Test Procedure for

CALIBRATING AND CERTIFYING WEIGHTS

TxDOT Designation: Tex-900-K

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1. SCOPE

1.1 This method details the procedure for the calibration and certification of laboratory weights

1.1.1 Use precision weights to calibrate analytical balances and laboratory scales. Only calibrate and certify precision weights using very close tolerance standards traceable to the National Institute of Standards and Technology (NIST) along with precision balances.

1.1.2 Use general-purpose weights as counterweights and to calibrate scales to commercial tolerances. They may be calibrated using certified precision weights and general-purpose laboratory balances with sufficient readability and repeatability.

1.1.3 Adjusting the quantity of material in the adjustment cavity can bring both precision and general-purpose weights into the specification limits.

1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. DEFINITIONS

2.1 *Calibration*—Calibration is determining the errors in a device relative to a standard, calculating a correction factor, and correcting the errors.

2.2 *Certification*—Certifications are documents stating that the device/material under test meets a specified standard.

2.3 *Precision Weights*—Precision weights meet the requirements of one of the four classes in Table 1. Use Class 1 and Class 2 weights as standards for calibration of analytical balances, in the calibration of lesser class weights, and as counterweights with analytical balances. Use Class 3 and Class 4 weights as working weights and for calibration of general-purpose balances.

2.4 *General-Purpose Weights*—General-purpose weights meet the requirements in Table 2. These weights are also known as Class F weights. Use these as counter-weights in general-purpose balances and to calibrate scales to commercial tolerances. Most chrome plated, brass, and cast iron weights are general-purpose weights.

3. APPARATUS

3.1 *Certified standard weights.*

3.2 *Weight adjustment material.*

3.3 *Analytical balances.*

3.4 *Precision balances.*

4. REFERENCE DOCUMENTS

4.1 AASHTO M-231, NIST *Handbook No. 44.*

PART I—CALIBRATING PRECISION WEIGHTS

5. SCOPE

5.1 Precision class weights should be made of corrosion resistant metals such as stainless steel. They should not be painted or plated. They may include a sealed adjustment cavity.

5.2 Precision weights normally deviate from their nominal or marked value. State the deviation of Class 1 and Class 2 weights in the calibration report, normally in a column titled "Apparent Mass, milligrams, 8.0 g/cm^3." Only report Class 3 and 4 weights as in tolerance for that class.

5.3 The true value of a precision weight slowly drifts downward as the body wears, and upward as the adjusting material oxidizes. When the deviation from the nominal value reaches the limit in Table 1, adjust the weight as a part of the calibration procedure. All adjustment material should be either brass or stainless steel.

5.4 The Department of Agriculture Metrology Laboratory or other properly qualified standards laboratories calibrate Class 1 and Class 2 weights. Laboratories having the proper balances and Class 1 or Class 2 standards can calibrate other class weights.

5.5 The Texas Department of Agriculture now assesses a fee for calibrating each weight.

6. PROCEDURE

6.1 Clean each weight with alcohol or a solvent that leaves no residue. Handle clean weights with gloves or forceps.

6.2 Use an analytical balance to perform comparison weighing against ASTM Class 1 or Class 2 weights with known and documented deviations. Balances must be sensitive to weight changes of less than one-half of the tolerance listed in Table 1.

EXAMPLE: If the tolerance in Table 1 is 50 mg, the balance must be sensitive to changes of less than 25 mg.

6.3 Balance errors change as the load changes. Use a certified weight or combination of weights equal to the nominal value of the weight under test.

6.4 Find the true value of a Class 1 or Class 2 weight adding the deviation to the nominal value. Observe and use the sign of the deviation. Subtract a negative deviation from the nominal value and add a positive deviation.

6.5 Weigh a Class 1 or Class 2 weight and record this balance reading.

6.6 Subtract the true weight from this balance reading. This is the balance error for this nominal weight. Record the value and any minus sign.

EXAMPLE: If the balance reads higher than the true weight, the error is a positive value. If the balance reads lower, the error is a minus value. Use this error to determine the true value for the non-calibrated weight

6.7 Place the weight to be calibrated on the balance and record the reading.

6.8 Subtract the error found in Section 6.6 from the reading recorded in Section 6.7. This is the true value of the unknown weight.

6.9 Subtract this true weight value from the nominal weight value stamped on the weight. This is the deviation or error from that nominal weight. Record this value in milligrams.

6.10 Compare the weight's error found in Section 6.9 with the tolerance in Table 1 for that class.

6.10.1 Accept a weight that is within the tolerance.

6.10.2 Reject or adjust any weight not within this tolerance and make adjustments in accordance with Part III.

6.11 You can also check Class 3 or Class 4 weights using a calibrated precision balance with a sensitivity, repeatability, and resolution one tenth of the tolerance in Table 1. Calibrate the balance with Class 1 or Class 2 weights.

6.12 Verify the calibration of the balance for the nominal weight of the weight to be tested.

6.13 Weigh the unknown Class 3 or Class 4 weight. Use this value as the true weight.

6.14 Subtract the true weight determined in Section 6.13 from the nominal value. This is the error.

6.15 Compare this error found in Section 6.14 with the tolerance in for this class in Table 1.

6.15.1 Accept and report a Class 3 or Class 4 weight that is within the tolerance.

6.15.2 Reject or adjust any weight not within tolerance and make adjustments in accordance with Part III.

Table 1—Precision Metric Weight Acceptance Tolerances (from AASHTO M-231)

Weight	ASTM, Class 1	ASTM, Class 2	ASTM, Class 3	ASTM, Class 4
10 kg	25 mg	50 mg	100 mg	200 mg
5 kg	12 mg	25 mg	50 mg	100 mg
3 kg	7.5 mg	15 mg	30 mg	60 mg
2 kg	5.0 mg	10 mg	20 mg	40 mg
1 kg	2.5 mg	5.0 mg	10 mg	20 mg
500 g	1.2 mg	2.5 mg	5.0 mg	10 mg
300 g	0.75 mg	1.5 mg	3.0 mg	6.0 mg
200 g	0.50 mg	1.0 mg	2.0 mg	4.0 mg
100 g	0.25 mg	0.50 mg	1.0 mg	2.0 mg
50 g	0.12 mg	0.25 mg	0.6 mg	1.2 mg
30 g	0.074 mg	0.15 mg	0.45 mg	0.90 mg
20 g	0.074 mg	0.10 mg	0.35 mg	0.70 mg
10 g	0.050 mg	0.074 mg	0.25 mg	0.50 mg
5 g	0.034 mg	0.054 mg	0.18 mg	0.36 mg
3 g	0.034 mg	0.054 mg	0.15 mg	0.30 mg
2 g	0.034 mg	0.054 mg	0.13 mg	0.26 mg
1 g	0.034 mg	0.054 mg	0.10 mg	0.20 mg
500 mg	0.010 mg	0.025 mg	0.080 mg	0.16 mg
300 mg	0.010 mg	0.025 mg	0.070 mg	0.14 mg
200 mg	0.010 mg	0.025 mg	0.060 mg	0.12 mg
100 mg	0.010 mg	0.025 mg	0.050 mg	0.10 mg
50 mg	0.010 mg	0.014 mg	0.042 mg	0.085 mg
30 mg	0.010 mg	0.014 mg	0.038 mg	0.075 mg
20 mg	0.010 mg	0.014 mg	0.035 mg	0.070 mg
10 mg	0.010 mg	0.014 mg	0.030 mg	0.060 mg
5 mg	0.010 mg	0.014 mg	0.028 mg	0.055 mg
3 mg	0.010 mg	0.014 mg	0.026 mg	0.052 mg
2 mg	0.010 mg	0.014 mg	0.025 mg	0.050 mg
1 mg	0.010 mg	0.014 mg	0.025 mg	0.050 mg

PART II—CALIBRATING GENERAL-PURPOSE WEIGHTS

7. SCOPE

7.1 General-purpose weights are made of a corrosion resistant metal such as stainless steel, brass, or cast iron. Cast iron must be painted with a durable paint, usually aluminum, in order to show dirt and to slow rusting. The weight should have a sealed adjustment cavity.

7.2 Any weight may deviate from its nominal value. Only report the class of a general-purpose weight.

7.3 The true value of a general-purpose weight slowly drifts as the body and paint wear and the adjusting material oxidizes. When the difference from the nominal value approaches the maintenance limit in Table 2 or Table 3, adjust the weight immediately prior to calibration.

Table 2—ASTM Class 6 Metric General Purpose Metric Weight Maintenance Tolerances (from AASHTO M-231 and NIST Handbook 44)

Weight	Tolerance	Weight	Tolerance
20 kg	1500 mg	30 g	30.0 mg
10 kg	1000 mg	20 g	20.0 mg
5 kg	800 mg	10 g	15.0 mg
3 kg	500 mg	5 g	10.0 mg
2 kg	400 mg	3 g	8.0 mg
1 kg	250 mg	2 g	6.0 mg
500 g	175 mg	1 g	4.0 mg
300 g	150 mg	500 mg	3.0 mg
200 g	100 mg	300 mg	2.0 mg
100 g	70 mg	200 mg	1.5 mg
50 g	40 mg	100 mg	1.0 mg

Table 3—ASTM Class 6 General Purpose Pound Weight Maintenance Tolerances (from NIST Handbook 44)

Weight	Tolerance	Weight	Tolerance
50 lb.	2.3 g	0.5 lb.	23 mg
30 lb.	1.4 g	0.3 lb.	14 mg
25 lb.	1.1 g	0.2 lb.	9.1 mg
20 lb.	910 mg	0.1 lb.	6.8 mg
10 lb.	450 mg	0.05 lb.	4.5 mg
5 lb.	227 mg	0.03 lb.	3.2 mg
2 lb.	91 mg	0.02 lb.	2.3 mg
1 lb.	45 mg	0.01 lb.	1.4 mg

8. PROCEDURE

8.1 Clean the weights with alcohol or a solvent that leaves no residue. Handle clean weights with gloves or forceps. Cast iron weights must also be free of rust.

8.2 Calibrate general-purpose weights by comparison weighing as described in Section 6.

8.3 Calibrate general-purpose weights using calibrated scales with the sensitivity and readability to show weight differences of less than one-half the tolerance in Table 2 or Table 3.

EXAMPLE: If the tolerance is 50 mg, the balance must show changes of less than 25 mg.

8.4 Calibrate the balance with certified precision weights immediately before performing calibration of a general-purpose weight. The maximum error for the nominal value to be calibrated should be less than one-half of the tolerance in Table 2 or Table 3.

8.5 Calibrate balances used for calibration of Class 6 weights with Class 4 or better weights.

8.6 Reject or adjust the weight if it is not within tolerance. Adjust according to Part III.

8.7 Report the nominal value, the class, and either as passed or rejected.

PART III—ADJUSTING WEIGHTS

9. SCOPE

9.1 Table 1 lists the acceptance tolerances for ASTM Class 1 through Class 4 precision metric weights. When adjusting precision weights, the final deviation from the nominal value shall be as low as practical.

9.2 Table 2 lists the maintenance tolerances for ASTM Class 6 general-purpose metric weights. Table 3 lists the maintenance tolerances for ASTM Class 6 general-purpose pound weights. When adjusting general-purpose weights, set them as close as practical to the nominal value but no more than one-half of the tolerance in the tables.

10. PROCEDURE

10.1 Clean and inspect the weight prior to calibration.

10.2 Reject the weight if ANY plating or coating is flaking, peeling, or otherwise loose. Reject or clean and repaint any cast iron weight with rust.

10.3 Remove the seal and clean the adjusting cavity of any corroded adjusting material, dust, and moisture.

10.3.1 Many seals unscrew to open the cavity.

10.3.2 Seals of some weights must be drilled and pried out.

10.4 Obtain clean adjusting material and new seals as needed.

10.4.1 Use lead adjusting material for general-purpose weights, or use brass or stainless steel adjusting material for precision weights.

10.4.2 Cut new lead seals to size from sheet lead. Common automotive engine block freeze plugs of the proper size can often replace steel seals.

10.5 Use either comparison weighing with a calibrated weight or a calibrated balance.

10.6 All balances used shall meet the requirements for calibration of that weight class.

10.7 Place the weight and seal on the balance.

10.8 Place clean adjusting material on top of the weight until it is within tolerance in the table.

10.9 Push all selected adjusting material into the cavity of the weight and reseal it.

10.10 Verify that the sealed weight is within the allowed tolerance.

10.11 Record the true weight and class, and report as required.

11. CERTIFICATION

11.1 Place a signed and dated certification label on the weight's carrying case. The label should also include the serial number assigned to the weight or weight set.

12. REPORT

12.1 Report the following information:

- nominal value and class for each weight rejected
- nominal value, class, and number of weights for each value accepted.