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
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CALIBRATION REPORT FOR VOLUMETRIC FLASK

The artifact identified herein 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: 10-11-2014
Next due (specified by client): October 11, 2024

UUT (Unit Under Test) INFORMATION
VOLUMETRIC FLASK marked 'CLASS A' Capacity: 10mL
Graduations: Single line at indicated capacity
Accuracy tolerance: 0.020 mL
Graduated to contain
Manufacturer: PYREX
Serial No: XXXXXX
Engineering units: mL (milliliters @ 20 °C)

RESULTS OF PHYSICAL EXAMINATION
This artifact was examined under a polarized lens and strains in the glass, if any, were judged to be minimal and of no detriment to the function of the artifact. This artifact is in acceptable condition, free of cracks or obvious damage, unless otherwise noted below.

CALIBRATION PROCEDURE USED
ICL Procedure 03, which is based upon ASTM E542, with elements of NIST SOP-14 added for rigor.

LABORATORY ENVIRONMENTAL CONDITIONS
Air temperature: 21.3 °C Relative humidity: 51 % Atmospheric pressure: 766 mm, or 30.16 inches, of mercury.

RESULTS OF CALIBRATION
The volume(s) contained or delivered by this artifact cannot be adjusted or modified by ordinary means; accordingly, the values presented below should be considered to be both 'As Found' and 'As Left' values.

Indicated volume	*Measured*	*Correction*	*Tolerance*	*Accept limit**	*P/F/Ind*	*Uncertainty*
10.000 mL	9.989 mL	0.011 mL	± 0.020 mL	± 0.0172 mL	Pass	± 0.010 mL

THIS ARTIFACT COMPLIES WITH THE ACCURACY REQUIREMENTS FOR ASTM CLASS 'A' GLASSWARE.

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 full range calibration. No limitations of use are imposed on this artifact.

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 a minimum of three repetitions of the measurement, the standard deviation of the balance(s) used for weight measurements, the imprecision of the water density equation, the ambiguity of setting the water level meniscus, the effect that the imprecision of measuring air temperature, relative humidity and atmospheric pressure have on the calculated air density, and the impact of evaporation and drainage issues. Type B contributors include the uncertainty of the calibration of the masses used for balance verification, the uncertainty of the calibration of the thermometer used for measuring water temperature, and the uncertainty of the balance calibration, among others. 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). The equation used for the calculation of water density is the Patterson/Morris Water Density Equation (Patterson, J.B., and Morris, E.C., 'Measurement of Absolute Water Density, 1 deg C to 40 deg C', Metrologia, 31, 277-288, (1994).

TRACEABILITY INFORMATION

This calibration is traceable to NIST through the calibrations of the measuring equipment, detailed below. Measurement uncertainty has been calculated at each step, and every step in the chain is fully documented.

Our NIST primary reference thermometer from -196 to 420C is a Rosemount model 162CE 25.5 Ohm SPRT, serial number 5058, calibrated by NIST on August 17, 2012. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. PRT transfer standards and ASTM liquid-in-glass transfer standards are calibrated annually against this SPRT, per NIST GMP-11 recommendations. Our thermometer used for measuring water temperature during the calibration, S/N 306199, is calibrated at six-month intervals against these transfer standards.

This calibration was performed using either a Mettler AX-504, PR-1203, or PB-3002 balance, as appropriate for the volumes calibrated. These balances are serviced and calibrated annually by Mettler Toledo. The correct functioning of the balance was verified immediately before the calibration using an ASTM Class 1, NIST traceable calibrated set of weights. S/N P742. These weights are calibrated annually by ICL Calibration, which is accredited to ISO/IEC 17025 for the calibration of weights by the A2LA.

Environmental conditions measurements: air temperature and humidity are measured on a calibrated Hart Scientific 'Dewk' thermohygrometer, S/N A52576. Atmospheric pressure is measured on a Princo National Weather Service type barometer, S/N W14463, which is periodically verified against our calibrated Druck pressure calibrator, S/N 6103224206.

TECHNICIAN: DEBORAH M. WEBER

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

Reviewed by: _____

This report document was prepared by Lori J. Parr

Date report issued: 10-11-2014

Calibration valid through: October 11, 2024

IMPORTANT: The calibration interval reflected by the 'Valid Through' date shown above has been specified to us by this client. ICL Calibration Laboratories, Inc. takes no position with regard to the suitability or appropriateness of this interval.

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.