



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

BHD TEST & MEASUREMENT  
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CALIBRATION

Valid to: May 31, 2025

Certificate Number: 3104.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 8</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Gage Blocks	Up to 4 in	(1.4 + 1.4L) μin	Mechanical comparator dual probes
	(5 to 20) in	(2.7 + 0.9L) μin	Mechanical comparator
Micrometers <sup>3</sup> –	+;Outside	Up to 6 in	Gage blocks
		(7 to 36) in	
	Inside	(1 to 40) in	Trimos universal measuring machine
	Depth	Up to 12 in	Gage blocks
Intramic	(0.2 to 4.0) in	(28 + 8D) μin	Ring gages
Calipers <sup>3</sup> –	0.0005 in Graduation	Up to 12 in	Gage blocks
	0.001 in Graduation	Up to 36 in	

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Chamfer Check <sup>3</sup>	Up to 3 in diameter	120 μin	ULM & ring gages
Height Gage <sup>3</sup>	Up to 36 in	(26 + 2.7L) μin	Gage blocks
Indicators <sup>3</sup>	(0.01 to 4) in	(13 + 7.1L) μin	Universal measuring machine
Bore Gages <sup>3</sup>	(0.02 x .050) μin	14 μin	Universal measuring machine
Plug Gages – Threaded, 60 <sup>0</sup>			
Pitch Diameter	Up to 6 in	(64 + 0.31D) μin	Universal measuring Machine/laser interferometer
Major Diameter	Up to 6 in	19 μin	
Threaded NPT	Up to 4 in	72 μin	
Squareness – Measure	Up to 18 in	69 μin	Square master
Electronic Amplifier	Up to 0.2 in	3.5 μin	Universal measuring machine
Thickness Gages (Feeler Type)	Up to 0.1 in	20 μin	Universal measuring machine
Thread Wires	(5 to 80) TPI	3.4 μin	ULM & laser interferometer
Pin Gages	Up to 6 in	(2.9 + 2.7D) μin	ULM & laser interferometer
Ring Gages, Plain	(0.05 to 12) in	(12 + 1.1D) μin	Universal measuring machine
Thread Rings, 60 <sup>0</sup>	Up to 6 in	130 μin	Set plug/ULM



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
NPT Rings	Up to 4 in	170 μin	Master plug
Step Gage <sup>3</sup>	Up to 12 in	14 μin	Gage blocks & amp w/ gage head
Sine Bar	Up to 10 in	35 μin	Gage blocks & amp w/ gage head
Height Master	Up to 12 in	(6.6 + 2.7L) μin	Gage blocks & amp w/ gage head
Parallels <sup>3</sup>	Up to 10 in	48 μin	Gage blocks & amp w/ gage head
Levels <sup>3</sup>	Up to 12 in	75 μin	Sine bar
Steel Rules & Tapes	Up to 100 ft	130 μin per 60 in	Laser interferometer
Glass Scale & Reticle	Up to 12 in	(5.7 + 0.7L) μin	Laser interferometer
Length <sup>3</sup> – Measure	Up to 120 in	(1.2 + 0.03L) μin	Laser interferometer
Angle Block	Up to 4 in	15 arc sec	Sine bar
Protractor	Up to 90°	15 arc sec	Sine bar
Autocollimator	+/- 500 arc sec	0.60 arc sec	Laser interferometer

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 6, 7</sup> (±)	Comments
DC Voltage –  Generate <sup>3</sup>	Up to 220 mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	11 µV/V 7.0 µV/V 5.0 µV/V 5.8 µV/V 6.9 µV/V 8.0 µV/V	Fluke 5730A
Generate & Measure <sup>3</sup>	(1.0 to 45) kV	0.076 %	Fluke 289. Ross Eng. HV divider, 40 kV DC source
DC Voltage – Measure <sup>3</sup>	Up to 220 mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1000) V	9.0 µV/V 6.0 µV/V 4.3 µV/V 5.3 µV/V 6.7 µV/V 6.9 µV/V	Fluke 8508A
DC Current – Generate & Measure <sup>3</sup>	Up to 220 µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 1.1) A  (1.1 to 20.0) A	58 µA/A 53 µA/A 53 µA/A 0.05 % 0.023 %  0.17 %	Fluke 5730A, Agilent 3458A    Fluke 5522A, Fluke 8508A

Parameter/Equipment	Range	CMC <sup>2,6,7</sup> (±)	Comments
DC Resistance – Generate & Measure <sup>3</sup>	1 Ω (1 to 100) Ω (0.10 to 1.0) kΩ (1.0 to 10) kΩ (10 to 100) kΩ (0.10 to 1.0) MΩ (1 to 10) MΩ (1 to 100) MΩ (0.10 to 1.0) GΩ	0.011 % 45 μΩ/Ω 16 μΩ/Ω 15 μΩ/Ω 17 μΩ/Ω 30 μΩ/Ω 23 μΩ/Ω 0.059 % 0.13 %	Fluke 5730A, Agilent 3458A-02  Fluke 5522A
	(0.30 to 1.0) GΩ	0.11 %	IETVRS-100-10-1kOhm-ROT Fluke 8508A
Fixed Points <sup>3</sup>	1 Ω 10 Ω 100 Ω 10 k Ω	35 μΩ/Ω 31 μΩ/Ω 26 μΩ/Ω 17 μΩ/Ω	Fluke-742A-1 IET-SRX-10 IET-SRX-100 Fluke-742A-10K

Parameter/Range	Frequency	CMC <sup>2,6,7</sup> (±)	Comments
AC Voltage – Generate & Measure <sup>3</sup>	(1 to 100) mV	(10 to 100) Hz	Fluke 5730A, Fluke 5725, Agilent 3458A-02
	(1 to 100) mV	100 Hz to 1 kHz	
	(1 to 100) mV	(1 to 10) kHz	
	(1 to 100) mV	(10 to 100) kHz	
	(100 to 1000) mV	(10 to 100) Hz	0.18 %
	(100 to 1000) mV	100 Hz to 1 kHz	0.014 %
	(100 to 1000) mV	(1 to 10) kHz	0.18 %
	(100 to 1000) mV	(10 to 100) kHz	0.34 %
	(1 to 10) V	(1 to 10) kHz	0.11 %
	(1 to 100) V	(10 to 100) Hz	0.027 %
	(1 to 100) V	100 Hz to 1 kHz	0.23 %
	(1 to 100) V	100 Hz to 1 kHz	0.050 %
	(100 to 1000) V	50 Hz to 30 kHz	0.045 %
(1 to 30) kV	60 Hz	0.24 %	Fluke 289. Ross Eng. HV divider, 35 kV AC source

Parameter/Range	Frequency	CMC <sup>2, 6, 7</sup> (±)	Comments
AC Current – Generate & Measure <sup>3</sup>			
Up to 0.220 mA	100 Hz to 10 kHz	0.19 %	Fluke 5730A, Agilent 3458A-02
(2.2) mA	100 Hz to 10 kHz	0.20 %	
(10 to 50) mA	100 Hz to 30 kHz	0.09 %	
(100 to 200) mA	100 Hz to 30 kHz	0.50 %	
(0.5 to 2.0) A	10 Hz to 10 kHz	0.10 %	
(4.0 to 8.0) A	50 Hz to 10 kHz	0.11 %	Fluke 5730A, Agilent 3458A-02, Fluke 8508A Fluke 5725A amplifier
(10.0 to 19.0) A	50 Hz to 5 kHz	0.11 %	
Generate			Fluke 5522A Agilent 3458A-02 Fluke multi-turn coils
(50 to 1000) A	60 Hz	0.20 %	
(20 to 3000) A	(50 to 60) Hz	0.94 %	
Capacitance – Generate & Measure <sup>3</sup>			
Fixed Points			Capacitor Set, HP 16380A with Keysight E4980AL
1.0 pF	1 kHz	0.17 %	
10 pF	1 kHz	0.021 %	
100 pF	1 kHz	0.0017 %	
1000 pF	1 kHz	0.0072 %	
1.0 pF	300 kHz	0.13 %	
10 pF	300 kHz	0.015 %	
100 pF	300 kHz	0.0031 %	
1000 pF	300 kHz	0.0001 %	
1 nF	1 kHz	0.087 %	
10 nF	1 kHz	0.011 %	
100 nF	1 kHz	0.010 %	
1 nF to 10 000 µF	At various frequencies ranging anywhere from 20 Hz to 1 kHz	0.62 %	Fluke 5522A calibrator with Keysight E4980AL

Parameter/Range	Frequency	CMC <sup>2, 6, 7</sup> (±)	Comments
Inductance – Generate & Measure Fixed Points <sup>3</sup>			
1 mH	20 Hz to 20 kHz	0.14 %	Genrad 1482 series standard inductors Keysight E4980A LCR meter
100 mH	20 Hz to 10 kHz	0.11 %	
1 H	20 Hz to 1 kHz	0.48 %	

Parameter/Equipment	Range	CMC <sup>2, 6, 7</sup> (±)	Comments	
Electrical Calibration of Thermocouples – Thermocouple Simulation <sup>3</sup>				
Generate & Measure				
E-Type	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.41 °C 0.18 °C 0.17 °C 0.18 °C 0.21 °C	Fluke 5522A	
J-Type	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.25 °C 0.18 °C 0.17 °C 0.19 °C 0.23 °C		
K-Type	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.29 °C 0.20 °C 0.18 °C 0.24 °C 0.34 °C		
T-Type	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.51 °C 0.23 °C 0.18 °C 0.17 °C		
ESD Impulse Current – Measure	Voltage: (1 to 30) kV	3.7 %		Tek 694C oscilloscope, EMC partner ESD Veri-V, target 2-DN, Agilent 34401A DMM

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Oscilloscope – Rise Time, Generate & Measure <sup>3</sup>	150 ps	36 ps	Fluke 9500B, active head 9530, Tek 694C oscilloscope

### III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
RF Voltage Low Frequency – Generate & Measure <sup>3</sup>	10 Hz to 1.0 MHz	0.06 V <sub>RMS</sub>	Fluke 9640A-LPN, Fluke 8508A DMM
RF Power – Low to Medium Frequency Generate & Measure <sup>3</sup>  (-110 to +20) dBm	(1 to 120) MHz	0.19 dBm	Fluke 9640A-LPN synthesized signal generator, HP8902A-050 measuring receiver, HP 11722A sensor
RF Power – Generate & Measure <sup>3</sup>  (10 to -40) dBm	20 MHz to 1 GHz	0.082 dBm	HP 8902A-050 measuring receiver; 11793A microwave converter; Fluke 9640A-LPN & HP 8340B generators with 11722A sensor
(-50 to -110) dBm	20 MHz to 1.3 GHz	0.84 dBm	with 11722A sensor
(10 to -30) dBm	(2 to 8) GHz	0.49 dBm	with 11792A sensor
(10 to -30) dBm	(10 to 20) GHz	0.9 dBm	with 11792A sensor
(0 to -30) dBm	(22 to 26.5) GHz	1.3 dBm	with 11792A sensor



Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
RF Attenuation Tuned RF Level – Generate & Measure <sup>3</sup>  (0 to -110) dB	10 MHz	0.41 dB	Agilent 8902A-050 measuring receiver Agilent 11793A microwave converter, HP 8496B / 8494B step attenuators with Agilent 11722A sensor  with 11792A power sensor
	50 MHz	0.43 dB	
	1 GHz	0.50 dB	
	4 GHz	0.35 dB	
	10 GHz	0.71 dB	
	15 GHz	1.0 dB	
	18 GHz	0.45 dB	

#### IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5, 7</sup> (±)	Comments
Torque Wrench <sup>3</sup>	(15 to 200) oz·in	0.44 %	CDI torque system
	(5 to 50) lb·in	0.43 %	
	(50 to 250) lb·in	0.40 %	
	(250 to 1000) lb·in	0.36 %	
	(25 to 250) lb·ft	0.41 %	
	(250 to 1000) lb·ft	0.35 %	
Torque Transducer	(15 to 200) oz·in	0.29 %	Torque arm & mass
	(5 to 50) lb·in	0.34 %	
	(25 to 250) lb·in	0.32 %	
	(100 to 1000) lb·in	0.29 %	
	(25 to 250) lb·ft	0.33 %	
	(10 to 1000) lb·ft	0.31 %	

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Pressure/Vacuum <sup>3</sup> – Measure & Measuring Equipment	(-5 to 3000) psi	0.013 % Full Scale	Additel ADT 783K automatic pressure standard
	(4000 to 10 000) psi	0.011 % Full Scale	Fluke RPM-4-E-DWT dead weight calibrator

#### IV. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Humidity – Measure	(10 to 15 %) RH (15 to 33 %) RH (33 to 75 %) RH (75 to 90 %) RH (90 to 95 %) RH (95 to 97 %) RH	1.1 % RH 1.2 % RH 1.3 % RH 1.4 % RH 1.5 % RH 2.2 % RH	Vaisala Probe
Temperature – Measure & Measuring Equipment	(-20 to 200) °C	0.045 °C	Temperature Probe with Dry Well, Oil bath /Temperature Chamber
Temperature – Measuring Equipment & Measure, Actual Temperatures			
Using a Heated Metrology Well <sup>3</sup>	(50 °C to 650 °C)	0.018 °C	Temperature Probe with Dry Well, Oil bath /Temperature Chamber
Using a Cold Metrology Well <sup>3</sup>	(-90 °C to +40 °C)	0.045 °C	

V. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2,5</sup> ( $\pm$ )	Comments
Frequency – Measuring Equipment & Measure <sup>3</sup>	(10 MHz Reference) 1.0 mHz to 26.5 GHz	4.6 pHz/Hz 36 nHz/Hz	Agilent 5071A (cesium beam) Symetricom GPS receiver, Agilent 8340B synthesized sweeper, HP 3325B & HP 5343A frequency counter & time interval counter

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

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

<sup>3</sup> Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer’s site being larger than the CMC.

<sup>4</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches,  $D$  is the numerical value of the nominal diameter of the device measured in inches.

<sup>5</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

<sup>6</sup> The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC’s are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

<sup>7</sup> The statement of CMC, percentages are percentages of reading.

<sup>8</sup> This scope meets A2LA’s *P112 Flexible Scope Policy*.



# Accredited Laboratory

A2LA has accredited

## **BHD TEST & MEASUREMENT**

*Broomfield, CO*

for technical competence in the field of

## Calibration

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



Presented this 3<sup>rd</sup> day of October 2023.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3104.01  
Valid to May 31, 2025

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