



**National Voluntary
Laboratory Accreditation Program**



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Hart Scientific Calibration Laboratory

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CALIBRATION LABORATORIES

NVLAP LAB CODE 200348-0

NVLAP Code: 20/A01

ANSI/NCSL Z540-1-1994; Part 1

Compliant

ELECTROMAGNETICS - DC/LOW FREQUENCY

NVLAP Code: 20/E05

DC Resistance

<i>Range in Ω</i>	<i>Best Uncertainty (\pm) in ppm^{note 1}</i>	<i>Remarks</i>
1 to 10	0.30	DC Resistance
10 to 100	0.40	DC Resistance
100 to 1000	0.55	DC Resistance
1000 to 10 000	0.65	DC Resistance

NVLAP Code: 20/E05

Digital Thermometry - Indicators

Readout devices that actually measure resistance

<i>Range in Ω</i>	<i>Best Uncertainty (\pm) in ppm^{note 1} (unless otherwise noted)</i>	<i>Remarks</i>
0.25 to 4.0	0.20	Ratio Function
1	5	Resistance Function
10	4	Resistance Function
100	1	Resistance Function
10 000	2	Resistance Function
0 to 25	0.0001 Ω	Resistance Function

2008-10-01 through 2009-09-30

Effective dates

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25 to 400	4	Resistance Function
400 to 10 k	8	Resistance Function
10 k to 100 k	8	Resistance Function
100 k to 1 M	25	Resistance Function

NVLAP Code: 20/E05

DC Current

Range in mA

4.0 to 20.0

Best Uncertainty ^{Note 1}

40 μ A/A + 0.4 μ A

Remarks

Source/Measure

NVLAP Code: 20/E06

Digital Thermometry - Indicators

Readout devices that actually measure voltage

Range in mV

0 to 50

50 to 100

Best Uncertainty (\pm) in μ V ^{note 1}

0.45

0.75

Remarks

Voltage Function

Voltage Function

Digital Thermometers- Reference Junction Compensation Circuits

Range in $^{\circ}$ C

0.0 to 25.0

Best Uncertainty in $^{\circ}$ mK

10

Remarks

Internal Reference Junction Compensation

THERMODYNAMICS

NVLAP Code: 20/T02

Humidity – Calibration of Digital Thermo-Hygrometers and Chilled Mirror Hygrometers

Range

10 % RH to 50 % RH

50 % RH to 70 % RH

70 % RH to 90 % RH

0 $^{\circ}$ C to 70 $^{\circ}$ C

0 $^{\circ}$ C to 70 $^{\circ}$ C

Best Uncertainty (\pm) ^{note 1}

0.30 %

0.35 %

0.40 %

0.025 $^{\circ}$ C

0.010 $^{\circ}$ C

Remarks

RH Function (valid from 15 $^{\circ}$ C to 35 $^{\circ}$ C)

RH Function (valid from 15 $^{\circ}$ C to 35 $^{\circ}$ C)

RH Function (valid from 15 $^{\circ}$ C to 35 $^{\circ}$ C)

Temperature Function, in Air

Temperature Function, in Stirred Liquid

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NVLAP Code: 20/T06

Radiation Thermometry

Direct Calibration of Infrared Radiation Thermometers Using BB Cavities

<i>Range in °C</i>	<i>Best Uncertainty (±) in °C</i> ^{Note 1, 4}
-15	0.127
0	0.124
35	0.123
50	0.122
100	0.121
120	0.121
200	0.122
250	0.146
350	0.226
500	0.366

Direct Calibration of IR Calibrators Using Infrared Radiation Thermometers

<i>Range in °C</i>	<i>Best Uncertainty (±) in °C</i> ^{Note 1, 4, 5}
-15	0.20
0	0.16
50	0.16
100	0.20
120	0.21
200	0.27
250	0.32
350	0.45
500	0.79

NVLAP Code: 20/T07

Resistance Thermometry - Fixed Point Schedule 1

<i>Range</i>	<i>Best Uncertainty (±) in mK</i> ^{note 1}	<i>Remarks</i>
-197 °C (LN2) (TPAr substitution)	0.60	Direct Comparison
-38.8344 °C (TPHg)	0.35	Fixed Point

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0.010 °C (TPW)	0.20	Fixed Point
29.7646 °C (MPGa)	0.35	Fixed Point
156.599 °C (FPIn)	0.70	Fixed Point
231.928 °C (FPSn)	0.90	Fixed Point
419.527 °C (FPZn)	1.2	Fixed Point
660.323 °C (FPA1)	2.0	Fixed Point
961.78 °C (FPAg)	8.0	Fixed Point

Resistance Thermometry - Fixed Point Schedule 2

-197 °C (LN2)	1.0	Routine Measurement Capability
-38.8344 °C (TPHg)	0.8	Routine Measurement Capability
0.010 °C (TPW)	0.5	Routine Measurement Capability
29.7646 °C (MPGa)	0.8	Routine Measurement Capability
156.599 °C (FPIn)	1.5	Routine Measurement Capability
231.928 °C (FPSn)	1.5	Routine Measurement Capability
419.527 °C (FPZn)	1.8	Routine Measurement Capability
660.323 °C (FPA1)	3.0	Routine Measurement Capability
961.78 °C (FPAg)	10.0	Routine Measurement Capability

Resistance Thermometry - Fixed Point Schedule 3

-197 °C (LN2)	2.0	Single Power Calibration - any SPRTs
-38.8344 °C (TPHg)	2.0	Single Power Calibration - any SPRTs
0.010 °C (TPW)	2.0	Single Power Calibration - any SPRTs
29.7646 °C (MPGa)	2.0	Single Power Calibration - any SPRTs
156.599 °C (FPIn)	3.0	Single Power Calibration - any SPRTs
231.928 °C (FPSn)	4.0	Single Power Calibration - any SPRTs
419.527 °C (FPZn)	6.0	Single Power Calibration - any SPRTs
660.232 °C (FPA1)	8.0	Single Power Calibration - any SPRTs
961.78 °C (FPAg)	15.0	Single Power Calibration - any SPRTs

Resistance Thermometry - Fixed Point Schedule 4 - Single Power Calibration in Mini Fixed Points

-197 °C (LN2)	6.0	High Quality PRTs only
-100 °C	10.0	High Quality PRTs only
-38.8344 °C (TPHg)	6.0	High Quality PRTs only

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0.010 °C (TPW)	4.0	High Quality PRTs only
156.599 °C (FPIn)	6.0	High Quality PRTs only
231.928 °C (FPSn)	6.0	High Quality PRTs only
419.527 °C (FPZn)	9.0	High Quality PRTs only
660.323 °C (FPA1)	14.0	High Quality PRTs only
961.78 °C (FPAg)	20.0	High Quality PRTs only

Resistance Thermometry Comparison Schedule 1 - Single Power Calibration by Comparison

-200 °C	10	High Quality PRTs only
-100 °C to -50 °C	10	High Quality PRTs only
-50 °C to 0 °C	8	High Quality PRTs only
0.010 °C	6	High Quality PRTs only
0 °C to 200 °C	9	High Quality PRTs only
200 °C to 300 °C	12	High Quality PRTs only
300 °C to 400 °C	14	High Quality PRTs only
400 °C to 500 °C	16	High Quality PRTs only

Resistance Thermometry Comparison Schedule 2 - Single Power Calibration by Comparison

-200 °C	25	Any Quality PRTs
-100 °C to -50 °C	25	Any Quality PRTs
-50 °C to 0 °C	25	Any Quality PRTs
0 °C to 100 °C	25	Any Quality PRTs
100 °C to 300 °C	30	Any Quality PRTs
300 °C to 420 °C	35	Any Quality PRTs
420 °C to 500 °C	45	Any Quality PRTs
-20 °C to 100 °C	1.5	Precision Thermistors
100 °C to 150 °C	3.0	Precision Thermistors
-50 °C to -20 °C	5.0	Thermistors
-20 °C to 120 °C	4.0	Thermistors
120 °C to 150 °C	6.0	Thermistors

Certification of Thermometric Fixed Point Cells

TPHg	0.20	Direct Comparison to Reference Cells
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NVLAP LAB CODE 200348-0

TPW	0.07	Direct Comparison to Reference Cells
MPGa	0.08	Direct Comparison to Reference Cells
FPIIn	0.50	Direct Comparison to Reference Cells
FPSn	0.60	Direct Comparison to Reference Cells
FPZn	0.80	Direct Comparison to Reference Cells
FPA1	1.50	Direct Comparison to Reference Cells
FPAg	3.50	Direct Comparison to Reference Cells
TPHg	0.25	Direct Comparison to Working Cells
TPW	0.10	Direct Comparison to Working Cells
MPGa	0.10	Direct Comparison to Working Cells
FPIIn	0.70	Direct Comparison to Working Cells
FPSn	0.80	Direct Comparison to Working Cells
FPZn	1.00	Direct Comparison to Working Cells
FPA1	1.80	Direct Comparison to Working Cells
FPAg	4.50	Direct Comparison to Working Cells

Resistance Thermometry- Dry Block Calibrators

<i>Range in °C</i>	<i>Best Uncertainty in °C^{Note1}</i>	<i>Remarks</i>
-45.0 to 155.0	0.020	Direct Comparison to PRT
155 to 225	0.030	Direct Comparison to PRT
225 to 425	0.040	Direct Comparison to PRT
425 to 660	0.050	Direct Comparison to PRT

NVLAP Code: 20/T08
Thermocouples

<i>Range</i>	<i>Best Uncertainty in mK^{notes 1, 2}</i>	<i>Remarks</i>
Thermocouples - High Quality Thermocouples Only		
156.599 °C (FPIIn)	150	Type S and Type R
231.928 °C (FPSn)	150	Type S and Type R
419.527 °C (FPZn)	150	Type S and Type R

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NVLAP LAB CODE 200348-0

660.323 °C (FPA1)	150	Type S and Type R
961.78 °C (FPAg)	150	Type S and Type R

Thermocouples - High Quality Thermocouples Only

0.010 °C (TPW)	10	Au/PT
156.599 °C (FPIIn)	20	Au/PT
231.928 °C (FPSn)	20	Au/PT
419.527 ° (FPZn)	20	Au/PT
660.323 °C (FPA1)	20	Au/PT
961.78 °C (FPAg)	20	Au/PT
1000.00 °C (extrapolated)	25	Au/PT

Digital Thermometer with PRT System ^{Note 3}

-200 °C	10	Comparison or Mini Fixed Points
-100 °C to -50 °C	10	Comparison or Mini Fixed Points
-50 °C to 0 °C	8	Comparison or Mini Fixed Points
0.010 °C	5	Comparison or Mini Fixed Points
0 °C to 200 °C	8	Comparison or Mini Fixed Points
200 °C to 300 °C	9	Comparison or Mini Fixed Points
300 °C to 400 °C	10	Comparison or Mini Fixed Points
400 °C to 550 °C	11	Comparison or Mini Fixed Points
660.323 °C (FPA1)	15.0	Comparison or Mini Fixed Points

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1. Represents an expanded uncertainty using a coverage factor, $k = 2$, at an approximate level of confidence of 95 %.
2. Calibration of used thermocouples may result in larger uncertainties due to increased inhomogeneity.
3. Probe uncertainty is not included in stated uncertainty.
4. Uncertainty between points to be linearly interpolated from adjacent points.
5. Calibration is performed over the spectral band of 8 to 14 μm .

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A handwritten signature in cursive script that reads 'Sally S. Bruce'.

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