CALIBRATION REPORT FOR LABORATORY WEIGHTS

SAMPLE COMPANY
S/N: XXXXXX
Report Number: W210065

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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CALIBRATION REPORT FOR LABORATORY WEIGHTS

The weights identified herein were inspected and calibrated in ICL's metrology laboratory, using NIST traceable standards, followingthe calibration procedure referenced below. This calibration fulfills the requirements of ISO/IEC 17025-2005, 'General Requirements forthe Competence of Testing and Calibration Laboratories' and ANSI/NCSL Z540-1-1994,'Calibration Laboratories and Measuring andTest Equipment - General Requirements'.

CLIENT
SAMPLE COMPANY

Purchase order number:
Submitted by: SAMPLE CUSTOMER

DATES
Date received: 10-09-2014
Date report issued: 10-11-2014

WEIGHT INFORMATION
Serial number of set: XXXXXX

Description: 1 g THROUGH 100 g WEIGHT SET

Manufacturer or brand: NOT MARKED

ASTM/OIML/NIST accuracy class: See table on Page 2.

Number of weights submitted for calibration: 9

Number of weights found to be out-of-tolerance: 0

Number of weights found to be Indeterminate (See Page 2): 0

Number of weights replaced with new weights: 0

Total number of weights on this report: 9

Materials of construction: see table on Page 5

CALIBRATION PROCEDURE
ICL Procedure 16, which is based upon NIST SOP-5, September, 2014, 'Recommended Standard Operations Procedure for Using a 3-1 Weighing Design'. Also incorporated in this procedure are elements of NIST GLP-1, GLP-9, GMP-5 and GMP10, all from NIST Handbook 145, and relevant components from ASTM E617-13.

RESULTS OF PHYSICAL EXAMINATION
An examination of the weights showed no visually apparent flaws, and they were judged to be in good condition unless otherwise noted below.

COMMENTS
There is corrosion on the 20 g weight.

CLEANING OF WEIGHTS
The weights were cleaned and dried in accordance with NIST GMP 5 and permitted to come to temperature equilibrium in the mass laboratory prior to beginning calibration.

REPLACEMENT OF OUT-OF-TOLERANCE WEIGHTS
At the specific instruction of this client, any out-of-tolerance weights discovered during the performance of the calibration will be replaced with new weights.

RESULTS OF CALIBRATION

CONVENTIONAL MASS
(Mass in air versus reference density of 8.0 g/cm3)

Nominal	Class	Marks	As Found/As Left	Error	MPE*	Lower accept limit**	Upper accept limit**	P/F/Ind	Uncertainty
100.000 g	1		100.000124 g	0.124 mg	± 0.250 mg	99.999795 g	100.000205 g	Pass	± 0.045 mg
50.000 g	1		50.000026 g	0.026 mg	± 0.120 mg	49.999906 g	50.000094 g	Pass	± 0.026 mg
30.000 g	1		29.999975 g	-0.025 mg	± 0.074 mg	29.999944 g	30.000056 g	Pass	± 0.018 mg
20.000 g	1		20.000010 g	0.010 mg	± 0.074 mg	19.999945 g	20.000055 g	Pass	± 0.019 mg
10.000 g	1		10.000029 g	0.029 mg	± 0.050 mg	9.999964 g	10.000036 g	Pass	± 0.014 mg
5.000 g	1		5.0000244 g	0.0244 mg	± 0.0340 mg	4.9999709 g	5.0000291 g	Pass	± 0.0049 mg
3.000 g	1		3.0000262 g	0.0262 mg	± 0.0340 mg	2.9999702 g	3.0000298 g	Pass	± 0.0042 mg
2.000 g	1		2.0000275 g	0.0275 mg	± 0.0340 mg	1.9999702 g	2.0000298 g	Pass	± 0.0042 mg
1.000 g	1		1.0000162 g	0.0162 mg	± 0.0340 mg	0.9999691 g	1.0000309 g	Pass	± 0.0031 mg

A single dot: '.' denotes weight is marked with a dot. Two dots: '..' denotes weight is marked with 2 dots.
'X' denotes weight was found to not comply with acceptance criteria. 'N' denotes a new weight was provided.*
New weight(s) supplied, if any, were manufactured by Troemner, LLC. or by Rice Lake Weighing Systems.

GUARD BANDING (acceptance criteria)

Both ASTM E617-13 (September, 2013) and NIST SOP-5, (September 2014 version), require that:
The expanded uncertainty (k=2) of the measurement shall be 1/3 or less of the maximum permissible error MPE (tolerance).*
The measurement result be 'guard banded' with 100% of the expanded uncertainty, U.

***Accordingly, the lower and upper acceptance limits are defined as follows:*
The Lower accept limit is defined as the nominal mass value - (MPE-U)
The Upper accept limit is defined as the nominal mass value + (MPE-U)

This required guard banding strategy is a very safe, very conservative approach to minimizing the possibility of a false acceptance, and is endorsed by ASTM E617-13, NIST Weights and Measures, OIML, the 'International Organization for Legal Metrology', and other respected metrology organizations. However, this very conservative approach sometimes results in the rejection of weights that do not meet the acceptance criteria, even though at first glance the calibration result appears to be in-tolerance.

For example, a 100 mg ASTM Class 1 weight has an MPE of +/- 0.010 mg. For this example, the U of the measurement is +/- 0.0022 mg. The accept limits are calculated using the nominal mass (100 mg) plus or minus (MPE-U), or 0.0078 mg. For this weight to meet the MPE accuracy requirement, its measured mass value must be between 99.9922 mg and 100.0078 mg.

Making a credible declaration that a weight has FAILED requires the same guard banding technique beyond the tolerance. The fail thresholds are defined as nominal mass plus or minus (MPE+U). A measured mass value below 99.9878 mg or above 100.0122 mg would fail.

Measured mass values falling between the lower accept limit of 99.9922 mg and the lower fail threshold of 99.9878 mg, or between the upper accept limit of 100.0078 mg and the upper fail threshold of 100.0122 mg, are declared 'indeterminate', and cannot be credibly declared to either pass or fail MPE.

P/F/Ind Accordingly, there are three possible calibration outcomes for each weight:

1. Pass The measured mass value resides within the interval between the lower accept limit and the upper accept limit.
2. Ind (Indeterminate) The measured mass value resides either between the lower accept limit and the lower fail threshold, or between the upper accept limit and the upper fail threshold. In such a case, it is statistically and metrologically imprudent to declare that the weight definitively passes or fails.
3. Fail The measured mass value resides outside the fail thresholds.

LABORATORY ENVIRONMENTAL CONDITIONS

Temperature: between 20 and 23 degrees Celsius; rate of change not to exceed 1.0C per hour. Relative humidity: from 40 to 65%. These conditions satisfy NIST Echelon II requirements, which are required for this weighing design.

Temperature (inside the mass comparator's weighing chamber), humidity, and atmospheric pressure are precisely measured, and resultant air density calculated, for the approximately 8 minute time interval during which each weight is intercompared against the standard, a calibrated sensitivity weight, and a check standard (a total of 12 weighings). These values, as well as all observations, calculations, statistics, and check standard results, are recorded and archived with the results of each weight's calibration. This detailed data is available from ICL upon request.

EQUIPMENT AND TRACEABILITY INFORMATION

This calibration is traceable to NIST through a direct chain of comparisons. Measurement uncertainty was calculated and documented at each step in the chain.

The client's weights were compared using the calibrated weights and mass comparators referenced below.

Nominal mass	*Standard*	*Next Due*	*Chk Std*	*Next Due*	*Mass comparator used*
100.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Sartorius CCE-111 s/n 25802803
50.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Sartorius CCE-111 s/n 25802803
30.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Sartorius CCE-111 s/n 25802803
20.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Sartorius CCE-111 s/n 25802803
10.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Sartorius CCE-111 s/n 25802803
5.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Mettler UMX-6 s/n 1122173504
3.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Mettler UMX-6 s/n 1122173504
2.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Mettler UMX-6 s/n 1122173504
1.000 g	MTE-315	04/30/16	MTE-083	04/20/14	Mettler UMX-6 s/n 1122173504

Our working standard weights are calibrated by either by Troemner, LLC (NVLAP accredited) or by Rice Lake Weighing Systems (NVLAP accredited).

Our check standard weights are calibrated by Rice Lake Weighing Systems. These check standard weights are used in every SOP-5 (3-1) weighing to assure the validity of the calibration result. The result of each measurement is plotted on a control chart; these charts are monitored continually to assure the calibration process is meeting established control limits.

NOTES AND SUPPLEMENTAL INFORMATION

Temperature is measured inside the weighing chamber of each mass comparator by a Hart Scientific thermistor sensor, and read on a Hart Scientific model 1560 'Black Stack' thermometer readout. These sensors are calibrated annually against our NIST calibrated SPRT(s).

Relative humidity is measured on a Hart Scientific 'Dewk' humidity and temperature indicator, which is calibrated biannually by ICL in our Thunder Scientific model 2500 humidity generator.

Atmospheric pressure is measured either on a Druck pressure calibrator, S/N 6103224206, which is calibrated annually by an ISO/IEC 17025 accredited laboratory, or on a National Weather Service type mercury barometer, which is verified against the Druck standard at regular intervals.

The equations used in the weighing design and the calculation of Conventional Mass (mass in air vs. reference density of 8 g/cm3) are those appearing in NIST Handbook 145, SOP-5.

The equations used for computation of air density are those recommended by the CIPM 81/91.

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

The declaration of PASS or FAIL in the 'Results of Calibration' table on Page 2 relate only to the weights' compliance with the MPE (maximum permissible error) requirement of ASTM E617-13. No other metrological requirements were assessed.

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 obtained from process statistics, which must conform to the pooled standard deviation of the process, statistics from the performance of the mass comparator, and the standard deviation of check standards obtained from their control charts, among other items. Type B contributors include the uncertainty of the calibration of the standard, the resolution of the mass comparator, estimates for the imprecision of the air density equation, and contributions for such other concerns as drift of the standard, undetected magnetism, and off-center loading of the weight pan.

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).

The expanded uncertainty presented in this report was calculated using methodology consistent with 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 weight(s), or (3) any measurement uncertainties introduced by the user.

TECHNICIAN

This calibration was performed by Lawrence Nieland

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: 10-11-2013

Calibration valid through: October 11, 2015

IMPORTANT: The 'Calibration 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.

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

REFERENCE INFORMATION

TRUE MASS (MASS IN VACUUM)

Nominal mass	*Class*	*Marks*	*As Found/As Left*	*Deviation*	**Density*	*Material*	*Uncertainty*
100.000 g	1		100.000411 g	0.411 mg	7.85 g/cm3	SS	+/- 0.045 mg
50.000 g	1		50.000169 g	0.169 mg	7.85 g/cm3	SS	+/- 0.026 mg
30.000 g	1		30.000061 g	0.061 mg	7.85 g/cm3	SS	+/- 0.018 mg
20.000 g	1		20.000068 g	0.068 mg	7.85 g/cm3	SS	+/- 0.019 mg
10.000 g	1		10.000057 g	0.057 mg	7.85 g/cm3	SS	+/- 0.014 mg
5.000 g	1		5.0000387 g	0.0387 mg	7.85 g/cm3	SS	+/- 0.0049 mg
3.000 g	1		3.0000348 g	0.0348 mg	7.85 g/cm3	SS	+/- 0.0042 mg
2.000 g	1		2.0000333 g	0.0333 mg	7.85 g/cm3	SS	+/- 0.0042 mg
1.000 g	1		1.0000191 g	0.0191 mg	7.85 g/cm3	SS	+/- 0.0031 mg

** DENSITY IS ASSUMED*
MATERIAL KEY: SS-Stainless steel AL-Aluminum BR-Brass TA-Tantalum
A single dot: '.' denotes weight is marked with a dot. Two dots: '..' denotes weight is marked with 2 dots.
'X' denotes weight was found to not comply with acceptance criteria. 'N' denotes new weight.*

End of report