CALIBRATION REPORT FOR PRT & READOUT

Sample
S/N: 795107
Sensor S/N: 11A
Report Number: Y213475

ICL CALIBRATION LABORATORIES, INC.

Cert 526.01 Calibration

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CALIBRATION REPORT FOR PRT & READOUT

The instrument or device identified below was examined and calibrated in ICL's metrology laboratory, using NIST traceable standards, following the calibration procedure referenced below. This calibration fulfills the requirements of ISO/IEC 17025-2005, 'General Requirements for the Competence of Testing and Calibration Laboratories' and ANSI/NCSL Z540-1-1994, 'Calibration Laboratories and Measuring and Test Equipment - 'General Requirements'.

CLIENT
Sample
Sample
Sample, NY
Purchase order number: NOT AVAILABLE
Submitted by: Sample
ICL internal reference (SO): 351143

DATES
Date received: 05-20-2015
Date report issued: 05-26-2015
Recalibration date specified by client: May 26, 2016

UUT (Unit Under Test) INFORMATION

Sensor information:

Manufacturer: DOSTMANN
Model No: D1774
Serial No: 11A
Description: 4 wire 100 Ohm PRT
Manufacturer's specified temperature range: -200 to 420 °C
Calibrated range (limited calibration): -20 to 200 °C
Sensor immersion: RECOMMENDED 6 INCHES MINIMUM

Readout device information:

Manufacturer: DOSTMANN
Model No: P795
Serial No: 795107
Engineering units: °C
'As Found' readout calibration constants: N/A
No changes were made to these constants.

NOTE: The accuracy tolerance for this system calibration (sensor and readout) is either the root-sum-square of the accuracy tolerance of the sensor and the accuracy tolerance of the readout device, (if separate, independent devices), or the manufacturer's specification for the sensor and readout combination. Please see the 'Tolerance' column which appears in the 'Results of Calibration' table on the next page.

RESULTS OF PHYSICAL EXAMINATION
The condition of this device was satisfactory with no visually apparent defects, unless noted below. Minor cosmetic defects are generally not noted unless they are judged to impact the usability of the device.

Technician's comments: UUT was received with the battery cover missing.

CALIBRATION PROCEDURE
ICL Procedure 05, which references relevent elements of ASTM E644, ASTM E1137, ASTM E1750, and ASTM E2593.

LABORATORY ENVIRONMENTAL CONDITIONS
Temperature: 23 °C +/- 5 °C, Relative humidity: between 30% and 80%

RESULTS OF CALIBRATION

Note: the 'As Found' readings were observed using coefficients resident in the non-volatile memory of the device, which were:
R0: 99.978 A: 3.915240E-3 B: -6.185848E-7 C: 1.831955E-10 D: -3.660230E-13

AS FOUND

Nominal Temp	Standard Rdg.	UUT reading	Correction	Tolerance	Accept Limit*	P/F/Ind	Uncertainty
-20.000 °C	-20.003 °C	-20.005 °C	0.002 °C	± 0.0150 °C	± 0.0115 °C	Pass	± 0.010 °C
0.010 °C	0.010 °C	0.011 °C	-0.001 °C	± 0.0150 °C	± 0.0144 °C	Pass	± 0.005 °C
50.000 °C	49.997 °C	49.993 °C	0.004 °C	± 0.0150 °C	± 0.0103 °C	Pass	± 0.012 °C
100.000 °C	100.000 °C	99.995 °C	0.005 °C	± 0.0150 °C	± 0.0103 °C	Pass	± 0.012 °C
150.000 °C	149.998 °C	149.995 °C	0.003 °C	± 0.0150 °C	± 0.0097 °C	Pass	± 0.013 °C
199.000 °C	199.001 °C	198.996 °C	0.005 °C	± 0.0500 °C	± 0.0493 °C	Pass	± 0.013 °C

The 'As Found' values were determined to be within tolerance, and no adjustment of this device was undertaken. Accordingly, the 'As Left' values are the same as the 'As Found' values.

AS LEFT

Nominal Temp	Standard Rdg.	UUT reading	Correction	Tolerance	Accept Limit*	P/F/Ind	Uncertainty
-20.000 °C	-20.003 °C	-20.005 °C	0.002 °C	± 0.0150 °C	± 0.0115 °C	Pass	± 0.010 °C
0.010 °C	0.010 °C	0.011 °C	-0.001 °C	± 0.0150 °C	± 0.0144 °C	Pass	± 0.005 °C
50.000 °C	49.997 °C	49.993 °C	0.004 °C	± 0.0150 °C	± 0.0103 °C	Pass	± 0.012 °C
100.000 °C	100.000 °C	99.995 °C	0.005 °C	± 0.0150 °C	± 0.0103 °C	Pass	± 0.012 °C
150.000 °C	149.998 °C	149.995 °C	0.003 °C	± 0.0150 °C	± 0.0097 °C	Pass	± 0.013 °C
199.000 °C	199.001 °C	198.996 °C	0.005 °C	± 0.0500 °C	± 0.0493 °C	Pass	± 0.013 °C

GUARD BANDING

ISO/IEC 17025:2005(E) requires, in Section 5.10.4.2., that, "When statements of compliance are made, the uncertainty of measurement shall be taken into account." One valid way of complying with this requirement is applying a 'guard band' to the device's tolerance. The guard band is calculated as a function of the test uncertainty ratio (TUR), the ratio of the tolerance of the UUT to the measurement uncertainty. Basically, the smaller the uncertainty is relative to the tolerance, the smaller the guard band. A TUR of 5:1 or even 4:1 results in a guard band of zero, or very close to zero. A 3:1 TUR results in a modest guard band. As TUR declines, the guard band becomes larger. The use of the guard band in the decision process is designed to reduce the probability of a false acceptance (PFA), or a false failure, to 2% or less. The method and equations we use for calculation of the guard band comply with the requirements of ANSI/NCSL Z540.3

*The *Accept Limit(s) are calculated by subtracting the guard band from the tolerance. The Accept Limit is essentially a new tolerance, for this calibration only, which we use to make a declaration of Pass, Fail, or Indeterminate, as explained below:*

Pass The measured value falls within the interval described by the test point plus or minus the Accept Limit.
Fail The measured value falls outside the interval described by the test point plus or minus (the tolerance + the guard band).
Ind (Indeterminate) The measured value is indeterminate, falling in that grey area too close to permit a credible determination; it is statistically and metrologically imprudent to declare that the instrument is definitively either 'in-tolerance' or 'out-of-tolerance'.

LIMITATIONS OF USE

This is a limited, or partial-range calibration, and accordingly, this instrument may be used with confidence only within the range bracketed by the test points. If only a single test temperature was calibrated, the thermometer can be used with confidence only at and immediately around that test point.

MEASUREMENT UNCERTAINTY

The measurement uncertainty reported is the expanded uncertainty at 2 sigma (k=2), to provide a confidence level of approximately 95%.

The uncertainty is calculated considering both Type A and Type B contributors. Type A contributors include the standard deviation of the measurement process from check standard control charts, the standard deviation of monthly Triple Point of Water calibrations of the standard, and UUT variability observed during the calibration. Type B contributors include comparator uniformity, uncertainty of the calibration of the reference standard, stem conduction and other immersion effects, the sensitivity and accuracy of the reference standard thermometer's readout, resolution of the reference standard and resolution of the UUT.

The Type A and B contributors are combined using the root-sum-square method to obtain the standard uncertainty at 1 sigma. The standard uncertainty is then multiplied by 2 to obtain the expanded uncertainty at 2 sigma (k=2). This uncertainty calculation is consistent with the requirements of the ISO Guide to the Expression of Uncertainty in Measurement (the 'GUM') and NIST Technical Note 1297.

The expanded uncertainties (k=2) reported here do not contain estimates for (1) any effects that may be introduced by transportation of the instrument between ICL and the user's facility, (2) drift of the instrument, (3) hysteresis of the instrument, or (4) any measurement uncertainties introduced by the user.

NOTES AND SUPPLEMENTAL INFORMATION

All temperatures given in this report are those defined by the International Temperature Scale of 1990 (ITS-90).

IMPORTANT NOTE: The correct operation of digital electronic thermometers is dependent upon all components functioning properly. Correct temperature indication may be impeded by physical damage to the sensor or cable assembly, contamination of electrical contacts or components by water, oil or other contaminants, or by other, less obvious causes such as low battery level or failure of internal components. Accordingly, ICL Calibration Laboratories, Inc. represents that the calibration data provided in this report were those values observed during the performance of this calibration, however cannot be responsible for inaccurate readings which may be experienced in future uses due to conditions which are beyond our control.

TRACEABILITY INFORMATION

This calibration is traceable to NIST through an unbroken chain of comparisons. Our primary reference standard, a NIST calibrated SPRT, is used only to calibrate our transfer standards, which in turn are used to calibrate our clients' instruments. Measurement uncertainty has been calculated at each step in the chain and is fully documented.

ICL maintains three Rosemount model 162CE 25.5 Ohm SPRTs, for redundancy and to permit sequential rotation to NIST for calibration. As of this date, traceability is conveyed through S/N 5058, our MTE-262, calibrated by NIST on August 17, 2012. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. PRT transfer standards are calibrated annually against this SPRT, per NIST GMP-11 recommendations, and are monitored continually using measurement assurance strategies including check standards, control charts and monthly triple point of water checks.

The comparators and transfer standards used in the performance of this calibration are indicated below, organized by test point.

Nominal Temp	Comparator	Serial No	MTE#	Manufacturer
-20.000 °C	7341 Alc bath	A4B058	238	Hart Scientific
0.010 °C	TPW Maint bath	A89373	311	Hart Scientific
50.000 °C	6331 Water bath	A50146	242	Hart Scientific
100.000 °C	6020 Oil bath	A4C235	241	Hart Scientific
150.000 °C	6020 Oil bath	B2C371	376	Fluke Calibration
199.000 °C	6050H Salt bath	A4B233	240	Hart Scientific

Nominal Temp	Standard	Serial No.	MTE#	Manufacturer	Next Due	Position
-20.000 °C	5628-15 PRT	1755	306	Hart Scientific	05/09/16	Standard
	5628-15 PRT	1751	305	Hart Scientific	05/09/16	Check std
0.010 °C	TPW Cell	BG2609	385	Hart/Fluke	11/21/15	Standard
50.000 °C	5628-15 PRT	1729	307	Hart Scientific	05/09/16	Standard
	5628-15 PRT	1726	308	Hart Scientific	05/09/16	Check std
100.000 °C	5628-15 PRT	0974	247	Hart Scientific	05/09/16	Standard
	5628-15 PRT	0561	256	Hart Scientific	05/09/16	Check std
150.000 °C	5628-15 PRT	0541	237	Hart Scientific	05/09/16	Standard
	5628-15 PRT	1100	290	Hart Scientific	05/09/16	Check std
199.000 °C	5628-15 PRT	0992	252	Hart Scientific	05/09/16	Standard
	5628-15 PRT	1208	269	Hart Scientific	05/09/16	Check std

TECHNICIAN: *J. JEFF KELLY*

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Approved by: _____

J. Jeff Kelly, Technical Director
Deborah M. Weber, Quality Deputy
Date report issued: 05-26-2015

Reviewed by: _____

This report document was prepared by Lori J. Parr
Recalibration date specified by client: May 26, 2016

NIST GMP-11 (September 2014), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' cautions that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. GMP-11 recommends an initial calibration interval of 12 months for digital thermometers, standard thermistors and PRTs.

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated. This calibration report shall not be used to claim product endorsement by the A2LA.

End of Report No.Y213475