



# CERTIFICATE OF ACCREDITATION

## ANSI-ASQ National Accreditation Board

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

This is to certify that

### **Diamond Technical Services**

**11 Depot Street**

**South Grafton, MA 01560**

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 of

## **CALIBRATION**

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1196

Certificate Number

  
ANAB Approval

Certificate Valid: 10/28/2016-11/18/2017  
Version No. 005 Issued: 10/28/2016



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

### Diamond Technical Services

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### CALIBRATION

Valid to: November 18, 2017

Certificate Number: AC-1196

#### I. Electromagnetic - DC/Low Frequency

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
DC Voltage - Source	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	8.8 $\mu$ V/V + 0.63 $\mu$ V 5.9 $\mu$ V/V + 1.5 $\mu$ V 4.1 $\mu$ V/V + 3.1 $\mu$ V 4.1 $\mu$ V/V + 4.9 $\mu$ V 5.8 $\mu$ V/V + 48 $\mu$ V 7.7 $\mu$ V/V + 0.48 mV	Fluke 5720A
DC Voltage – Measure <sup>2</sup>	Up to 100 mV 100 mV to 1V (1 to 10) V (10 to 100) V 100 V to 1 kV  (1 to 30) kV <sup>2</sup>	11 $\mu$ V/V + 3.6 $\mu$ V 11 $\mu$ V/V + 6.1 $\mu$ V 11 $\mu$ V/V + 5 $\mu$ V 13 $\mu$ V/V + 40 $\mu$ V 14 $\mu$ V/V + 0.38 mV  1.2 mV/V + 27 mV	HP 3458A  Ross VD30
AC Voltage - Source	<b>Up to 2.2 mV</b> (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.28 mV/V + 4.6 $\mu$ V 0.11 mV/V + 4.6 $\mu$ V 93 $\mu$ V/V + 4.6 $\mu$ V 0.23 mV/V + 4.6 $\mu$ V 0.58 mV/V + 5.8 $\mu$ V 1.2 mV/V + 12 $\mu$ V 1.6 mV/V + 23 $\mu$ V 3.1 mV/V + 23 $\mu$ V	Fluke 5720A



Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
AC Voltage - Source (cont.)	<b>(2.2 to 22) mV</b>		
	(10 to 20) Hz	0.28 mV/V + 4.6 $\mu$ V	
	(20 to 40) Hz	0.11 mV/V + 4.6 $\mu$ V	
	40 Hz to 20 kHz	93 $\mu$ V/V + 4.6 $\mu$ V	
	(20 to 50) kHz	0.23 mV/V + 4.6 $\mu$ V	
	(50 to 100) kHz	0.58 mV/V + 5.8 $\mu$ V	
	(100 to 300) kHz	1.2 mV/V + 12 $\mu$ V	
	(300 to 500) kHz	1.6 mV/V + 23 $\mu$ V	
	500 kHz to 1 MHz	3.1 mV/V + 23 $\mu$ V	
	<b>(22 to 220) mV</b>		
	(10 to 20) Hz	0.28 mV/V + 4.6 $\mu$ V	
	(20 to 40) Hz	0.11 mV/V + 4.6 $\mu$ V	
	40 Hz to 20 kHz	93 $\mu$ V/V + 4.6 $\mu$ V	
	(20 to 50) kHz	0.23 mV/V + 4.6 $\mu$ V	
	(50 to 100) kHz	0.58 mV/V + 5.8 $\mu$ V	
	(100 to 300) kHz	1.2 mV/V + 12 $\mu$ V	
	(300 to 500) kHz	1.6 mV/V + 23 $\mu$ V	
	500 kHz to 1 MHz	3.1 mV/V + 23 $\mu$ V	
	<b>220 mV to 2.2 V</b>		
	(10 to 20) Hz	0.33 mV/V + 46 $\mu$ V	
	(20 to 40) Hz	0.13 mV/V + 17 $\mu$ V	
	40 Hz to 20 kHz	68 $\mu$ V/V + 9 $\mu$ V	
	(20 to 50) kHz	0.10 mV/V + 0.12 mV	
	(50 to 100) kHz	0.15 mV/V + 35 $\mu$ V	
	(100 to 300) kHz	5.3 $\mu$ V/V + 93 $\mu$ V	
	(300 to 500) kHz	1.2 mV/V + 0.23 mV	
	500 kHz to 1 MHz	2.0 mV/V + 0.35 mV	
	<b>(2.2 to 22) V</b>		
(10 to 20) Hz	0.29 mV/V + 0.46 mV		
(20 to 40) Hz	0.13 mV/V + 0.17 mV		
40 Hz to 20 kHz	68 $\mu$ V/V + 58 $\mu$ V		
(20 to 50) kHz	97 $\mu$ V/V + 0.12 mV		
(50 to 100) kHz	0.14 mV/V + 0.23 mV		
(100 to 300) kHz	0.38 mV/V + 0.69 mV		
(300 to 500) kHz	1.2 mV/V + 2.3 mV		
500 kHz to 1 MHz	1.9 mV/V + 37 mV		
<b>(22 to 220) V</b>			
(10 to 20) Hz	0.29 mV/V + 4.6 mV		
(20 to 40) Hz	0.13 mV/V + 1.7 mV		
40 Hz to 20 kHz	74 $\mu$ V/V + 0.7 mV		
(20 to 50) kHz	0.10 mV/V + 12 mV		
(50 to 100) kHz	0.18 mV/V + 2.9 mV		
(100 to 300) kHz	1 mV/V + 19 mV		
(300 to 500) kHz	5.2 mV/V + 46 mV		
500 kHz to 1 MHz	9.3 mV/V + 93 mV		

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
AC Voltage - Source (cont.)	<b>220 V to 1.1 kV</b> (15 to 50) Hz 50 Hz to 1 kHz <b>750 V</b> (30 to 50) kHz (50 to 100) kHz <b>1.1 kV</b> (1 to 20) kHz (20 to 30) kHz	4.9 $\mu$ V/V + 19 mV 0.35 mV/V + 4 mV 2.67 mV/V + 90 mV 2.67 mV/V + 90 mV 5.93 mV/V + 39 mV 5.97 mV/V + 71 mV	Fluke 5720A       Fluke 5720A, Fluke 5725A
AC Voltage - Measure	<b>(1 to 10) mV</b> (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz 100 kHz to 1MHz (1 to 4) MHz (4 to 8) MHz <b>(10 to 100) mV</b> (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 4) MHz (4 to 8) MHz (8 to 10) MHz <b>100 mV to 1 V</b> (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 4) MHz (4 to 8) MHz (8 to 10) MHz	0.32 mV/V + 4.2 $\mu$ V 0.26 mV/V + 3.2 $\mu$ V 0.36 mV/V + 3.2 $\mu$ V 1.2 mV/V + 3.2 $\mu$ V 5.8 mV/V + 3.5 $\mu$ V 14 mV/V + 6.5 $\mu$ V 81 mV/V + 8.6 $\mu$ V 0.23 V/V + 9.7 $\mu$ V 0.13 mV/V + 6.1 $\mu$ V 0.13 mV/V + 3.9 $\mu$ V 0.19 mV/V + 3.9 $\mu$ V 0.36 mV/V + 3.9 $\mu$ V 0.93 mV/V + 3.9 $\mu$ V 3.5 mV/V + 13 $\mu$ V 12 mV/V + 13 $\mu$ V 46 mV/V + 81 $\mu$ V 46 mV/V + 93 $\mu$ V 0.18 V/V + 0.12 mV 0.13 mV/V + 51 $\mu$ V 0.13 mV/V + 24 $\mu$ V 0.19 mV/V + 24 $\mu$ V 0.36 mV/V + 24 $\mu$ V 0.93 mV/V + 24 $\mu$ V 3.5 mV/V + 0.12 mV 12 mV/V + 0.12 mV 18 mV/V + 0.12 mV 46 mV/V + 0.93 mV 0.18 V/V + 1.2 mV	HP 3458A

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment	
AC Voltage - Measure <sup>2</sup> (cont.)	<b>(1 to 10) V</b> (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 4) MHz (4 to 8) MHz (8 to 10) MHz	0.13 mV/V + 54 $\mu$ V 0.13 mV/V + 0.24 mV 0.19 mV/V + 0.24 mV 0.36 mV/V + 0.24 mV 0.93 mV/V + 0.24 mV 3.5 mV/V + 1.2 $\mu$ V 12 mV/V + 1.2 $\mu$ V 18 mV/V + 8.1 $\mu$ V 46 mV/V + 9.3 $\mu$ V 0.18 V/V + 12 mV	HP 3458A	
	<b>(10 to 100) V</b> (1 to 40) Hz 40Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.32 mV/V + 5.9 mV 0.32 mV/V + 3.9 mV 0.32 mV/V + 3.9 mV 0.46 mV/V + 3.9 mV 1.4 mV/V + 3.9 mV 4.6 mV/V + 12 mV 18 mV/V + 12 mV		
	<b>100 V to 1 kV</b> (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.55 mV/V + 40 mV 0.55 mV/V + 29 mV 0.76 mV/V + 29 mV 1.4 mV/V + 2.8 mV 3.5 mV/V + 32 mV		
	<b>(1 to 30) kV</b> 20 Hz to 60 kHz <sup>2</sup>	5.8 mV/V + 31 mV		Ross VD30
DC Current - Source	Up to 220 $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	46 $\mu$ A/A + 7.4 nA 35 $\mu$ A/A + 9 nA 35 $\mu$ A/A + 0.40 $\mu$ A 52 $\mu$ A/A + 1.9 $\mu$ A 97 $\mu$ A/A + 35 $\mu$ A 0.38 mA/A + 6.8 mA	Fluke 5720A  with Fluke 5725A	
	(11 to 20) A	170 mA/A + 170 $\mu$ A	Fluke 5520	
DC Current - Measure <sup>2</sup>	(10 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A <sup>2</sup>	35 $\mu$ A/A + 0.47 nA 24 $\mu$ A/A + 6.4 nA 24 $\mu$ A/A + 58 nA 41 $\mu$ A/A + 0.58 $\mu$ A 0.13 mA/A + 13 $\mu$ A 4.4 mA/A + 0.62 mA	HP 3458A  HP 34401A	

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty(±)]	Reference Standard or Equipment	
AC Current - Source	<b>(9 to 220) µA</b> (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.30 mA/A + 16 nA 0.20 mA/A + 12 nA 0.16 mA/A + 9 nA 0.33 mA/A + 14 nA 1.3 mA/A + 75 nA	Fluke 5720A	
	<b>220 µA to 2.2 mA</b> (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.29 mA/A + 46 nA 0.19 mA/A + 41 nA 0.14 mA/A + 41 nA 0.23 mA/A + 0.13 µA 1.3 mA/A + 0.75 µA		
	<b>(2.2 to 22) mA</b> (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 0.46 µA 0.19 mA/A + 0.41 µA 0.14 mA/A + 0.41 µA 0.23 mA/A + 0.64 µA 1.3 mA/A + 5.8 µA		
	<b>(22 to 220) mA</b> (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 4.6 µA 0.19 mA/A + 4.0 µA 0.14 mA/A + 2.9 µA 0.23 mA/A + 4.0 µA 1.3 mA/A + 12 µA		
	<b>220 mA to 2.2 A</b> 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.33 mA/A + 41 µA 0.54 mA/A + 92 µA 8.1 mA/A + 0.19 mA		
	<b>(2.2 to 11) A</b> 40 Hz to 1kHz (1 to 5) kHz (5 to 10) kHz	0.57 mA/A + 0.20 mA 1.1 mA/A + 0.44 mA 4.2 mA/A + 0.87 mA		
	<b>(11 to 20) A</b> (45 to 100) Hz 100 Hz to 1kHz (1 to 5) kHz	0.17 A/A + 0.17 A 0.17 A/A + 0.17 A 0.17 A/A + 0.20 A		Fluke 5520A

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty(±)]	Reference Standard or Equipment
AC Current - Measure	<b>(5 to 100) µA</b> (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz <b>100 µA to 1 mA</b> (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 <b>(1 to 10) mA</b> (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 <b>(10 to 100) mA</b> (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 <b>100 mA to 1 A</b> (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 + 35 nA 1.7 mA/A + 35 nA 0.69 mA/A + 35 nA 0.69 mA/A + 35 nA  4.6 mA/A + 0.23 µA 1.7 mA/A + 0.23 µA 0.70 mA/A + 0.23 µA 0.35 mA/A + 0.23 µA 0.70 mA/A + 0.23 µA 4.6 mA/A + 0.46 µA 6.3 mA/A + 1.7 µA  4.6 mA/A + 2.3 nA 1.7 mA/A + 2.3 nA 0.70 mA/A + 2.3 nA 0.35 mA/A + 2.3 nA 0.70 mA/A + 2.3 nA 4.6 mA/A + 4.6 nA 6.3 mA/A + 1.7 µA  4.6 mA/A + 23 nA 1.7 mA/A + 23 nA 0.70 mA/A + 23 nA 0.35 mA/A + 23 nA 0.70 mA/A + 23 nA 4.6 mA/A + 46 nA 6.3 mA/A + 1.7 µA  4.6 mA/A + 0.20 mA 1.8 mA/A + 0.20 mA 0.90 mA/A + 0.20 mA 1.2 mA/A + 0.20 mA 3.5 mA/A + 0.20 mA 12 mA/A + 0.40 mA	HP 3458A

<b>Parameter/ Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability[Expressed as Uncertainty(±)]</b>	<b>Reference Standard or Equipment</b>	
Electrical Simulation of Thermocouples (Source & Measure)	Type B <sup>2</sup>	(600 to 800) °C	0.54 °C	Fluke 5520A
		(800 to 1 000) °C	0.43 °C	
		(1 000 to 1 550) °C	0.38 °C	
		(1 550 to 1 820) °C	0.41 °C	
	Type C <sup>2</sup>	(0 to 150) °C	0.37 °C	
		(150 to 650) °C	0.37 °C	
		(650 to 1 000) °C	0.39 °C	
		(1 000 to 1 800) °C	0.64 °C	
		(1 800 to 2 316) °C	0.75 °C	
	Type E <sup>2</sup>	(-250 to -100) °C	0.60 °C	
		(-100 to -25) °C	0.22 °C	
		(-25 to 350) °C	0.20 °C	
		(350 to 650) °C	0.22 °C	
		(650 to 1 000) °C	0.27 °C	
	Type J <sup>2</sup>	(-210 to -100) °C	0.34 °C	
		(-100 to -30) °C	0.22 °C	
		(-30 to 150) °C	0.20 °C	
		(150 to 760) °C	0.23 °C	
		(760 to 1 200) °C	0.30 °C	
	Type K <sup>2</sup>	(-200 to -100) °C	0.41 °C	
		(-100 to -25) °C	0.24 °C	
		(-25 to 120) °C	0.22 °C	
		(120 to 1 000) °C	0.33 °C	
		(1 000 to 1 372) °C	0.48 °C	
	Type N <sup>2</sup>	(-200 to -100) °C	0.48 °C	
		(-100 to -25) °C	0.29 °C	
		(-25 to 120) °C	0.26 °C	
		(120 to 410) °C	0.25 °C	
(410 to 1 300) °C		0.34 °C		
Type R <sup>2</sup>	(0 to 250) °C	0.69 °C		
	(250 to 400) °C	0.45 °C		
	(400 to 1 000) °C	0.41 °C		
	(1 000 to 1 767) °C	0.49 °C		



<b>Parameter/ Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability[Expressed as Uncertainty(±)]</b>	<b>Reference Standard or Equipment</b>
Electrical Simulation of Thermocouples (cont.) Type S <sup>2</sup>	(0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C	0.58 °C 0.44 °C 0.45 °C 0.56 °C	Fluke 5520A
Type T <sup>2</sup>	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.75 °C 0.25 °C 0.19 °C 0.20 °C	
Electrical Simulation of RTDs Pt 385, 100 Ω <sup>2</sup>	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.12 °C 0.12 °C 0.13 °C 0.15 °C 0.15 °C 0.17 °C 0.29 °C	
Pt 3926, 100 Ω <sup>2</sup>	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.31 °C 0.11 °C 0.12 °C 0.12 °C 0.13 °C 0.14 °C 0.15 °C 0.15 °C 0.29 °C	
Pt 3916, 100 Ω <sup>2</sup>	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.11 °C 0.11 °C 0.11 °C 0.12 °C 0.17 °C 0.18 °C 0.19 °C 0.20 °C	

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty(±)]	Reference Standard or Equipment
Electrical Simulation of RTDs (cont.) Pt 385, 200 Ω <sup>2</sup>  Pt 385, 500 Ω <sup>2</sup>  Pt 385, 1 000 Ω <sup>2</sup>  PtNi 385, 120 Ω <sup>2</sup> (Ni 120)  Cu 427, 10 Ω <sup>2</sup>	(-200 to -80) °C	0.11 °C	Fluke 5520A
	(-80 to 0) °C	0.12 °C	
	(0 to 100) °C	0.12 °C	
	(100 to 260) °C	0.12 °C	
	(260 to 300) °C	0.14 °C	
	(300 to 400) °C	0.14 °C	
	(400 to 600) °C	0.15 °C	
	(600 to 630) °C	0.16 °C	
	(-200 to -80) °C	0.11 °C	
	(-80 to 0) °C	0.11 °C	
	(0 to 100) °C	0.11 °C	
	(100 to 260) °C	0.12 °C	
	(260 to 300) °C	0.12 °C	
	(300 to 400) °C	0.13 °C	
	(400 to 600) °C	0.13 °C	
	(600 to 630) °C	0.29 °C	
	(-200 to -80) °C	0.11 °C	
	(-80 to 0) °C	0.11 °C	
	(0 to 100) °C	0.11 °C	
	(100 to 260) °C	0.12 °C	
	(260 to 300) °C	0.12 °C	
(300 to 400) °C	0.13 °C		
(400 to 600) °C	0.13 °C		
(600 to 630) °C	0.29 °C		
(-80 to 0) °C	0.14 °C		
(0 to 100) °C	0.14 °C		
(100 to 260) °C	0.19 °C		
(-100 to 260) °C	0.36 °C		



Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
Resistance - Source <sup>2</sup>	Up to 11 $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ 330 $\Omega$ to 1.1 k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ 1.1 M $\Omega$ to 3.3 M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ 330 M $\Omega$ to 1.1G $\Omega$	40 $\mu\Omega/\Omega$ + 1 m $\Omega$ 30 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ 28 $\mu\Omega/\Omega$ + 1.4 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20 m $\Omega$ 28 $\mu\Omega/\Omega$ + 0.20 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.20 m $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$ 60 $\mu\Omega/\Omega$ + 30 $\Omega$ 0.13 m $\Omega/\Omega$ + 50 $\Omega$ 0.25 m $\Omega/\Omega$ + 2.5 k $\Omega$ 0.50 m $\Omega/\Omega$ + 3 k $\Omega$ 3 m $\Omega/\Omega$ + 0.10 M $\Omega$ 15 m $\Omega/\Omega$ + 0.50 M $\Omega$	Fluke 5520A
Fixed Points	1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	0.16 m $\Omega$ 0.16 m $\Omega$ 0.30 m $\Omega$ 0.45 m $\Omega$ 0.30 m $\Omega$ 0.45 m $\Omega$ 2.5 m $\Omega$ 3.9 m $\Omega$ 0.12 $\Omega$ 0.13 $\Omega$ 1.1 $\Omega$ 2.1 $\Omega$ 20 $\Omega$ 40 $\Omega$ 0.40 k $\Omega$ 0.90 k $\Omega$ 10 k $\Omega$	Fluke 5720A
Resistance - Measure	Up to 10 $\Omega$ (10 to 100) $\Omega$ 100 $\Omega$ to 1 k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 22 $\mu\Omega/\Omega$ + 0.50 m $\Omega$ 15 $\mu\Omega/\Omega$ + 0.50 m $\Omega$ 30 $\mu\Omega/\Omega$ + 5 m $\Omega$ 30 $\mu\Omega/\Omega$ + 50 m $\Omega$ 45 $\mu\Omega/\Omega$ + 1 m $\Omega$ 0.12 m $\Omega/\Omega$ + 1 m $\Omega$ 1.3 m $\Omega/\Omega$ + 10 m $\Omega$ 12 m $\Omega/\Omega$ + 12 k $\Omega$	HP 3458A

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty(±)]	Reference Standard or Equipment
<b>Oscilloscopes</b>			
Amplitude DC Signal 50 Ω @ 1 kHz <sup>2</sup> 1 MΩ @1 kHz <sup>2</sup>	(0 to 6.6) V p-p (0 to 130) V p-p	2.5 mV/V + 40 μV 0.50 mV/V + 40 μV	
Leveled Sine Wave <sup>2</sup>	50 kHz to 100 MHz	35 μV/V + 0.30 mV	
Amplitude Squarewave 50 Ω Load <sup>2</sup>	1 mV to 6.6 V p-p 10Hz to 10 KHz	2.5 mV/V + 40 μV	
1M Ω Load <sup>2</sup>	1 mV to 130 V p-p 10Hz to 1 KHz 1KHz to 10 KHz	1 mV/V + 0.40 mV 2.5 mV/V + 40 μV	
Flatness (50 kHz ref) <sup>2</sup>	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	15 μV/V + 0.10 mV 20 μV/V + 0.10 mV 40 μV/V + 0.10 mV	
Time Marker - Source Period @ 50 Ω <sup>2</sup> Rise Time <sup>2</sup>	5 s to 50 ms 20 ms to 2 ns ≤ 300 ps	(25 + 1 000 <i>t</i> ) μs/s 2.5 μs/s +0 / -100 ps	
Edge Specs into 50Ω Load Rise Time <sup>2</sup> Amplitude (p-p) <sup>2</sup>	≤ 350 ps 5mV to 2.5 V	0 ps/-100 ps 20 mV/V + 0.20 mV	
Wave Generator - Source Amplitude (10Hz to 10KHz) <sup>2</sup>			
Square, Sine, Triangle Into 1M Ω <sup>2</sup>	1.8 mV to 55 V p-p	30 mV/V + 0.10 mV	
Square, Sine, Triangle Into 50 Ω <sup>2</sup>	1.8 mV to 2.5 V p-p	30 mV/V + 0.10 mV	
Frequency <sup>2</sup>	10 Hz to 100 kHz	25 μs/s + 15 mHz	
			Fluke 5520A/SC1100

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
Capacitance - Source <sup>2</sup>	(190 to 400) pF 400 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF 330 nF to 1.1 $\mu$ F (1.1 to 3.3) $\mu$ F (3.3 to 11) $\mu$ F (11 to 33) $\mu$ F (33 to 110) $\mu$ F (110 to 330) $\mu$ F 330 $\mu$ F to 1.1 mF (1.1 to 3.3) mF (3.3 to 33) mF (11 to 33) mF (33 to 110) mF	5.8 mF/F + 12 pF 5.8 mF/F + 12 pF 5.8 mF/F + 12 pF 2.9 mF/F + 1.0 pF 2.9 mF/F + 0.12 nF 2.9 mF/F + 0.12 nF 2.9 mF/F + 0.35 nF 2.9 mF/F + 1.2 nF 2.9 mF/F + 3.5 nF 2.9 mF/F + 12 nF 5.5 mF/F + 35 nF 5.5 mF/F + 0.12 $\mu$ F 7.7 mF/F + 0.35 $\mu$ F 5.5 mF/F + 1.2 $\mu$ F 7.7 mF/F + 3.5 $\mu$ F 5.6 mF/F + 12 $\mu$ F 13 mF/F + 35 $\mu$ F 18 mF/F + 0.12 mF	Fluke 5520A

## II. Time & Frequency

Parameter/ Equipment	Range	Calibration and Measurement Capability [Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
Frequency Measure	0.1 Hz to 3 GHz	0.0017 $\mu$ Hz/Hz	HP 53131A with Datum 9390-52033 GPS 10 MHz Receiver/Discipline Oscillator

## III. Dimensional

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
Gage Blocks	Up to 12 in	(3.4 + 1.0L) $\mu$ in	Gage Block Comparator, Gage Blocks
Gage Blocks	(12 to 20) in	(5.2 + 2.1 L) $\mu$ in	LabMaster, Gage Blocks

<b>Parameter/ Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability[Expressed as Uncertainty(±)]</b>	<b>Reference Standard or Equipment</b>
Gage Blocks	(12 to 20) in	$(9.6 + 1.0L) \mu\text{in}$	Universal Length Measuring Machine, Gage Blocks
Plug Gages - Cylindrical	Up to 12 in	$(5.8 + 1.7D) \mu\text{in}$	LabMaster, Gage Blocks
Rings - Cylindrical	Up to 12 in	$(5.1 + 1.7D) \mu\text{in}$	LabMaster, Gage Blocks
Calipers <sup>2</sup>	Up to 40 in	$(290 + 12.6L) \mu\text{in}$	Gage Blocks
Micrometers <sup>2</sup>	Up to 36 in	$(36 + 5.2L) \mu\text{in}$	
Indicators - Test <sup>2</sup> - Drop <sup>2</sup>	Up to 0.06 in Up to 4 in	35 $\mu\text{in}$ $(6.2 + 33.3L) \mu\text{in}$	
Plug Gages - Cylindrical	Up to 12 in	$(9.1 + 5.4L) \mu\text{in}$	ULM, Gage Blocks
Rings - Cylindrical	Up to 12 in	$(18 + 4.8D) \mu\text{in}$	ULM, Gage Blocks
Height Gages <sup>2</sup>	Up to 40 in	$(12 + 3.0L) \mu\text{in}$	Gage Blocks
Surface Plates - Flatness <sup>2</sup>	Up to 200 in	$(21 + 0.58D) \mu\text{in}$	Electronic Levels, Repeat Reading Gage
ULM/ Bench Micrometer <sup>2</sup>	Up to 20 in	$(9.1 + 4.5L) \mu\text{in}$	Gage Blocks, Digital Force Gage
Radius Gage/Weld Fillets	Up to 9.0 in Diameter (4.5 Inch Radius)	$(1\ 200 + 200D) \mu\text{in}$	Optical Comparator
Electronic and Machinist Precision Levels <sup>2</sup>	$(0 \text{ to } 90)^\circ$	1 sec of arc	Sine Bar, Gage Blocks, Surface Plate

<b>Parameter/ Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability[Expressed as Uncertainty(<math>\pm</math>)]</b>	<b>Reference Standard or Equipment</b>
Length Calibration	Up to 7.4 in Up to 12 in Up to 8 in Up to 24 in	(730 + 19.0 <i>L</i> ) $\mu$ in (5.2 + 2.1 <i>L</i> ) $\mu$ in (200 + 100 <i>L</i> ) $\mu$ in (700 + 60 <i>L</i> ) $\mu$ in	Optical Comparator, LabMaster, Micrometer, Digital Slide Caliper
Steel Ruler	Up to 24 in Up to 7.4 in	(320 + 5.38 <i>L</i> ) $\mu$ in (840 + 8.05 <i>L</i> ) $\mu$ in	ULM System Optical Comparator
Protractor	360 °	(4.4 + 0.03 <i>A</i> ) min of Arc	Optical Comparator
Optical Comparator	Up to 6 in	(220 + 4.3 <i>L</i> ) $\mu$ in	Glass Scale
Thread Ring Gage (thread set plug method)	4 to 80 tpi	(110 + 14 <i>PD</i> ) $\mu$ in	LabMaster, thread plug
Thread Plug, Thread Set Plug (3 wire method)	4 to 80 tpi	(17 + 2.3 <i>PD</i> ) $\mu$ in	LabMaster, working thread wire
Thread Wire, Master	0.004 to 0.029 in	(8.1 + 152 <i>D</i> ) $\mu$ in	LabMaster, gage blocks
Thread Wire, Working	0.004 to 0.029 in	(13 + 240 <i>D</i> ) $\mu$ in	LabMaster, Master thread wire

#### IV. Mechanical

<b>Parameter/ Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability[Expressed as Uncertainty(<math>\pm</math>)]</b>	<b>Reference Standard or Equipment</b>
Pressure	(1 000 to 20 000) psi	(0.59 + 0.0002 <i>P</i> ) psi	Deadweight Tester, Fluke P3116

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
Pressure	(-15 to 15) in H <sub>2</sub> O (-15 to -60) in H <sub>2</sub> O (15 to 60) in H <sub>2</sub> O	0.019 in H <sub>2</sub> O (0.019 + 0.0002P) in H <sub>2</sub> O (0.019 + 0.0002P) in H <sub>2</sub> O	Pressure Controller/Calibrator, Fluke 7250LP
Pressure	(-14.5 to 12.5) psi) (12.5 to 50) psi	0.012 psi (0.012 + 0.00012P) psi	Dual Channel Pressure Controller, Fluke 7252i
Pressure	(50 to 1 000) psi	(0.019 + 0.000086P) psi	Pressure Controller/Calibrator, Fluke 7250xi

### V. Thermodynamic

Parameter/ Equipment	Range	Calibration and Measurement Capability[Expressed as Uncertainty( $\pm$ )]	Reference Standard or Equipment
Temperature Uniformity Survey (TUS) – Oven Mapping - using Type K thermocouple wire	(32 to 375) °F (375 to 2 500) °F	1.30 °F 1.09 °F + 0.000546 °F/°F	Chart Recorder, Eurotherm Chessell 6100A, Pyromation Type K Thermocouple Wire (special limits)

**Notes:**

1. Calibration and Measurement Capabilities (CMC) (Expanded Uncertainties) are based on approximately a 95% confidence interval, using a coverage of k=2.
2. This laboratory's capabilities include in-laboratory and on-site calibrations performed at customer-designated locations. 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. The use of (t) signifies Time in seconds.
4. The term (D) is the Diameter of the surface plate in inches.
5. The term (L) refers to Length in inches.
6. The term (P) refers to Pressure in psi and inH<sub>2</sub>O
7. The term (PD) refers to Pitch Diameter length.
8. This scope is formatted as part of a single document including the Certificate of Accreditation No. AC-1196.

  
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 Vice President