

Use, Calibration, and Maintenance of Analytical Balances

1 INTRODUCTION

This SOP covers the operation, calibration check, and maintenance of electronic analytical balances used for weighing standards and samples.

2 SCOPE AND APPLICATION

2.1 OVERVIEW

2.1.1 Electronic balances use a device called a “strain gauge load cell.” A strain gauge is a thin device which changes its electrical resistance when it is stretched or compressed. Typically, several strain gauges are used together in a special arrangement, and are connected to the load cell (the balance’s pan or plate) in a protected location. When a force is applied to the load cell, the strain gauge bends a tiny amount, and this tiny bending is detected by its electrical resistance. A load cell can only measure force; therefore an electronic balance can only measure weight. To obtain the mass, the value must be divided by the weight and the local acceleration due to gravity. That is:

$$F = mg$$

Where F is the force (weight), m is the mass, and g is the local acceleration of gravity. However, under usual conditions, the balance is measuring differences, and the g value cancels out.

3 REQUIRED TRAINING

4 EQUIPMENT AND MATERIALS

4.1 APPARATUS AND MATERIALS

- 4.1.1 Weigh paper or weigh boats (if needed).
- 4.1.2 Standard weights.
- 4.1.3 Electronic balances, various brands and models. Current WSL models include Mettler ML4002T/00 (#4), Mettler PJ360 (#3), Mettler AE240 (#1), and Mettler XS205 (#2).
- 4.1.4 Clean forceps to handle the weights, or gloves to be worn if the weights are to be

moved by hand.

5 SAFETY PRECAUTIONS

5.1 SAFETY PRECAUTIONS

- 5.1.1 Handling of large or small weights can represent a hazard to either the weights or personnel if the weights are dropped.

6 SOLUTIONS AND REAGENTS

7 STANDARD SOLUTIONS

8 PROTOCOL

8.1 USE OF BALANCES

- 8.1.1 Choose a balance appropriate for the range of the object to be weighed and the precision of a particular analysis.
- 8.1.2 Prior to use, the balance should be checked for spilled substances and to ensure that the balance is level, on a stable surface, and free from drafts or air currents. Spilled solids should be brushed away.
- 8.1.3 The pan of the balance should be checked to ensure that it is properly seated on the pan mechanism.
- 8.1.4 Turn on the balance. If an error message is received in lieu of the tare value, consult the balance's operation manual.
- 8.1.5 Press the tare button and wait until a stable zero point reading is obtained. Re-press the tare button if necessary. If a container or weight paper is to be used, press the tare button and wait until a stable zero point reading is obtained.
- 8.1.6 Place the object to be weighed on the pan or in the container, in the center area.
- 8.1.7 Allow the reading to stabilize and record the weight.

8.2 BALANCE CALIBRATION CHECK

- 8.2.1 *Procedure for Mettler AE240 (#1)*
1. Ensure all doors are closed, the balance is zeroed, and that there is nothing on the balance.
 2. Press and hold **MODE** button until CAL appears on the screen, and then release the button.
 3. When 100.0000 appears, move the black dial located on the right-hand side of the balance back.
 4. The weight will appear. Record this number in the Analytic Balance and Pipette Calibration Check Laboratory Notebook.

5. CAL will appear again and 0.0000 will blink on the screen. Slide the dial back forward to the beginning position.
6. Record the date, balance number, recorded weight, and operator name in the Analytical Balance and Pipette Calibration Check Laboratory Notebook.

8.2.2 *Procedure for Mettler XS205 (#2)*

1. Ensure all doors are closed, the balance is zeroed, and that there is nothing on the balance.
2. Press **ADJUST INTERNAL** in the bottom left hand corner of the screen.
3. Once adjustment is complete, a screen pops up with the temperature.
4. Record the date, balance number, and operator name in the Analytical Balance and Pipette Calibration Check Laboratory Notebook.

8.2.3 *Procedure for Mettler PJ360 (#3)*

1. Ensure all doors are closed, the balance is zeroed, and that there is nothing on the balance.
2. Press and hold the **TARE** bar.
3. When CAL appears, release the bar.
4. When 100.000 appears on the screen and begins blinking, place a 100g weight on the balance.
5. When 0.000 appears on the screen, take off the weight.
6. Record the date, balance number, and operator name in the Analytical Balance and Pipette Calibration Check Laboratory Notebook.

8.2.4 *Procedure for Mettler ML4002T/00 (#4)*

1. Ensure all doors are closed, the balance is zeroed, and that there is nothing on the balance.
2. Press the button at the bottom of the touch screen that shows a picture of a weight.
3. Once adjustment is complete, a screen pops up with the temperature.
4. Record the date, balance number, and operator name in the Analytical Balance and Pipette Calibration Check Laboratory Notebook.

8.3 CALIBRATION

8.3.1 At least once a year, when balances are moved off of a physical surface, or as deemed necessary, the current user shall check all analytical and electronic balances with standard weights. This shall be done at two levels in the range for which the balance is used, typically with 1 and 50 g weights.

8.3.2 The control limits for each type of balance is as follows:

Balance Sensitivity	10 mg Limit (± g)	1 g Limit (± g)	50 g Limit (± g)
0.1	-	0.1	0.1
0.01	-	0.02	0.02
0.001	-	0.002	0.002
0.0001	0.0003	0.0003	0.0005
0.00001	0.00009	0.00009	-

8.3.3 If the results exceed the control limits, attempt to re-calibrate the balance if possible. Consult the balance operation manual, if necessary. If this does not

remedy the situation, contact the Laboratory Director. The balance should be taken out of service until properly calibrated.

- 8.3.4 The results should be recorded in the Balance Calibration and Maintenance 3-Ring Binder.

8.4 MAINTENANCE

- 8.4.1 Routine maintenance should be done as stated by the manufacturer, or as deemed necessary by the operator (i.e. the balance has been moved, etc).
- 8.4.2 Non-routine maintenance should be done whenever the balance is not operating properly, or as deemed necessary by the operator.
- 8.4.3 All maintenance done on a balance should be recorded in the Balance Calibration and Maintenance 3-Ring Binder. The following format should be used:
- 8.4.3.1 Indicate the date, time, and person who is servicing the balance.
 - 8.4.3.2 State whether the maintenance is routine (R) or non-routine (NR).
 - 8.4.3.3 If the maintenance is routine, state the intended action. If the maintenance is non-routine, indicate the problem/malfunction that occurred for which the maintenance is intended to resolve.
 - 8.4.3.4 Indicate the action taken, and, for non-routine maintenance, if the action corrected the malfunction. If the instrument is still malfunctioning, state the next action to be taken, and its result, etc.

8.5 INTERFERENCES

- 8.5.1 Air drafts, spilled substances, vibrations, and temperature fluctuations should be eliminated prior to any weighing requiring precision greater than 0.1 g. Static electricity can be reduced using an anti-static brush or gun.

9 DATA REDUCTION AND STATISTICS

10 QUALITY ASSURANCE

- 10.1.1 Any calibrations or maintenance done on a balance must be recorded in the Balance Calibration and Maintenance 3-Ring Binder. It is the responsibility of the individual operator to ensure all records are accurate and precise.

11 ADDITIONAL INFORMATION

11.1 REFERENCES

- 11.1.1 APHA (1992) Standard Methods for the Examination of Water and Wastewater. 18th Edition. A.E. Greenberg, L.S. Clesceri, A.D. Eaton, Eds., American Public Health Association, American Water Works Association, and Water Environment Federation.

12 PREVIOUS ISSUES AND CHANGES

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Gen-Balances-001	001	April 1 st , 2006 – April 12 th , 2018	Monica Hollrah
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12.1 ISSUE CHANGES

12.1.1 Issue 001:

- None

12.1.2 Issue 002:

- Moved SOP over to new format

13 DIAGRAMS, FIGURES, AND PHOTOGRAPHS
