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BALANCE USE, MAINTENANCE AND TRAINING IN THE INORGANICS LAB

Access to this SOP shall be available within the laboratory for reference purposes; the official copy of this SOP resides on the official Georgia EPD website at https://epd.georgia.gov/about-us/epd-laboratory-operations. Printed copies of this SOP will contain a watermark indicating the copy is an uncontrolled copy.

1. Scope and Application

1.1 This SOP will provide guidelines in the use of balances. These instruments are delicate and susceptible to errors in measurement if improperly calibrated, leveled, and maintained. The following document will provide the analyst with proper use of ASTM UltraClass weights, rules for validating a measurement, and preventative maintenance. Attached is a Checklist for training analysts in the use of balances (see Table 1). A copy of this Checklist should be completed and filed in the analyst's training records.

2. Definitions

2.1 ASTM Class Weights: Weight sets that fall within the acceptable tolerance established by ASTM and NVLAP. There are 5 classes of weights: UltraClass, Class 1, Class 2, Class 3, and Class 4. These provide a wider tolerance (and greater inaccuracy) with each higher number. UltraClass has the smallest tolerances and is the most accurate.

2.2 Spirit Level: A clear usually round chamber attached to the base of a balance. This window has another circle embossed in the glass. The chamber is filled with liquid, usually ethylene glycol, and has a bubble in the liquid. The diameter of bubble will be slightly smaller than the embossed inner circle. If the balance is level, the bubble will be entirely contained within the embossed inner circle in the window of the chamber.

2.3 Draft Chamber: A Plexiglas ™ box built around the weighing pan of the balance. It usually has several sliding doors for access to the weighing surface. These doors should be closed when a measurement is taken or a tare is made.

2.4 Tare: When a "tare" is made of an object, usually a beaker or other holding vessel, the balance will weigh the object and subtract from the total, giving a final value of zero on the balance display. Most tare switches are a button with a "T" "Re-zeroed" marking.

2.5 Zeroing the Balance: A balance should be reset, "zeroed," between each measurement. This usually means pressing the "tare" button or lever with an

empty weighing container on the pan, or the empty pan itself. This phrase is interchangeable with section 2.4, Tare.

3. **Interferences**

3.1 Drafts and dirt are the primary interferences for accurate weight measurements. Keep both to a minimum when weighing.

3.2 Weighing volatile liquids is also prone to inaccuracies due to evaporation. Speed is of the essence in this case. A set time for each measurement will give a more uniform procedure. For example, if weighing acetone into a vial, the weight will continually drop due to evaporation. If a time of say, 5 seconds, is given before the measurement is taken and the vial immediately sealed, for each measurement, the precision between multiple measurements will be good.

4. Safety

Refer to the Laboratory Chemical Hygiene Plan online revision.

5. Apparatus and Equipment

5.1 Mettler Toledo MS603TS/00 Balance ±0.01g.

5.2 Mettler Toledo XSR304 Balance ±0.0001g

5.3 Mettler AE200 Balance ±0.0001g

5.4 Set of certified ASTM UltraClass weights

6. **Reagents**

6.1 Not Applicable

7. Sample Collection

7.1 Not Applicable

8. Calibration

8.1 Calibration of a Balance will be made by a certified vendor, annually. If a balance is in immediate need of recalibration, follow the instruction in the owner's manual. If the balance can be proven, with UltraClass weights, to be accurate, it is available for use. However, a re-certification of the balance should be made as soon as possible by the vendor.

9. Quality Control

9.1 Use of UltraClass Weights: UltraClass weights are expensive and easily rendered useless with improper usage. NEVER touch UltraClass weights without gloves. The oils on your finger will cause an accumulation of dirt and change the mass of the weight, destroying its usefulness. If gloves are not used, you must use tongs provided when moving weights from the case to the balance pan. DO NOT DROP an UltraClass weight. It will also change the mass of the weight and render it useless.

9.2 Bracketing a weight amount – If a sample, standard, or other substance has a weight taken, it must be bracketed with two UltraClass weights, one less than

and one greater than the mass value. For example, if the average weight measured for sample is 50 grams and a standard is 2-5 grams, use 1 gram and a 100 gram UltraClass weight each day to validate calibration. Do Not Use a 50-gram UltraClass weight for 50-gram weighings. Always use a higher value to bracket.

9.3 Balance Leveling - All Balances will have a bubble (spirit) level attached to the base. These levels will have a circle slightly larger than the bubble etched in the window. Adjust the foot on each corner of the balance until the bubble is inside the circle. Optimally, it should not touch the edge of the circle but as long as the entirety of the bubble is within the circle it is considered "level". This sounds easy, but in reality it can be frustrating. The actions of a level are a mirror image of the tilt of the balance base. If you carefully raise the balance front or rear corners with your hands and tilt the base until the bubble is properly set, it gives you an idea of which foot to adjust up or down to level it. The Mettler Toledo XSR304 Balance has a digital, internal level. Follow the prompts on the screen to level the balance.

9.4 Balance Cleaning – Periodically, a balance pan should be cleaned. Unplug or turn off the balance. Gently lift the pan off the load cell. Never remove the pan if the balance is in weighing mode. Remove any dirt or debris under the pan, being careful not to let any fall in the internal parts of the balance. The top of the balance can be cleaned with a mild solvent such as methanol or propanol. Never use a harsh or abrasive cleaner on the stainless steel surface. If it is scratched to badly it will rust, and the oxide will transfer to a sample or UltraClass weight during use. Place the pan gently back of the load cell. Make sure that it does not touch anything such as a cover or part of the base. This will cause erroneous readings during use. Turn the balance back on (plug it back in) and wait 15 minutes for the balance to warm up and equilibrate.

9.5 Balance Placement – In order to have consistent weighings, a balance should be placed in a draft free environment. Unfortunately, this can be a problem when weighing hazardous material in a fume hood. If the balance has a draft box over the pan, the problem is less, as long as the doors are closed for each weighing. With an open pan balance, the only option is to be consistent when weighing. All balances have some type of indication that the weight is stable. It may be the appearance of a "g" next to the weight, a circle, or some other notation.

9.6 On a daily basis, when the laboratory is open, for the Mettler Toledo XSR304 and Mettler Toledo MS603TS/00, use the weights listed in Table 2 to validate the balance for that day. If a weight is out of tolerance and no problem with the balance is found, then the balance is red-tagged and a service call must be placed to repair the balance.

9.6.1 The Mettler AE200 will be kept on hand for use as a backup balance. It will be validated only on days used. When not in use, it will be red-tagged and stored in cabinet. Use the weights listed in Table 2 to validate the balance when in use. If a weight is out of tolerance and no problem with the balance is found, then the balance is red-tagged and a service call must be placed to repair the balance.

10. Procedure

10.1 Mettler Toledo MS603TS/00

10.1.1 The balance is turned on 24/7. If it is off, turn it on and let it warm up for 30 minutes. Weight range is 0.01g to 620 g.

10.1.2 To zero the balance pan press "0", when ready the display will read "0.00g."

10.1.3 To weigh an object place it on the pan and wait for the beep then record the number.

10.1.4 To tare a weighing container place the container on the balance pan, press "T" and wait for "0.00g" to appear.

10.1.4.1 Transfer the approximate amount of material into the weighing container and wait for the beep then record the number.

10.2 Mettler Toledo XSR304

10.2.1 The balance is turned on 24/7. If it is off, turn it on and let it warm up for 2 hours. Weight range is 0.1mg to 320g. Press the power button to wake the balance from standby. Press "0." The balance is now ready for use.

10.2.2 The balance pan is unstable if a circle to the left of the number's readout appears. The balance is displaying a true weight value if there is no circle to the right of the number's readout. The balance has a automatic draft doors on the left and right side. The top draft door is manual. Press the double arrow buttons on the left or right side of the display to open or close the corresponding door.

10.2.1 To zero the balance pan press "0", when it is finished it will display "0.0000".

10.2.2 To weigh an object press "0." Press the double arrow button to open the door. Place the object on the balance. Close the door. Wait for the balance to stabilize and then record the number.

10.2.3 To tare a weighing container, open the door and place the container on the balance. Close the door and press "T." The balance will display "0.0000".

10.2.3.1 Open the door then transfer the amount of material into the container then press the double arrow button to close the door. The readout will display the weight.

10.3 Mettler AE200

10.3.1 The balance is turned on 24/7. If it is off, turn it on and let it warm up for 30 minutes.

10.3.2 Press and hold the single control bar until –CAL- appears on the display, then release control bar. The display changes to CAL__, then to CAL100(blinks). Move calibration lever (on right side of balance) all the way to the rear; the display changes to CAL---, followed by 100.0000, then to CAL0(blinks). Move calibration lever all the way back towards the front of the balance: the display changes to ___, followed by 0.0000. (These will be referred to as Ready signs from now on).

10.3.3 To zero the balance, make sure the glass doors are closed, then press "re-zero." When ready, the display will read "0.0000."

10.3.4 To weigh an object, open the doors and place the object on the center of the balance pan. Close all of the doors. The balance will display the weight in grams.

10.3.5 To tare a weighing container, place the container on the balance, close all doors, and press “re-zero”. The balance will display “0.0000”.

10.3.6 Next, open door, transfer the amount of material into the container then close the door. The readout will display the weight.

10.3.7 Do not leave any container or other item on the balance pan. Over time it will corrupt the load cell.

11. Calculation

11.1 Not Applicable

12 References

12.1 Mettler Owners manual

Table 1

Balance Training Form

Analyst Name:

Date:

Person responsible for training:

Question	Yes	No	Comments
Has the analyst read the SOP?			
Does the analyst know where the balance calibration check log is stored?			
Does the analyst know where the ASTM UltraClass weight set is stored?			
Has the analyst demonstrated the proper handling of the UltraClass weight set?			
Has the analyst demonstrated leveling a balance?			
Has the analyst demonstrated the use of balance controls?			
Has the analyst demonstrated how to clean a dirty balance?			
Has the analyst demonstrated bracketing a measurement with two UltraClass weights?			

Analyst Signature:_____ **Date:** _____
Trainer's Signature:_____ **Date:** _____

Table 2
Balance SOP
Appendix 1
Balance Tolerance

Mettler Toledo XSR304	
UltraClass Weight, g	**Tolerance**
0.0200	**±0.0002**
0.1000	**±0.0002**
0.2000	**±0.0002**
0.5000	**±0.0005**
1.0000	**±0.0005**
5.0000	**±0.0005**
20.000	**±0.0010**
100.00	**±0.0010**
200.00	**±0.0010**

Mettler Toledo MS603TS/00	
UltraClass Weight, g	**Tolerance**
0.1	**±0.01**
0.2	**±0.01**
0.5	**±0.01**
1.0	**±0.01**
5.00	**±0.01**
20.0	**±0.02**
100	**±0.02**
200	**±0.02**

Mettler Model AE200	
UltraClass Weight, g	**Tolerance**
0.1	**±0.01**
0.2	**±0.01**
0.5	**±0.01**
1.0	**±0.01**
5.00	**±0.01**
20.0	**±0.02**
100	**±0.02**
200	**±0.02**

Georgia Department of Natural Resources
Environmental Protection Division

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Routine Standards Verification Form
(UltraClass Weights)

Lab. ID #: _____ **Balance ID#:** _____ **Weight Set Name**: _____

Analyst	Date	Level	0.0200 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	5.0000 g	20.0000 g	100.0000 g	200.0000 g