



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**Thermo-Temp, Inc.**  
**813-A Woodcrest**  
**Houston, TX 77018**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and national standards

**ANSI/NCSL Z540-1-1994 (R2002) and**  
**ANSI/NCSL Z540.3-2006 (R2013)**

In the field of

**CALIBRATION**

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).

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 12 December 2023

Certificate Number: AC-2535



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,  
ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3-2006 (R2013)**

**Thermo-Temp, Inc.**  
813-A Woodcrest  
Houston, Texas 77018  
Chuck Osterhaus 713-695-1939

**CALIBRATION**

Valid to: **December 12, 2023**

Certificate Number: **AC-2535**

**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 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1 000) V	18.5 $\mu$ V/mV + 1 $\mu$ V 18.3 mV/V + 2 $\mu$ V 18.3 mV/V + 20 $\mu$ V 18.3 mV/V + 0.15 mV 20 mV/V + 1.5 mV	Fluke 5520A Multiproduct Calibrator
DC Voltage – Measure <sup>1</sup>	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (10 to 1 000) V	18.3 $\mu$ V/V + 1 $\mu$ V 19.2 $\mu$ V/V + 0.1 mV 59 $\mu$ V/V + 0.1 mV 1 mV/V + 0.4 mV 14.6 mV/V + 40 $\mu$ V	HP 3458A 8.5 Digit Multimeter
AC Voltage – Source <sup>1</sup>	(1 to 33) mV (10 to 45) Hz 45 Hz 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 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	23 $\mu$ V/V + 96 $\mu$ V 20 $\mu$ V/V + 96 $\mu$ V 20 $\mu$ V/V + 96 $\mu$ V 20 $\mu$ V/V + 96 $\mu$ V 50 $\mu$ V/V + 0.1 mV 54 $\mu$ V/V + 0.14 mV 26 $\mu$ V/V + 98 $\mu$ V 32 $\mu$ V/V + 98 $\mu$ V 27 $\mu$ V/V + 98 $\mu$ V 31 $\mu$ V/V + 98 $\mu$ V 41 $\mu$ V/V + 0.13 mV 0.35 mV/V + 0.16 mV	Fluke 5520A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Source <sup>1</sup>	(0.33 to 3.3) V		Fluke 5520A Multiproduct Calibrator
	(10 to 45) Hz	21 mV/V + 0.25 mV	
	45 Hz to 10 kHz	21 mV/V + 0.26 mV	
	(10 to 20) kHz	21 mV/V + 0.26 mV	
	(20 to 50) kHz	21 mV/V + 0.25 mV	
	(50 to 100) kHz	21 mV/V + 0.33 mV	
	(100 to 500) kHz	21 mV/V + 0.8 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	0.1 V/V + 2.7 mV	
	45 Hz to 10 kHz	0.1 V/V + 2.6 mV	
	(10 to 20) kHz	0.1 V/V + 2.6 mV	
	(20 to 50) kHz	0.1 V/V + 2.6 mV	
	(50 to 100) kHz	0.1 V/V + 3.6 mV	
	(33 to 330) V		
	10 Hz to 45 Hz	27 mV/V + 12 mV	
	45 Hz to 10 kHz	28 mV/V + 16 mV	
	10 kHz to 20 kHz	29 mV/V + 16 mV	
	20 kHz to 50 kHz	56 mV/V + 16 mV	
50 kHz to 100 kHz	0.15 V/V + 60 mV		
(330 to 1 000) V			
45 Hz to 1 kHz	74 mV/V + 40 mV		
1 kHz to 5 kHz	83 mV/V + 40 mV		
5 kHz to 10 kHz	79 mV/V + 40 mV		
AC Voltage – Measure <sup>1</sup>	Up to 10 mV		HP 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	1.4 μV/V + 0.5 μV	
	40 Hz to 1 kHz	1.4 μV/V + 0.31 μV	
	(1 to 20) kHz	1.4 μV/V + 0.31 μV	
	(10 to 100) mV		
	(1 to 40) Hz	1.4 μV/V + 4.1 μV	
	40 Hz to 1 kHz	1.4 μV/V + 2.1 μV	
	(1 to 20) kHz	1.4 μV/V + 2.1 μV	
	(0.1 to 1) V		
	(1 to 40) Hz	5.8 μV/V + 41 μV	
	40 Hz to 1 kHz	5.8 μV/V + 21 μV	
	(1 to 20) kHz	5.8 μV/V + 21 μV	
	(1 to 10) V		
	(1 to 40) Hz	59 μV/V + 0.41 mV	
	40 Hz to 1 kHz	59 μV/V + 0.21 mV	
(1 to 20) kHz	59 μV/V + 0.21 mV		



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**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure <sup>1</sup>	(10 to 100) V 40 Hz to 1 kHz (1 to 20) kHz (100 to 1 000) V 40 Hz to 1 kHz (1 to 20) kHz	1 mV/V + 2.1 mV 1 mV/V + 2.1 mV 14.6 mV/V + 21 mV 14.6 mV/V + 21 mV	HP 3458A 8.5 Digit Multimeter
Resistance – Source <sup>1</sup>	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 1.1) kΩ (1.1 to 11) kΩ (11 to 110) kΩ (0.11 to 1.1) MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (0.33 to 1.1) GΩ	0.5 mΩ/Ω + 1 mΩ 0.5 mΩ/Ω + 1.5 mΩ 1.6 mΩ/Ω + 1.4 mΩ 9 mΩ/Ω + 2 mΩ 0.11 Ω/Ω + 2 mΩ 1 Ω/Ω + 0.2 Ω 18 Ω/Ω + 2 Ω 0.2 kΩ/Ω + 30 Ω 0.4 kΩ/Ω + 50 Ω 2.3 kΩ/Ω + 2.5 kΩ 34.1 kΩ/Ω + 3 kΩ 0.16 MΩ/Ω + 0.1 MΩ 11 MΩ/Ω + 0.5 MΩ	Fluke 5520A Multiproduct Calibrator
Resistance – Measure <sup>1,2</sup>	Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	0.2 mΩ/Ω + 0.1 mΩ 1.8 mΩ/Ω + 0.1 mΩ 16 mΩ/Ω + 0.1 mΩ 0.15 Ω/Ω + 0.1 mΩ 1.5 Ω/Ω + 0.1 mΩ 16 Ω/Ω + 1 mΩ 0.3 kΩ/Ω + 2 mΩ 0.3 kΩ/Ω + 2 mΩ 48 kΩ/Ω + 2 mΩ	HP 3458A 8.5 Digit Multimeter
DC Current – Source <sup>1</sup>	(0 to 330) μA (0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 1.1) A (1.1 to 3) A (0 to 11) A (11 to 20.5) A	33 nA/A + 20 nA 30.4 μA/A + 20 nA 30.4 μA/A + 0.25 μA 35.4 μA/A + 2.5 μA 30.4 mA/A + 40 μA 30.5 mA/A + 40 μA 30.6 mA/A + 0.5 mA 33.5 mA/A + 0.75 mA	Fluke 5520A Multiproduct Calibrator (Locked Ranges)
DC Current – Measure	(0 to 100) nA (0.1 to 1) μA (1 to 10) μA	46 pA/A + 0.2 nA 31 nA/A + 2 nA 31 nA/A + 4 nA	HP 3458A 8.5 Digit Multimeter



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**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Current – Measure	(10 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	31 nA/A + 3 nA 45 nA/A + 20 nA 0.33 $\mu$ A/A + 20 nA 4.6 $\mu$ A/A + 20 nA 98 $\mu$ A/A + 30 nA	HP 3458A 8.5 Digit Multimeter
AC Current – Source <sup>1</sup>	(29 to 330) $\mu$ A (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 (0.33 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 (3.3 to 33) 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 (33 to 330) 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 (0.33 to 1.1) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (1.1 to 3) A (10 to 45) Hz 45 Hz to 1 kHz	65 nA/A + 0.6 $\mu$ A 61 nA/A + 0.6 $\mu$ A 61 nA/A + 0.6 $\mu$ A 73 nA/A + 0.65 $\mu$ A 0.13 $\mu$ A/A + 0.7 $\mu$ A 0.68 $\mu$ A/A + 0.9 $\mu$ A 31 $\mu$ A/A + 1.7 $\mu$ A 31 $\mu$ A/A + 0.3 $\mu$ A 31 $\mu$ A/A + 0.3 $\mu$ A 31 $\mu$ A/A + 1.7 $\mu$ A 31 $\mu$ A/A + 1.8 $\mu$ A 31 $\mu$ A/A + 1.1 $\mu$ A 32 $\mu$ A/A + 7 $\mu$ A 32 $\mu$ A/A + 7 $\mu$ A 33 $\mu$ A/A + 7 $\mu$ A 37 $\mu$ A/A + 7 $\mu$ A 37 $\mu$ A/A + 8 $\mu$ A 40 $\mu$ A/A + 8 $\mu$ A 97 $\mu$ A/A + 70 $\mu$ A 62 $\mu$ A/A + 70 $\mu$ A 62 $\mu$ A/A + 70 $\mu$ A 70 $\mu$ A/A + 0.1 mA 79 $\mu$ A/A + 0.15 mA 0.1 mA/A + 0.25 mA 32 mA/A + 0.6 mA 32 mA/A + 0.6 mA 32 mA/A + 1.5 mA 32 mA/A + 5.5 mA 33 mA/A + 0.6 mA 33 mA/A + 0.6 mA	Fluke 5520A 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>	(3 to 11) A 45 Hz to 500 Hz 500 Hz to 1 kHz (11 to 20.5) A 45 Hz to 100 Hz 100 Hz to 1 kHz	39 mA/A + 3 mA 42 mA/A + 3 mA 33 mA/A + 3 mA 42 mA/A + 3 mA	Fluke 5520A Multiproduct Calibrator
AC Current – Measure	Up to 110 $\mu$ A 20 Hz to 1 kHz (0.1 to 1) mA 20 Hz to 1 kHz (1 to 10) mA 20 Hz to 1 kHz (10 to 100) mA 20 Hz to 1 kHz (0.1 to 1) A 20 Hz to 1 kHz	31 nA/A + 30 nA 31 nA/A + 0.2 $\mu$ A 39 nA/A + 2 $\mu$ A 0.25 $\mu$ A/A + 20 $\mu$ A 3 $\mu$ A/A + 0.2 mA	HP 3458A 8.5 Digit Multimeter
Capacitance – Source <sup>1</sup> (Simulated)	(0.19 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 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 (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	13 pF/F + 10 pF 13 pF/F + 10 pF 19 pF/F + 10 pF 0.16 nF/F + 0.1 nF 0.3 nF/F + 0.3 nF 16 nF/F + 1 nF 14 nF/F + 3 nF 19 nF/F + 10 nF 44 nF/F + 30 nF 0.32 $\mu$ F/F + 0.1 $\mu$ F 0.22 $\mu$ F/F + 0.3 $\mu$ F 0.1 mF/F + 1 $\mu$ F 11 $\mu$ F/F + 3 $\mu$ F 13 $\mu$ F/F + 10 $\mu$ F 23 $\mu$ F/F + 30 $\mu$ F 0.16 mF/F + 0.1 mF	Fluke 5520A Multiproduct Calibrator
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1</sup>	Type J (-210 to -100) $^{\circ}$ C (-100 to -30) $^{\circ}$ C (-30 to 150) $^{\circ}$ C (150 to 760) $^{\circ}$ C (760 to 1 200) $^{\circ}$ C	0.2 $^{\circ}$ C 0.17 $^{\circ}$ C 0.19 $^{\circ}$ C 0.17 $^{\circ}$ C 0.21 $^{\circ}$ C	Fluke 5520A Multiproduct Calibrator

**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 K		Fluke 5520A Multiproduct Calibrator
	(-200 to -100) °C	0.21 °C	
	(-100 to -25) °C	0.16 °C	
	(-25 to 120) °C	0.17 °C	
	(120 to 1 000) °C	0.17 °C	
	(1 000 to 1 372) °C	0.22 °C	
	Type N		
	(-200 to -100) °C	0.19 °C	
	(-100 to -25) °C	0.16 °C	
	(-25 to 120) °C	0.16 °C	
	(120 to 410) °C	0.17 °C	
	(410 to 1 300) °C	0.21 °C	
	Type R		
	(0 to 250) °C	0.2 °C	
	(250 to 400) °C	0.22 °C	
	(400 to 1 000) °C	0.23 °C	
	(1 000 to 1 767) °C	0.24 °C	
	Type S		
	(0 to 250) °C	0.19 °C	
	(250 to 1 000) °C	0.22 °C	
(1 000 to 1 400) °C	0.25 °C		
(1 400 to 1 767) °C	0.25 °C		
Type T			
(-250 to -150) °C	0.23 °C		
(-150 to 0) °C	0.22 °C		
(0 to 120) °C	0.19 °C		
(120 to 400) °C	0.19 °C		



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance Simulation of RTD Indicating Devices – Source <sup>1</sup>	Pt 385, 100 Ω		Fluke 5520A Multiproduct Calibrator
	(-200 to -80) °C	0.044 °C	
	(-80 to 0) °C	0.044 °C	
	(0 to 100) °C	0.054 °C	
	(100 to 300) °C	0.064 °C	
	(300 to 400) °C	0.074 °C	
	(400 to 630) °C	0.084 °C	
	(630 to 800) °C	0.084 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.044 °C	
	(-80 to 0) °C	0.044 °C	
	(0 to 100) °C	0.048 °C	
	(100 to 260) °C	0.054 °C	
	(260 to 300) °C	0.064 °C	
	(300 to 400) °C	0.074 °C	
	(400 to 600) °C	0.084 °C	
	(600 to 630) °C	0.084 °C	
	Pt 385, 500 Ω		
	(-200 to -80) °C	0.042 °C	
	(-80 to 0) °C	0.042 °C	
	(0 to 100) °C	0.052 °C	
	(100 to 260) °C	0.062 °C	
	(260 to 300) °C	0.072 °C	
	(300 to 400) °C	0.082 °C	
	(400 to 600) °C	0.082 °C	
	(600 to 630) °C	0.24 °C	
	Pt 385, 1 kΩ		
	(-200 to -80) °C	0.053 °C	
(-80 to 0) °C	0.053 °C		
(0 to 100) °C	0.063 °C		
(100 to 260) °C	0.073 °C		
(260 to 300) °C	0.083 °C		
(300 to 400) °C	0.093 °C		
(400 to 600) °C	0.093 °C		
(600 to 630) °C	0.25 °C		
PtNi 385, 120 Ω			
(-80 to 0) °C	0.093 °C		
(0 to 100) °C	0.093 °C		
(100 to 260) °C	0.15 °C		



**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance Simulation of RTD Indicating Devices – Source <sup>1</sup>	Pt 3916, 100 Ω		Fluke 5522A Multiproduct Calibrator
	(-200 to -190) °C	0.026 °C	
	(-190 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 260) °C	0.08 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.11 °C	
	(600 to 630) °C	0.24 °C	
Cu 427, 10 Ω			
(-100 to 260) °C	0.31 °C		

**Mass and Mass Related**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Rockwell Hardness Testers <sup>1</sup>	HRA		Indirect Verification per ASTM E 18 using Test Blocks
	Low	0.89 HRA	
	Middle	0.89 HRA	
	High	0.53 HRA	
	HRBW		
	Low	1.43 HRBW	
	Middle	1.37 HRBW	
	High	1.17 HRBW	
	HRC		
	Low	0.81 HRC	
	Middle	0.79 HRC	
	High	0.71 HRC	
Brinell Hardness Testers <sup>1</sup>	HBW		Indirect Verification per ASTM E 10 using Test Blocks
	Low	2.59 HBW	
	Middle	2.98 HBW	
	High	3.68 HBW	
Pressure Gauges, Differential Pressure Gauges	(-14 to 15) psig	0.025 psi	Druck DPI150 Pressure/Vacuum Calibrator
	Up to 1 000 psig (200 to 20 000) psig	0.166 psi 0.484 psi	Budenberg CPB5800 Deadweight Tester
Pressure Gauges, Differential Pressure Gauges <sup>1</sup>	(10 000 to 72 500) psig	0.405 psi	Fluke PG7302 Hydraulic Piston Gauge

**Thermodynamic**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Temperature – Measure <sup>1</sup>	(-197 to -80) °C	0.013 °C	Fluke 1502A Thermometer Readout, Fluke 562xA Secondary PRT
	(-80 to -38.84) °C	0.013 °C	
	(-38.84 to 0) °C	0.009 °C	
	(0 to 156.6) °C	0.013 °C	
	(156.6 to 231.9) °C	0.015 °C	
	(231.9 to 419.5) °C	0.019 °C	
	(419.5 to 660) °C	0.029 °C	

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. For 2-wire measurement, add 0.25  $\Omega$ .
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2535.



R. Douglas Leonard Jr., VP, PILR SBU