Calibration of Laboratory Scales and Analytical Balances

1. Introduction

Analytical Balances are used in conjunction with many laboratory analyses requiring gravimetric data and the calibration of balances and scales is essential to successful and accurate analysis.

2. Interfaces with Other Methods

This method is cited by other methods; however, this method does not rely on results from any other method.

3. Materials and Equipment

Balance or scale

Standard weights: The set should include a series of weights up to the capacity of the scale with sufficient subdivisions such that increments of about 10% of the capacity can be tested. However, weights spanning the range of samples typically weighed are adequate. See attachment 3.

4. Procedure

Follow manufacturer's recommended procedures for operation.

5. Calibration and Quality Control Samples

Balances are calibrated with certified weights and cleaned professionally once per year by a contracted vendor.

The balance must be calibrated every time it is moved to a new location. Balances need to be placed on stable surfaces and leveled for proper operation.

Calibration Verification

Place a standard weight in the center of the weighing pan. This should be done each time before the balanced is used and recorded in the logbook.

The reading on the balance must correspond to the weight of the standard within the accepted tolerance interval stated in the attachment 2. Attachment 1 shows an example of entries for an instrument logbook that is maintained for each balance or scale.

If any standard is outside the accepted tolerance interval, repeat the manufacturer's internal calibration and then repeat the calibration verification using certified weights. Use of a second set of weights may be necessary if weights appear damaged or give anomalous readings.

If the instrument calibration is not verifiable using certified weights, use of the balance or scale will be discontinued, and the balance will be clearly tagged as "OUT OF CALIBRATION: DO NOT USE". The proper service personnel will be contacted, and the instrument will only be brought back into use after it has been repaired and passes the verification process outlined above.

6. Limits, Precautions, and Interferences

In order to achieve the highest levels of precision and accuracy during normal weighing and calibration operations, it is recommended that, to the extent possible, electronic scales and balances be maintained in a clean, temperature-controlled laboratory environment free of strong drafts. Large temperature fluctuations are not permitted during the period in which balances are calibrated, and weighed materials should be at ambient temperature. Because static charge causes balance deviations for weighing sub-milligram quantities of material, efforts shall be taken to eliminate static electricity from the immediate work environment if balances capable of reporting weights to 0.0001g or 0.00001 g are being calibrated. Be sure to use a balance that is suited for the precision needed. See attachment 3.

7. Acceptance of Data

The balance must be properly calibrated. Results of the calibration verification should be recorded in a laboratory notebook. See attachment 2.

8. Data Handling and Transfer

Balances that are electronically connected to a computer transfer weight values directly into a spreadsheet via balance software or other similar program. Transcription errors are not encountered. When not attached to a computer, weight values are recorded in a lab notebook and are re-checked against the balance reading to avoid transcription error.

9. References

Mettler Toledo PG-S balances Operations Manual, Mettler-Toledo GmbH, Laboratory and Weighing Technologies, CH-8606 Greifensee, Switzerl

10. Attachments

Attachment 1: Balance Maintenance and Calibration Log (Example)

Attachment 2: Weight Tolerances

Attachment 3: Weight Classes

11. History of Changes

Revision 0: initial issue.

Attachment 1

Balance Maintenance and Calibration Log (Example)

Serial Number of certified weight Set	0.1g	0.25g	0.5g	1g	Pass Y/N	Comments	Date	Initials

Attachment 2

Weight Tolerances

This table shows the limits of actual values for various weights in various accuracy classes.

	Upper Limit	Lower Limit
Weight (gram)	ASTM Class 1	(like class S)
100	100.0003	99.9998
200	200.0005	199.9995
300	300.0008	299.9993
500	500.0013	499.9988
1000	1,000.0025	999.9975
2000	2,000.0050	1,999.9950
3000	3,000.0075	2,999.9925
5000	5,000.0125	4,999.9875
	ASTM Class 2	
100	100.0005	99.9995
200	200.0010	199.9990
300	300.0015	299.9985
500	500.0025	499.9975
1000	1,000.005	999.995
2000	2,000.010	1,999.990
3000	3,000.015	2,999.985
5000	5,000.025	4,999.975

ASTM Class 3

100	100.001	99.999
200	200.002	199.998
300	300.003	299.997
500	500.005	499.995
1000	1,000.01	999.99
2000	2,000.02	1,999.98
3000	3,000.03	2,999.97
5000	5,000.05	4,999.95

ASTM Class 4 (like class P)

100	100.002	99.998
200	200.004	199.996
300	300.006	299.994
500	500.010	499.990
1000	1,000.02	999.98
2000	2,000.04	1,999.96
3000	3,000.06	2,999.94
5000	5,000.10	4,999.90

Attachment 3

Weight Classes

Description of different weight classes and uses

- **ANSI/ASTM Class 1 –** Can be used as a reference standard in calibrating other weights and is appropriate for calibrating high precision analytical balances with a readability as low as 0.1 mg to 0.01 mg.
- **ANSI/ASTM Class 2 –** Appropriate for calibrating high-precision top loading balances with a readability as low as 0.01 g to 0.001 g.
- **ANSI/ASTM Class 3 –** Appropriate for calibrating balances with moderate precision, with a readability as low as 0.1 g to 0.01 g.
- **ANSI/ASTM Class 4 –** For calibration of semi-analytical balances and for student use.
- **ANSI/ASTM Class 5 –** For student laboratory use.
- **ANSI/ASTM Class 6 –** Student brass weights are typically calibrated to this class. This class also meets the specifications of OIML R 111 Class M2.
- **ANSI/ASTM Class 7 –** For rough weighing operations in physical and chemical laboratories, such as force measuring apparatus.
- **NIST Class F –** Primarily used to test commercial weighing devices by state and local weights and measures officials, device installers and service technicians. Class F weights may be used to test most accuracy Class III scales, all scales of Class IIIL or IIII, and scales not marked with a class designation.
- **OIML Class E1 –** Used as primary reference standards for calibrating other reference standards and weights.
- **OIML Class E2 –** Can be used as a reference standard in calibrating other weights and is appropriate for calibrating high precision analytical balances with a readability as low as 0.1 mg to 0.01 mg.
- **OIML Class F1 –** Appropriate for calibrating high-precision top loading balances with a readability as low as 0.01 g to 0.001 g.
- **OIML Class F2 –** For calibration of semi-analytical balances and for student use.
- **OIML Class M1, M2, M3 –** Economical weights for general laboratory, industrial, commercial, technical and educational use. Typically fabricated from cast iron or brass. Class M2 is commonly used for student brass weights.