Mass II Calibration Certificate 1463

Missouri Department of Agriculture
Weights, Measures and Consumer Protection, Metrology Laboratory
Location: 1616 Missouri Blvd., Jefferson City, MO 65109
Mailing Address: PO Box 630 Jefferson City, MO 65102
Telephone (573) 751-3440 or (573) 751-9487

University of Arkansas/CTTP , 700 Research Center Blvd, Fayetteville, AR 72701
Phone Number: 479-575-3369, Customer Number: 635, Submission Date: 9/14/12

Procedure is NISTIR 5672 SOP 5. The 3-1 weighing design is a combination of three double substitution comparisons of three weights of equal nominal value; a standard, an unknown weight, and a second standard which can be a summation of weights. The Missouri metrology laboratory has demonstrated measurement proficiency through training and interlaboratory comparisons compliant to NIST HB 143:2007 (ISO/IEC 17025:2005): Laboratory standards used for comparison are traceable to the National Institute of Standards and Technology (NIST). Traceable test numbers: NIST(39598); NIST(822/259883-98); NIST(822/274998-07); OK(OBS 11-0913).

The Kragten method was used to quantify the measurement uncertainty and estimate the magnitude of each uncertainty component. Uncertainty conforms to NIST Technical Note 1297 *"Guidelines for Evaluating and Expressing the Uncertainty of Measurement Results."* Uncertainty is multiplied by Technical Note 1297 Table B.1 coverage factor for an approximate 95 % confidence level.

Conditions During Test (Temperature 21.3 to 22.6 °C) (Barometric Pressure 745.9 to 746.8 mmHg) (Humidity 43.8 to 44.6 %)

Weight Manufacturer: Rice Lake Condition: good Weight set ID/Serial: 19GM

Calibrating Metrologist: Kevin Hanson Laboratory Manager:

Conventional Mass (Mass in air versus reference density of 8.0 g/cm^3), represents the mass at exactly 20°C, atmospheric pressure of 760.5 mmHg, and a relative humidity of 50%. Formula to calculate True Mass = weight's conventional mass/(1- 0.0012/weight's density) x 0.99985

University of Arkansas/CTTP Weight set ID/Serial: 19GM

Test Date	Standard Serial/ID	Nominal Value	Conventional Mass (Mass vs 8.0 g/cm^3) As Found	If Adjusted	Correction	Density g/cm^3	Tolerance Applied To Test		Measurement ± Uncertainty	Comparator Used For Test
9/18/12		500 mg	0.49999535 g		-0.00465 mg	7.95	ASTM 1	0.01 mg	0.00097 mg	Mettler UMT5
9/18/12		200 mg	0.20000849 g		0.00849 mg	7.95	ASTM 1	0.01 mg	0.00042 mg	Mettler UMT5
9/18/12		200 mg	0.20001322 g	0.2000034 g	0.0034 mg	7.95	ASTM 1	0.01 mg	0.00042 mg	Mettler UMT5
9/18/12		100 mg	0.1000058 g		0.0058 mg	7.95	ASTM 1	0.01 mg	0.00077 mg	Mettler UMT5
9/18/12		50 mg	0.05000744 g		0.00744 mg	7.95	ASTM 1	0.01 mg	0.00083 mg	Mettler UMT5
9/18/12		20 mg	0.02000185 g		0.00185 mg	7.95	ASTM 1	0.01 mg	0.00038 mg	Mettler UMT5
9/18/12		20 mg	0.01999827 g		-0.00173 mg	7.95	ASTM 1	0.01 mg	0.00039 mg	Mettler UMT5
9/19/12		10 mg	0.01000597 g		0.00597 mg	7.95	ASTM 1	0.01 mg	0.00034 mg	Mettler UMT5
9/19/12		5 mg	0.00500406 g		0.00406 mg	7.95	ASTM 1	0.01 mg	0.00029 mg	Mettler UMT5
9/19/12		2 mg	0.00200507 g		0.00507 mg	7.95	ASTM 1	0.01 mg	0.00055 mg	Mettler UMT5
9/19/12		2 mg	0.00200672 g		0.00672 mg	7.95	ASTM 1	0.01 mg	0.00054 mg	Mettler UMT5
9/19/12		1 mg	0.00100615 g		0.00615 mg	7.95	ASTM 1	0.01 mg	0.00042 mg	Mettler UMT5

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Certificate Expires
September 2014

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Test Item(s) Description

(1 - metric weight set; Material Type: stainless steel; Tolerance: NIST Class F; Manufacturer: Rice Lake; Serial: 146V; Condition: good)
(1 - 10 kg weight; Material Type: cast iron; Tolerance: NIST Class F; Manufacturer: Rice Lake; Serial: 146W; Condition: good)

Method and Traceability The SI unit for mass is the kilogram (kg) 1 kg = 1000 g and 1 lb = 453.59237 g

Procedure is NISTIR 6969 Standard Operating Procedure (SOP) 8, modified substitution compares a standard and an unknown weight once to determine the difference. The Missouri metrology laboratory has demonstrated measurement proficiency through training and interlaboratory comparisons compliant to NIST HB 143:2007 (ISO/IEC 17025:2005): Laboratory standards used for comparison are traceable to the National Institute of Standards and Technology (NIST). Traceable test numbers: NIST(39598); NIST(822/259883-98); NIST(822/274998-07); OK(OBS 11-0913). *As found or adjusted values are not intended for use as weight correction factors.*

Uncertainty Information

Uncertainty is based on NIST Technical Note 1297 *"Guidelines for Evaluating and Expressing the Uncertainty of Measurement Results."* Uncertainty is calculated using the root sum square (RSS) of the uncertainty components. Uncertainty is multiplied by Technical Note 1297 Table B.1 coverage factor for an approximate 95% confidence level.

Conditions During Test: (Temperature 22.1 °C) (Barometric Pressure 745.0 mmHg) (Humidity 37 %)

Calibrating Metrologist: Tom Hughes **Lab Manager:** **Date Calibrated: 9/20/12**

Nominal Value Units	Standard Serial	As Found Value	Value If Adjusted	± Tolerance NIST Class F	Uncertainty k=2	Mass comparator used for the calibration
5 kg		152 mg		500 mg	12 mg	Mettler PR5003 (5100 g x 1 mg)
2 kg		86.3 mg		200 mg	8.6 mg	Mettler PR2004 (2300 g x 0.1 mg)
2 kg		82.5 mg		200 mg	8.6 mg	Mettler PR2004 (2300 g x 0.1 mg)
1 kg		28.8 mg		100 mg	8.3 mg	Mettler PR2004 (2300 g x 0.1 mg)
500 g		23.1 mg		70 mg	6.5 mg	Mettler PR2004 (2300 g x 0.1 mg)
200 g		15.96 mg		40 mg	0.53 mg	Mettler AT201 (205 g x 0.01 mg)
200 g		15.46 mg		40 mg	0.53 mg	Mettler AT201 (205 g x 0.01 mg)
100 g		8.9 mg		20 mg	0.29 mg	Mettler AT201 (205 g x 0.01 mg)
50 g		1.39 mg		10 mg	0.23 mg	Mettler AT201 (205 g x 0.01 mg)
20 g		2.032 mg		4 mg	0.048 mg	Mettler XP26C (22 g x 0.001 mg)
20 g		1.678 mg		4 mg	0.048 mg	Mettler XP26C (22 g x 0.001 mg)
10 g		0.635 mg		2 mg	0.046 mg	Mettler XP26C (22 g x 0.001 mg)
5 g		0.076 mg		1.5 mg	0.030 mg	Mettler XP26C (22 g x 0.001 mg)
2 g		0.189 mg		1.1 mg	0.035 mg	Mettler XP26C (22 g x 0.001 mg)
2 g		0.231 mg		1.1 mg	0.035 mg	Mettler XP26C (22 g x 0.001 mg)
1 g		0.224 mg		0.9 mg	0.025 mg	Mettler XP26C (22 g x 0.001 mg)
10 kg	146W	2.75 g	0.05 g	1 g	0.28 g	Mettler KA50.2 (52 kg x 0.01 g)