

# ICL CALIBRATION LABORATORIES, INC.



Cert 526.01 Calibration

**ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited**

*The specialists in ASTM and laboratory thermometers & hydrometers*  
 Members: A2LA ASTM API NCSLI ASQ NCWM  
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1501 SE Decker Avenue, Suite 118, Stuart, FL 34994 USA  
 Tel: 772-286-7710 1-800-713-6647  
 Fax: 772-286-8737 email: sales@icllabs.com  
 Internet: www.icllabs.com

## CALIBRATION REPORT FOR PORTABLE ELECTRONIC THERMOMETER (PET)

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 CUSTOMER  
 STREET ADDRESS  
 CITY, STATE ZIP  
 Purchase order number: NOT AVAILABLE  
 Submitted by: SAMPLE COMPANY  
 ICL internal reference (SO): 123456

### DATES

Date report issued: 08-25-2016

### LABORATORY ENVIRONMENTAL CONDITIONS

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

### UUT (Unit Under Test) INFORMATION

This is a new instrument, in original packaging.

Manufacturer: MMC  
 Resolution: 0.1 °  
 Sensor serial number: XXXX  
 Sensor type: Ullage, Temperature, Interface (UTI) sensor

Model: D-2401-2  
 Immersion: complete sensor  
 Engineering units: degrees Fahrenheit (°F)

Range: 32 to 190F °F  
 Readout serial number: XXXXX

Accuracy tolerance: +/- 0.5 °F

### RESULTS OF PHYSICAL EXAMINATION

This instrument was received in operable condition, unless otherwise noted.

NOTE: Closed Gauging, 100 Ft.

### CALIBRATION PROCEDURE

ICL Procedure 04, which incorporates methodology discussed in ASTM E77, ASTM E220, ASTM E644 and ASTM E2593.

### RESULTS OF CALIBRATION

#### AS FOUND

Nominal Temp	Standard Rdg.	UUT reading	Correction	Tolerance	Accept Limit*	P/F/Ind	Uncertainty
40.0 °F	40.002 °F	40.2 °F	-0.2 °F	± 0.500 °F	± 0.490 °F	Pass	± 0.13 °F
90.0 °F	90.001 °F	89.8 °F	+0.2 °F	± 0.500 °F	± 0.490 °F	Pass	± 0.13 °F
140.0 °F	140.001 °F	140.1 °F	-0.1 °F	± 0.500 °F	± 0.490 °F	Pass	± 0.13 °F

The technician determined that the indications of this instrument could be improved, and an adjustment was undertaken to optimize its readings.

#### AS LEFT

Nominal Temp	Standard Rdg.	UUT reading	Correction	Tolerance	Accept Limit*	P/F/Ind	Uncertainty
40.0 °F	40.002 °F	40.0 °F	0.0 °F	± 0.500 °F	± 0.490 °F	Pass	± 0.13 °F
90.0 °F	90.001 °F	90.0 °F	0.0 °F	± 0.500 °F	± 0.490 °F	Pass	± 0.13 °F
140.0 °F	140.001 °F	140.0 °F	0.0 °F	± 0.500 °F	± 0.490 °F	Pass	± 0.13 °F

The 'As Left' indications of this device meet the accuracy requirements of Table 3, API Chapter 7, June 2001 (R2012).

### 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 typically results in a guard band of zero, or nearly zero. A 4:1 TUR produces in a guard band very close to zero. A 3:1 TUR results in a modest guard band. And so forth. 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/NC SL 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 statistical '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.

### 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.

### NOTES AND SUPPLEMENTAL INFORMATION

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

### 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 working 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 NIST calibrated Rosemount model 162CE 25.5 Ohm SPRTs, for redundancy and to permit sequential rotation to NIST for calibration. As of this date, traceability from -196 to 420 °C (-320 to 788 °F) is conveyed through S/N 5369, MTE-358, calibrated by NIST on May 28, 2015. NIST GMP-11 recommends a 36-month calibration interval for SPRTs. PRT and other working standards are calibrated annually against the reference 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 working standards used in the performance of this calibration are indicated below, organized by test point.

Nominal Temp	Comparator	MTE#	Manufacturer
40.0 °F	7080 Alc bath	023	Hart Scientific
90.0 °F	Water bath	022	PolyScience
140.0 °F	6331 Water bath	303	Hart Scientific

Nominal Temp	Standard	Serial No.	MTE#	Manufacturer	Next Due	Position
40.0 °F	5614 PRT	787635	302	Hart Scientific	08/20/17	Standard
90.0 °F	T100-450 PRT	9102I03	354	ISOTECH	08/20/17	Standard
140.0 °F	PRT	9102I07	355	ISOTECH	08/20/17	Standard

TECHNICIAN: Pedro Ortiz

### ICL CALIBRATION LABORATORIES, INC.

Approved by: \_\_\_\_\_

Reviewed by: \_\_\_\_\_

J. Jeff Kelly, Technical Director  
Deborah M. Weber, Quality Deputy  
Date report issued: 08-25-2016

This report document was prepared by Christina Capocci  
Recalibration date specified by client: August 25, 2017

The API's 'Manual of Petroleum Measurement Standards', Chapter 7, 'Temperature Determination', First Edition, June 2001 (R2012), Paragraph 8.2 requires that, "Before initial use, and at least once a year thereafter, each portable electronic thermometer (PET) shall be re-standardized by a laboratory or other qualified calibration facility." This and other API standards may be purchased from the American Petroleum Institute at [www.api.org](http://www.api.org)

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 calibration report may not be reproduced except in full without the express written permission of ICL Calibration Laboratories, Inc. This report applies only to the item calibrated. This calibration report shall not be used to claim product endorsement by the A2LA.