega$<br>0.011 % + 6 $\Omega$<br>0.012 % + 6 $\Omega$<br>0.015 % + 55 $\Omega$<br>0.015 % + 55 $\Omega$<br>0.06 % + 550 $\Omega$<br>0.1 % + 550 $\Omega$<br>0.5 % + 5.5 k $\Omega$<br>0.5 % + 16 k $\Omega$ | Fluke 5500A  |
| Electrical Calibration of Thermocouple Indicators & Indicating Systems <sup>3</sup> –<br><br>Type B<br>Type C<br>Type E<br>Type J<br>Type K<br>Type L<br>Type N<br>Type R<br>Type S<br>Type T<br>Type U | (600 to 1820) $^{\circ}\text{C}$<br>(0 to 2316) $^{\circ}\text{C}$<br>(-250 to 1000) $^{\circ}\text{C}$<br>(-210 to 1200) $^{\circ}\text{C}$<br>(-200 to 1372) $^{\circ}\text{C}$<br>(-200 to 900) $^{\circ}\text{C}$<br>(-200 to 1300) $^{\circ}\text{C}$<br>(0 to 1767) $^{\circ}\text{C}$<br>(0 to 1767) $^{\circ}\text{C}$<br>(-250 to 400) $^{\circ}\text{C}$<br>(-200 to 600) $^{\circ}\text{C}$                                 | 0.44 $^{\circ}\text{C}$<br>0.84 $^{\circ}\text{C}$<br>0.50 $^{\circ}\text{C}$<br>0.27 $^{\circ}\text{C}$<br>0.40 $^{\circ}\text{C}$<br>0.37 $^{\circ}\text{C}$<br>0.40 $^{\circ}\text{C}$<br>0.57 $^{\circ}\text{C}$<br>0.47 $^{\circ}\text{C}$<br>0.63 $^{\circ}\text{C}$<br>0.56 $^{\circ}\text{C}$   | Fluke 5500A<br>Fluke 724   |
| High Voltage – Measure <sup>3</sup><br><br>AC Voltage @ 60 Hz<br>DC Voltage   | Up to 40 kV  | 2.5 %<br>0.5 %  | Fluke 45,<br>Kyoritsu 1008,<br>High voltage probe,<br>Fluke 80K-40 |

| Parameter/Equipment  | Range  | Best Uncertainty <sup>2,4</sup> (±)   | Comments                                   |
|--|--|---|--|
| High Current – Measure <sup>3</sup>  |  |   |  |
| AC Current, Fixed Points @ 60 Hz   | 30 A<br>300 A<br>3000 A  | 0.1 A<br>1.0 A<br>3.5 A   | Fluke 45, AC current clamp<br>Fluke 13000S |
| DC Current   | (0 to 200) A<br>(200 to 1000) A  | 0.6 A<br>1.0 A  | Fluke 336                                  |
| Electrical Calibration of RTD Indicators & Indicating Systems <sup>3</sup> – |  |   |  |
| Pt 385, 100 Ω  | (-200 to 800) °C   | 0.23 °C   | Fluke 5500A                                |
| Pt 3926, 100 Ω   | (-200 to 630) °C   | 0.12 °C   |  |
| Pt 9316, 100 Ω   | (-200 to 630) °C   | 0.23 °C   |  |
| Pt 385, 200 Ω  | (-200 to 630) °C   | 0.15 °C   |  |
| Pt 385, 500 Ω  | (-200 to 630) °C   | 0.11 °C   |  |
| Pt 385, 1000 Ω   | (-200 to 630) °C   | 0.23 °C   |  |
| PtNi 385, 120 Ω  | (-80 to 260) °C  | 0.14 °C   |  |
| Cu 427, 10 Ω   | (-100 to 260) °C   | 0.30 °C   | Fluke 724                                  |
| Ni 120   | -80 °C to 260 °C   | 0.2 °C  |  |
| Pt 100 to 385  | -200 °C to 800 °C  | 0.33 °C   |  |
| Pt 100-392   | -200 °C to 630 °C  | 0.3 °C  |  |
| Pt 100-JIS   | -200 °C to 630 °C  | 0.3 °C  |  |
| Pt 200 -385  | -200 °C to 630 °C  | 0.8 °C  |  |
| Pt 500-385   | -200 °C to 630 °C  | 0.4 °C  |  |
| Pt 1000-385  | -200 °C to 630 °C  | 0.2 °C  |  |
| Capacitance – Generate <sup>3</sup>  | (0.33 to 10.999) nF<br>(11 to 109.99) nF<br>(110 to 329.99) nF<br>(0.33 to 1.0999) μF<br>(1.1 to 3.2999) μF<br>(3.3 to 10.999) μF<br>(11 to 32.999) μF<br>(33 to 109.99) μF<br>(110 to 329.99) μF<br>(330 to 1.1) mF | 0.5 % + 0.01 nF<br>0.25 % + 0.1 nF<br>0.25 % + 0.3 nF<br>0.25 % + 1 nF<br>0.35 % + 3 nF<br>0.35 % + 10 nF<br>0.40 % + 30 nF<br>0.50 % + 100 nF<br>0.70 % + 300 nF<br>1 % + 300 nF | Fluke 5500A                                |

| Parameter/Equipment  | Range   | Best Uncertainty <sup>2,6</sup> (±)   | Comments   |
|--|---|---|--|
| Sound Level Meter <sup>3</sup>   | 94/114 db to 250 Hz<br>94/114 db to 1000 Hz   | 0.18 db<br>0.18 db  | Quest Technologies<br>calibrator QC-2A                         |
| Inductance <sup>3</sup>  | Up to 9.999 H   | 0.02 % of range   | Inductance master<br>IET LS-400                                |
| Megohmmeter – DC Voltage <sup>3</sup><br><br>(250, 500, 1000) V  | 100 kΩ to 11.1 GΩ   | 1.0 % of range  | High Resistance<br>Decade Substituter<br>IET HRRS-F-5-<br>100K |
| Current Clamp Meter <sup>3</sup> –<br><br>AC Current<br><br>(45 to 65) Hz<br>(65 to 440) Hz<br><br>DC Current  | Up to 550 A<br><br>Up to 550 A  | <br><br>0.30 %<br>0.82 %<br><br>0.27 %  | <br><br>Fluke 5500A w/coil                                     |
| Oscilloscope Calibration <sup>3</sup> –<br><br>Squarewave Amplitude<br>1 MΩ Load<br><br>50 Ω Load<br><br>Flatness @ 50 Ω –<br>50 kHz to 100 MHz<br>(100 to 250) MHz<br><br>Time Marker @ 50 Ω Load<br><br>Rise Time –<br>1 kHz to 1 MHz @ 50 Ω | (0 to 33) V<br>1.8 mV to 105 V <sub>pk-pk</sub><br><br>(0 to 2.2) V<br>1.8 mV to 2.2 V <sub>pk-pk</sub><br><br>5 mV to 5.5 V<br><br>2 ns to 4 s<br><br>4.5 mV to 2.75 V | <br><br>0.25 % + 200 μV<br>0.5 % + 200 μV<br><br>0.25 % + 200 μV<br>0.25 % + 200 μV<br><br>1.5 % + 100 μV<br>2.0 % + 100 μV<br><br>0.0025 %<br><br>1 ns | <br><br>Fluke 5500A<br>w/SC300                                 |

| Parameter/Equipment                       | Range  | Best Uncertainty <sup>2,6</sup> (±)  | Comments    |
|---|--|--|-------------|
| Power Meter Calibration <sup>3</sup> –    |  |  |             |
| DC @ (11 & 1020) V                        | (3.3 to 8.99) mA<br>(9 to 32.999) mA<br>(33 to 89.99) mA<br>(90 to 329.99) mA<br>(0.33 to 0.8999) A<br>(0.9 to 2.1999) A<br>(2.2 to 4.4999) A<br>(4.5 to 11) A | 0.04 %<br>0.03 %<br>0.04 %<br>0.03 %<br>0.08 %<br>0.06 %<br>0.12 %<br>0.09 % | Fluke 5500A |
| AC: @ (45 to 65) Hz<br>(33 to 329.999) mV | (3.3 to 8.99) mA<br>(9 to 32.999) mA<br>(33 to 89.99) mA<br>(90 to 329.99) mA<br>(0.33 to 0.8999) A<br>(0.9 to 2.1999) A<br>(2.2 to 4.4999) A<br>(4.5 to 11) A | 0.04 %<br>0.25 %<br>0.35 %<br>0.25 %<br>0.35 %<br>0.25 %<br>0.35 %<br>0.25 % |             |
| 330 mV to 1020 V                          | (3.3 to 8.99) mA<br>(9 to 32.999) mA<br>(33 to 89.99) mA<br>(90 to 329.99) mA<br>(0.33 to 0.8999) A<br>(0.9 to 2.1999) A<br>(2.2 to 4.4999) A<br>(4.5 to 11) A | 0.25 %<br>0.15 %<br>0.25 %<br>0.15 %<br>0.25 %<br>0.15 %<br>0.20 %<br>0.15 % |             |

#### IV. Mechanical

| Parameter/Equipment     | Range   | Best Uncertainty <sup>2</sup> (±)  | Comments   |
|-------------------------|---|--|--|
| Pressure <sup>3</sup> – |   |  |  |
| Gages                   | Up to 25 inH <sub>2</sub> O<br>Up to 200 inH <sub>2</sub> O<br>Up to 60 psi<br>Up to 150 psi<br>Up to 500 psi<br>Up to 1500 psi<br>Up to 5000 psi | 0.038 inH <sub>2</sub> O<br>0.21 inH <sub>2</sub> O<br>0.07 psi<br>0.11 psi<br>0.6 psi<br>1.0 psi<br>5.8 psi | HEISE Dresser<br>PTE-1, differential<br>pressure module<br>HQS-1 |
| Transducers             | (4 to 20) mA  | 0.010 mA   |  |

| Parameter/Equipment  | Range  | Best Uncertainty <sup>2,5</sup> ( $\pm$ )  | Comments  |
|--|--|--|---|
| Force Gage <sup>3</sup>  | Up to 370 lbf<br>Up to 5000 lbf<br>Up to 100 000 lbf<br>Up to 300 000 lbf  | 0.08 lb<br>$(1.5 + 0.0006P)$ lb<br>$(14 + 0.0004P)$ lb<br>$(50 + 0.0006P)$ lb  | Class M2 weight<br>Load Cell                                  |
| Vacuum Gages <sup>3</sup>  | (0 to 29) inHg   | 0.012 inHg   | HEISE Dresser PTE-1,<br>differential pressure<br>module HQS-2 |
| Indirect Verification of<br>Rockwell Hardness<br>Testers (Mean Hardness<br>Values Only) <sup>3</sup> | HRBW:<br>Low<br>Middle<br>High<br><br>HRC:<br>Low<br>Middle<br>High<br><br>HR15N:<br>Low<br>Middle<br>High<br><br>HR30N:<br>Low<br>Middle<br>High<br><br>HR45N:<br>Low<br>Middle<br>High<br><br>HR15TW:<br>Low<br>Middle<br>High<br><br>HR30TW:<br>Low<br>Middle<br>High<br><br>HR45TW:<br>Low<br>Middle<br>High | 0.71 HRBW<br>0.71 HRBW<br>0.60 HRBW<br><br>0.42 HRC<br>0.41 HRC<br>0.37 HRC<br><br>0.50 HR15N<br>0.66 HR15N<br>0.42 HR15N<br><br>0.66 HR30N<br>0.60 HR30N<br>0.51 HR30N<br><br>0.60 HR45N<br>0.59 HR45N<br>0.52 HR45N<br><br>0.69 HR15TW<br>0.65 HR15TW<br>0.44 HR15TW<br><br>0.59 HR30TW<br>0.51 HR30TW<br>0.46 HR30TW<br><br>0.59 HR45TW<br>0.58 HR45TW<br>0.59 HR45TW | Indirect verification per<br>ASTM E18                         |

| Parameter/Equipment   | Range   | Best Uncertainty <sup>2,6</sup> (±)           | Comments   |
|---|---|---|--|
| Indirect Verification of Microindentation Hardness Testers <sup>3</sup> :             | Repeatability under Forces P(gf):<br>500 ≤ P ≤ 1000                               |   | Indirect verification per ASTM E384.   |
| Knoop   | 100 ≤ HK ≤ 250<br>250 ≤ HK ≤ 650  | 1.1 %<br>1.1 %                                | Uncertainty is stated as a percentage of the standardized test block hardness value. |
| Vickers   | 100 ≤ HV ≤ 240<br>240 ≤ HV ≤ 600  | 0.82 %<br>0.82 %                              |  |
|   | Repeatability under Forces P(gf):<br>10 ≤ P ≤ 500                                 |   |  |
| Knoop and Vickers (100 g Load)  | HK > 650<br>HV > 600  | 1.1 %<br>0.93 %                               |  |
| Indirect Verification of Brinell Hardness Testers at Test Condition(s) <sup>3</sup> : | Repeatability:  |   | Indirect verification method per ASTM E10  |
| 10/3000/10  | (100 to 200) HBW<br>(300 to 400) HBW<br>(500 to 600) HBW                          | 0.66 %<br>0.88 %<br>0.77 %                    | Best uncertainty is stated as the repeatability as defined in E384.                  |
|   | Error   | 4 HBW   |  |
| 5/250/10  | (40 to 80) HBW<br>(100 to 140) HBW<br>(160 to 200) HBW                            | 0.71 %<br>0.87 %<br>0.73 %                    |  |
|   | Error   | 3 HBW   |  |
| Scales & Balances <sup>3</sup>  | 1 mg to 210 g<br>(210 to 610) g<br>(610 to 1600) g<br>Up to 11 kg<br>Up to 500 kg | 0.08 mg<br>0.8 mg<br>8 mg<br>80 mg<br>0.07 kg | Class E2<br>Class E2<br>Class E2<br>Class M2<br>Class M2                             |

| Parameter/Equipment                   | Range               | Best Uncertainty <sup>2,6</sup> (±) | Comments                           |
|---------------------------------------|---------------------|-------------------------------------|------------------------------------|
| Torque <sup>3</sup> –<br><br>Wrenches | (25 to 250) in·lb   | 0.63 %                              | Mountz torque analyzer             |
|                                       | (25 to 250) ft·lb   | 0.63 %                              |                                    |
|                                       | (250 to 1000) ft·lb | 1.2 %                               |                                    |
| Analyzers,<br>Transducers             | Up to 250 lb·in     | 0.24 %                              | Weights M2                         |
|                                       | Up to 250 lb·ft     | 0.23 %                              |                                    |
|                                       | Up to 750 lb·ft     | 0.40 %                              |                                    |
|                                       | Up to 250 lb·in     | 0.10 %                              |                                    |
| Analyzers,<br>Transducers             | Up to 250 lb·ft     | 0.31 %                              | Torque arms with Class M2 weights, |
|                                       | Up to 500 lb·ft     | 0.27 %                              |                                    |

#### V. Thermodynamic

| Parameter/Equipment                      | Range          | Best Uncertainty <sup>2</sup> (±) | Comments             |
|--|----------------|-----------------------------------|----------------------|
| Infrared Temperature Measuring Equipment | (50 to 425) °C | 1 °C                              | Hart Calibrator 9132 |

#### VI. Time and Frequency

| Parameter/Equipment           | Range                           | Best Uncertainty <sup>2,6</sup> (±) | Comments                          |
|-------------------------------|---------------------------------|-------------------------------------|-----------------------------------|
| Stopwatch – Time              | Up to 0 h 59 m 59 s             | 0.25 s                              | Direct comparison to stopwatch    |
| Frequency – Measure           | DC to 225 MHz                   | 0.3 µHz/Hz                          | Agilent 53131A Universal counter, |
|                               | 30 Hz to 300 MHz                | 5 µHz/Hz                            | Tektronix TDS3052B oscilloscope   |
| Frequency Measuring Equipment | (1 to 40) Hz<br>40 Hz to 10 MHz | 0.05 %<br>0.01 %                    | Fluke 5500A                       |

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<sup>1</sup> This laboratory offers commercial calibration and field calibration service.

<sup>2</sup> “Best Uncertainty” is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer’s device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the uncertainties achievable on a customer's site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

<sup>4</sup> The measurands stated are generated with the Fluke 5550A or 45 series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Best measurement uncertainties are expressed as either a specific value that covers the full range or as a fraction/percentage of the reading plus a fixed floor specification.

<sup>5</sup> In the statement of best uncertainty,  $L$  is the numerical value of the nominal length of the device measured in millimeters and  $P$  is the force of the unit under test in pounds (lbs).

<sup>6</sup> In the statement of best uncertainty, percentage refers to percent of reading unless otherwise noted.