



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Rothe Enterprises, Inc. Metrology Services Division
1100 Hercules Ave, Suite 230
Houston, TX 77058

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994

while demonstrating technical competence in the field(s) of

CALIBRATION

Refer to the accompanying Scope(s) of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

AC-1440

Certificate Number

ANAB Approval



Certificate Valid: 03/11/2015-03/11/2017
Version No. 001 Issued: 02/20/2015



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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 January 2009).



ANSI-ASQ National Accreditation Board

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

Rothe Enterprises, Inc. Metrology Services Division

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CALIBRATION

Valid to: March 11, 2017

Certificate Number: AC-1440

I. Electromagnetic - DC/Low Frequency

| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|-----------------------------------|---|---|---|--|
| DC Voltage – Source ³ | Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1 kV | 16 µV/V + 1.2 µV 8.5 µV/V + 2.3 µV 9.3 µV/V + 23 µV 14 µV/V + 0.18 mV 14 µV/V + 1.8 mV | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |
| DC Voltage – Measure ³ | (10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100V to 1 kV (1 to 15) kV Up to 150 kV | 13 µV/V + 0.36 µV 12 µV/V + 0.68 µV 12 µV/V + 5.8 µV 14 µV/V + 68 µV 14 µV/V + 0.59 mV 1.2 mV/V + 1.16 V 6.4 mV/V + 19 V | HP 3458A Ross VD-15-8.3-A-LB- AL Ross VD-150-10Y-AK- LB-AL with HP 3458A | |
| DC Current - Source ³ | Up to 330 µA 330 µA to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1A (1.1 to 3) A (3 to 11) A (11 to 20.5) A (25 to 120) A (20 to 50) A (50 to 150) A (150 to 550) A (550 to 1 k) A | 0.13 mA/A + 23 nA 90 µA/A + 58 nA 86 µA/A + 0.29 µA 89 µA/A + 2.9 µA 0.22 mA/A + 74 µA 0.34 mA/A + 74 µA 0.46 mA/A + 0.58 mA 0.80 mA/A + 0.87 mA 4.7 mA + 85 mA/A 5.2 mA/A + 0.14 A 5.4 mA/A + 0.14 A 5.5 mA/A + 0.53 mA 6 mA/A + 0.54 mA | Fluke 5520A SC1100 Fluke 5520A SC1100 with 5500A Coil 52120A | |



| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|-----------------------------------|---|---|--|--|
| DC Current - Measure ³ | (10 to 100) nA 100 nA to 1 µA (1 to 10) µA (10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A 1 mΩ (15 to 150) µA (1.5 to 150) mA (1.5 to 15) A 10 mΩ (1 to 100) A 100 mΩ (1 to 100) A 100 µΩ (5 to 200) A | 1.8 mA/A + 0.58 nA 0.17 mA/A + 0.58 nA 32 µA/A + 0.59 nA 30 µA/A + 1.1 nA 46 µA/A + 82 nA 0.13 mA/A + 0.13 µA 0.13 mA/A + 1.3 µA 0.14 mA/A + 13 µA 0.68 mA/A + 5.4 µA 0.13 mA/A + 15 µA 0.13 mA 11 mA/A 9 mA/A 8.7 mA/A | HP 3458A HP 3458A with Honeywell 2759 with Rubicon 100 with Deltec MSA101 with Deltec MKBC408 | |
| AC Voltage - Source ⁴ | Up to 33 mV (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz 330 mV to 3.3 V (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (3.3 to 33) V (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.62 mV/V + 6.9 µV 0.12 mV/V + 6.9 µV 0.16 mV/V + 6.9 µV 0.78 mV/V + 6.9 µV 2.7 mV/V + 14 µV 6.2 mV/V + 58 µV 0.23mV/V + 9.2 µV 0.11mV/V + 9.2 µV 0.12mV/V + 9.2 µV 0.27 mV/V + 9.2 µV 0.62 mV/V + 37 µV 1.6 mV/V + 81 µV 0.23 mV/V + 58 µV 0.12 mV/V + 69 µV 0.15 mV/V + 69 µV 0.23 mV/V + 58 µV 0.54 mV/V + 0.14 mV 1.9 mV/V + 0.69 mV 0.23 mV/V + 0.75 mV 0.12 mV/V + 0.69 mV 0.19 mV/V + 0.69 mV 0.27 mV/V + 0.69 mV 0.70 mV/V + 1.8 mV | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |



| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|---|---|--|---------------------------------------|--|
| AC Voltage - Source ³ (cont.) | (33 to 330) V (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz 330 V to 1.02 kV 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.15 mV/V + 2.3 mV 0.16 mV/V + 6.9 mV 0.19 mV/V + 6.9 mV 0.23 mV/V + 6.9 mV 1.6 mV/V + 58 mV 0.23 mV/V + 12 mV 0.19 mV/V + 12 mV 0.23 mV/V + 12 mV | Fluke 5520A SC1100 | |
| AC Voltage - Measure ³ | (1 to 10) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1MHz (1 to 4) MHz (4 to 8) MHz (10 to 100) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz 100 mV to 1 V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz | 0.37 mV/V + 3.5 μV 0.27 mV/V + 1.3 μV 0.36 mV/V + 1.3 μV 1.2 mV/V + 1.3 μV 5.8 mV/V + 1.3 μV 40 mV/V + 2.3 μV 14 mV/V + 5.8 μV 81 mV/V + 1.2 μV 0.23 V/V + 9.2 μV 86 μV/V + 4.7 μV 95 μV/V + 2.4 μV 0.17 mV/V + 2.4 μV 0.35 mV/V + 2.4 μV 0.93 mV/V + 2.4 μV 3.5 mV/V + 12 μV 12 mV/V + 12 μV 17 mV/V + 12 μV 46 mV/V + 81 μV 46 mV/V + 92 μV 0.17 V/V + 0.10 mV 86 μV/V + 47 μV 91 μV/V + 24 μV 0.17 mV/V + 24 μV 0.35 mV/V + 24 μV 0.93 mV/V + 24 μV 3.5 mV/V + 0.12 mV 12 mV/V + 0.12mV 17 mV/V + 0.12 mV 46 mV/V + 0.81 mV 46 mV/V + 0.92 mV 0.17 V/V + 1.2 mV | HP 3458A | OEM and GIDEP Sourced and Locally Developed Procedures |



| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(\pm)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|--|--|--|--|--|
| AC Voltage - Measure ³ (cont.) | (1 to 10) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz (10 to 100) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (100 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (1 to 15) kV @ 60 Hz Up to 100 kV @ 60 Hz | 0.11 mV/V + 0.47 mV 0.11 mV/V + 0.24 mV 0.18 mV/V + 0.24 mV 0.35 mV/V + 0.24 mV 0.93 mV/V + 0.24 mV 3.5 mV/V + 1.2 mV 12 mV/V + 1.2 mV 17 mV/V + 1.2 mV 46 mV/V + 8.1 mV 46 mV/V + 9.2 mV 0.17 V/V + 12 mV 0.23 mV /V + 4.7 mV 0.25 mV /V + 2.4 mV 0.25 mV /V + 2.4 mV 0.41 mV/V + 2.4 mV 1.4 mV/V + 2.4 mV 4.6 mV/V + 12 mV 0.20 V/V + 12 mV 0.46 mV V/V + 47 mV 0.46 mV /V + 24 mV 0.88 mV V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV 4.9 mV/V + 6 V 9.5 mV/V + 2.6 V | HP 3458A Ross VD-15-8.3-A-LB-AL Ross VD-150-10Y-AK-LB-AL with HP 3458A | OEM and GIDEP Sourced and Locally Developed Procedures |
| | AC Current - Source ³ | (29 to 330) μA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz 330 μA to 3.3 mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz | 1.6 mA/A + 0.12 μ A 1.2 mA/A + 0.12 μ A 1 mA/A + 0.12 μ A 2.3 mA/A + 0.17 μ A 6.2 mA/A + 0.23 μ A 12 mA/A + 0.46 μ A 1.6 mA/A + 0.17 μ A 1 mA/A + 0.17 μ A 0.78 mA/A + 0.17 μ A 1.6 mA/A + 0.23 μ A 3.9 mA/A + 0.35 μ A 7.8 mA/A + 0.69 μ A | |



| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|---|------------------------|--|--|--|
| AC Current - Source ³ (cont.) | (3.3 to 33) mA | | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |
| | (10 to 20) Hz | 1.4 mA/A + 2.3 μA | | |
| | (20 to 45) Hz | 0.70 mA/A + 2.3 μA | | |
| | 45 Hz to 1 kHz | 0.31 mA/A + 2.3 μA | 52120A | |
| | (1 to 5) kHz | 0.78 mA/A + 2.3 μA | | |
| | (5 to 10) kHz | 1.6 mA/A + 3.5 μA | | |
| | (10 to 30) kHz | 3.1 mA/A + 4.6 μA | | |
| | (33 to 330) mA | | | |
| | (10 to 20) Hz | 1.4 mA/A + 23 μA | | |
| | (20 to 45) Hz | 0.70 mA/A + 23 μA | Fluke 5520A - SC1100 With 5500 Coil | |
| | 45 Hz to 1 kHz | 0.31mA/A + 23 μA | | |
| | (1 to 5) kHz | 0.78 mA/A + 58 μA | | |
| | (5 to 10) kHz | 1.6 mA/A + 0.12 mA | | |
| | (10 to 30) kHz | 3.1 mA/A + 0.23 mA | | |
| | 330 mA to 1.1 A | | | |
| | (10 to 45) Hz | 1.5 mA/A + 0.12 mA | Y5020 | |
| 45 Hz to 1 kHz | 0.39 mA/A + 0.12 mA | | | |
| (1 to 5) kHz | 4.7 mA/A + 1.2 mA | | | |
| (5 to 10) kHz | 19 mA/A + 1.2 mA | | | |
| (1.1 to 3) A | | | | |
| 45 Hz to 1 kHz | 1.73 mA/A + 0.12 mA | 52120A with 25 turn Coil | | |
| (3 to 11) A | | | | |
| (40 to 100) Hz | 1.4 μAA + 1.2 mA | | | |
| (11 to 20.5) A | | | | |
| (40 to 100) Hz | 1.4 mA/A + 1.2 mA | | | |
| (2 to 120) A | | | | |
| 60 Hz | 13 mA/A + 19 mA | 52120A with 50 turn Coil | | |
| 400 Hz | 0.78 mA/A + 94 mA | | | |
| (20 to 50) A | | | | |
| (45 to 65) Hz | 3.3 mA/A + 30 mA | | | |
| (65 to 440) Hz | 8.4 mA/A + 32 mA | | | |
| (50 to 150) A | | | | |
| (45 to 65) Hz | 3.4 mA/A + 30 mA | | | |
| (65 to 440) Hz | 8.5 mA/A + 32 mA | | | |
| (150 to 500) A | | | | |
| (45 to 65) Hz | 3.4 mA/A + 0.19 A | | | |
| (65 to 440) Hz | 8.9 mA/A + 0.20 A | | | |
| (500 to 1 000) A | | | | |
| (45 to 65) Hz | 4 mA/A + 0.28 A | | | |
| (65 to 440) Hz | 9.4 mA/A + 0.35 A | | | |
| (500 to 3 000) A | | | | |
| 60 Hz | 7.33 mA/A + 0.56 mA | | | |
| 400 Hz | 7.33 mA/A + 0.50 mA | | | |
| (3 000 to 6 000) A | | | | |
| 60 Hz | 7.54 mA/A + 780 mA | | | |
| 400 Hz | 7.54 mA/A + 780 mA | | | |

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|--|--|---|---------------------------------------|--|
| AC Current - Measure ³ (cont.) | (5 to 100) µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz | 4.6 mA/A + 35 nA 1.7 mA/A + 35 nA 1.2 mA/A + 35 nA 1.2 mA/A + 35 nA 0.70 mA + 35 nA | HP 3458A | OEM and GIDEP Sourced and Locally Developed Procedures |
| | 100 µA to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 4.6 mA/A + 0.24 µA 1.9 mA/A + 0.24 µA 1.9 mA/A + 0.24 µA 0.36 mA/A + 0.24 µA 0.70 mA/A + 0.24 µA 4.6 mA/A + 0.47 µA 6.4 mA/A + 1.7 µA | | |
| | (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 4.6 mA/A + 2.4 µA 1.7 mA/A + 2.4 µA 0.70 mA/A + 2.4 µA 0.35 mA/A + 2.4 µA 0.70 mA/A + 2.3 µA 4.6 mA/A + 4.6 µA 6.4 mA/A + 17 µA | Y5020 | |
| | (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 4.6 mA/A + 23 µA 1.7 mA/A + 23 µA 0.70 mA/A + 23 µA 0.36 mA/A + 23 µA 1.1 mA/A + 23 µA 4.7 mA/A + 46 µA 6.4 mA/A + 0.17 mA | | |
| | 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz | 4.6 mA/A + 0.23 mA 1.8 mA/A + 0.23 mA 0.93 mA/A + 0.23 mA 1.2 mA/A + 0.23 mA 3.5 mA/A + 0.23 mA 10 mA/A + 0.40 mA | | |
| | (1 to 20) A 60 Hz | 1.22 mA/A + 1.4 mA | HP 3458A, Y5020 | |

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|-----------------------------------|---|---|---------------------------------------|--|
| Resistance - Source ³ | Up to 11 Ω (11 to 33) Ω (33 to 111) Ω (110 to 330) Ω 330 Ω to 1.1k Ω (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.19 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ | 0.12 mΩ/Ω + 1.2 mΩ 0.12 mΩ/Ω + 1.7 mΩ 27 μΩ/Ω + 1.6 mΩ 24 μΩ/Ω + 2.3 mΩ 25 μΩ/Ω + 2.3 mΩ 26 μΩ/Ω + 2.3 mΩ 25 μΩ/Ω + 2.3 mΩ 23 μΩ/Ω + 0.23 Ω 23 μΩ/Ω + 0.23 Ω 26 μΩ/Ω + 2.3 Ω 35 μΩ/Ω + 2.3 Ω 48 μΩ/Ω + 35 Ω 0.12 mΩ/Ω + 58 Ω 0.28 mΩ/Ω + 2.9 kΩ 0.47 mΩ/Ω + 3.5 kΩ 2.3 μΩ/Ω + 0.12 MΩ 12 μΩ/Ω + 0.50 MΩ | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |
| Resistance - Measure ³ | Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ | 23 μΩ/Ω + 86 μΩ 17 μΩ/Ω + 0.64 mΩ 15 μΩ/Ω + 0.86 mΩ 15 μΩ/Ω + 8.6 μΩ 15 μΩ/Ω + 86 μΩ 21 μΩ/Ω + 2.4 Ω 61 μΩ/Ω + 0.12 kΩ 0.58 mΩ/Ω + 3.5 kΩ 5.8 mΩ/Ω + 0.33 MΩ | HP 3458A | |

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|--|--|--|---------------------------------------|--|
| Electrical Simulation of Thermocouple Indicators - Source and Measure ³ | | | | |
| Type B | (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C | 0.34 °C 0.26 °C 0.23 °C 0.26 °C | | |
| Type C | (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C | 0.23 °C 0.20 °C 0.24 °C 0.39 °C 0.65 °C | | |
| Type E | (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C | 0.39 °C 0.12 °C 0.11 °C 0.12 °C 0.16 °C | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |
| Type J | (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C | 0.21 °C 0.13 °C 0.11 °C 0.13 °C 0.18 °C | | |
| Type K | (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C | 0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C | | |

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|---|---|--|---------------------------------------|--|--|--|
| Electrical Simulation of Thermocouple Indicators ³ (cont.) Type L | (-200 to -100) °C (-100 to 800) °C (800 to 900) °C | 0.29 °C 0.20 °C 0.13 °C | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures | | |
| Type N | (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1 300) °C | 0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °C | | | | |
| Type R | (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C | 0.44 °C 0.27 °C 0.26 °C 0.31 °C | | | | |
| Type R Thermocouple Probe | (660 to 1 000) °C | (0.7 + 0.0025Y) °C | | | | |
| Type S | (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C | 0.47 °C 0.36 °C 0.37 °C 0.46 °C | | | | |
| Type T | (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C | 0.49 °C 0.19 °C 0.12 °C 0.11 °C | | | | |
| Type U | (-200 to 0) °C (0 to 600) °C | 0.56 °C 0.27 °C | | | | |
| Electrical Simulation of RTDs ³ Pt 385 (100 Ω) | (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C | 0.04 °C 0.06 °C 0.07 °C 0.08 °C 0.10 °C 0.18 °C | | | | |

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|--|---|--|---------------------------------------|--|
| DC Power - Source ³ (1 to 1 000) V | 1.5 W 6 W 12 W 20 W 30 W 60 W 120 W 500 W 1.5 kW 6 kW 30 kW 50 kW | 0.06 % of Watts Output 0.05 % of Watts Output 0.07 % of Watts Output 0.06 % of Watts Output 0.10 % of Watts Output 0.08 % of Watts Output 0.05 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.10 % of Watts Output 0.09 % of Watts Output 0.09 % of Watts Output | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |
| AC Power - Source ³ (45 to 65) Hz P=1 (1 to 1 000) V | 1.5 W 6 W 12 W 20 W 30 W 60 W 120 W 500 W 1500 W 6 kW 30 kW 50 kW | | | |
| Capacitance - Source ³ (11 to 33) nF (110 to 330) nF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF | 10Hz to 1kHz 10Hz to 1kHz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz | 0.57 nF/F + 0.94 nF 0.57 nF/F + 0.94 nF 8.9 nF 27 nF 0.12 μF 0.42 μF 1.3 μF 4.0 μF | | |

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|--|--|---|---------------------------------------|--|
| Oscilloscopes³ DC Signal into 50 Ω Load into 1 MΩ Load Square Wave 50 Ω Load 1 MΩ Load Leveled Sine Wave - Flatness Relative to 50 kHz [5 mV to 5.5 V] [5mV to 3.5V] Time Marker into 50 Ω Load-Source ⁴ Edge Specs into 50 Ω Load - Source Rise Time Amplitude Frequency | (-6.6 to 6.6) V (-130 to 130) V 1 mV to 6.6 V p-p 10 Hz to 10 kHz 1 mV to 130 V p-p 10 Hz to 10 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz 5 s to 50 ms 20 ms to 100 ns (50 to 20) ns 10 ns (5 to 1) ns ≤ 300 ps 5 mV to 2.5V 1 kHz to 10 MHz | 1.9 mV/V + 46 μV 0.39 mV/V + 46 μV 1.9 mV/V + 46 μV 1.2 mV/V + 46 μV 12 mV/V + 0.12 mV 16 mV/V + 0.12 mV 31 mV/V + 0.12 mV 39 mV/V + 0.12 mV (25 + t x 1 000) ⁷ parts in 10 ⁶ 2.5 parts in 10 ⁶ 2.5 parts in 10 ⁶ 2.5 parts in 10 ⁶ 2.5 parts in 10 ⁶ 0 ps /-120ps 16 mV/V + 0.23 mV 1.9 parts in 10 ⁶ of setting | Fluke 5520A SC1100 | OEM and GIDEP Sourced and Locally Developed Procedures |
| Wave Generator - Source³ Amplitude (10 Hz to 10 kHz) Square, Sine, Triangle into 1 MΩ Square, Sine, Triangle into 50 Ω Frequency ³ | (1.8 mV to 55 V) p-p (1.8 mV to 2.5 V) p-p 10 Hz to 100 kHz | 30 mV/V + 0.10 mV 30 mV/V + 0.10 mV 25 parts in 10 ⁶ Hz + 15 mHz | | |

II. Time & Frequency

| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|----------------------------------|----------------------------|--|---|--|
| Frequency - Source ³ | 0.01 Hz to 2 MHz 10 MHz | 2 μHz/Hz + 8 μHz 1 part in 10 ⁻¹¹ Hz | Fluke 5520A SC1100 Spectracom 8194 | OEM and GIDEP Sourced and Locally Developed Procedures |
| Stopwatches /Timers ³ | Up to 24 hours | 5.8 ms | Fluke 5520A SC1100 with Spectracom 8194 and Fluke PM6680B | |
| Tachometers ³ | (60 to 99,999) rpm | 0.58 rpm | Fluke 5520A SC1100 with Spectracom 8194 | |

III. Thermodynamic

| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|---------------------------------------|--|--|---|--|
| Temperature - Source | (-45 to 155) °C | 0.05 °C | Ametek RTC 157B, PRT STS 200 B915 | OEM and GIDEP Sourced and Locally Developed Procedures |
| Temperature - Measure ³ | (-250 to 660) °C Ambient | (0.03 + 0.00042Y) °C 0.3 °C | Advanced Sensing Products WSP660 PRT and HP 3458A Rotronic Hygropalm | |
| IR Temperature - Source ³ | (122 to 350) °F (350 to 565) °F (565 to 740) °F (740 to 932) °F | 1.1 °F 1.5 °F 1.6 °F 1.8 °F | Hart 9132 | |
| Humidity | 11 % 33 % 75 % Ambient | 1.2 % 1.2 % 1.6 % 1.8 % | Saturated Salt Solutions LiCl MgCl NaCl Rotronic Hygropalm | |

IV. Mechanical

| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|---|---|--|---|--|
| Torque Wrenches ^{3,6} | 5 to 50) lbf-in (40 to 400) lbf-in (100 to 1 000) lbf-in (25 to 250) lbf-ft | (0.25 + 0.026T) lbf-in (2.1 + 0.0053T) lbf-in (3.8 + 0.0015T) lbf-in (0.7 + 0.023T) lbf-ft | CDI 5000ST and 2000-400-02 | OEM and GIDEP Sourced and Locally Developed Procedures |
| Pressure Gages, Transducers - Measure ^{3,7} | (3 to 30) psi (20 to 100) psi (100 to 500) psi (200 to 1 000) psi (1 000 to 5 000) psi (2 000 to 10 000) psi | (0.0086 + 0.00092P) psi (0.038 + 0.00087P) psi (0.04 + 0.0011P) psi (0.076 + 0.0011P) psi (0.40 + 0.0011P) psi (0.69 + 0.0011P) psi | Crystal 30PSIXP2I Crystal 100PSIXP2I Crystal 500PSIXP2I Crystal 1KPSIXP2I Crystal 5KPSIXP2I Crystal 10KPSIXP2I | |
| Pressure Gages, Transducers – Measure ⁷ | (-15 to 0) psi (0 to 30) psi (0 to 100) psi (100 to 1 500) psi (1 500 to 15 000) psi | (0.006 - 0.000716P) psi (0.0036 + 0.0000477P) psi (0.0042 + 0.00011P) psi (0.0049 + 0.000076P) psi (0.000075 + 0.000086P) psi | GE Druck Pace 1002 Mensor CPB5000 | |

V. Dimensional

| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|--------------------------|----------------------------|--|---------------------------------------|--|
| Micrometers ³ | Up to 1 in (2 to 12) in | 37 μin 150 μin | Grade 2 Gage Blocks | OEM and GIDEP Sourced and Locally Developed Procedures |
| Calipers ^{3,5} | Up to 6 in (6 to 12) in | (290 + 0.51L) μin 300 μin | | |
| Indicators | Up to 1 in | 140 μin | P&W Model C Supermicrometer | |

| PARAMETER/ EQUIPMENT | RANGE | CALIBRATION & MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(±)] | REFERENCE STANDARD OR EQUIPMENT | METHOD(S) |
|--|--------------------------|--|---|--|
| Plain Plug and Pin Gages | Up to 1 in | 51 µin | P&W Model C Supermicrometer, Grade 2 Gage Blocks | OEM and GIDEP Sourced and Locally Developed Procedures |
| Thread Plugs Pitch Diameter Major Diameter | Up to 5 in Up to 5 in | 105 µin 51 µin | P&W Model C Supermicrometer, Grade 2 Gage Blocks, Thread Wires | |

Notes:

1. Calibration and Measurement Uncertainties (CMC) (Expanded Uncertainties) are based on approximately a 95% confidence interval, using a coverage of $k=2$, unless otherwise indicated.
2. This laboratory's capabilities include both in-laboratory and on-site calibration services. Since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
3. On-site calibration service is available ^{for} this parameter.
4. The use of (t) signifies Time in seconds.
5. (L) stands for the nominal value of Length being measured in inches.
6. (T) refers to the nominal value of Torque being measured in lbf-in or lbf-ft.
7. (P) is the nominal value of Pressure being measured in psi.
8. (Y) stands for the nominal value of Temperature being measured in °C.
9. This scope is formatted as part of a single document including the Certificate of Accreditation No. AC-1440.



Vice President