QC for Analytical Balances
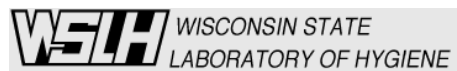
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Disclaimer

Suggested QC for Analytical Balances

- Calibrate balance daily if it is equipped with an on-board internal calibration feature
- Verify balance accuracy monthly with at least 2 external ASTM class 1 ("S") weights *(1 in mg range; 1 in the g range)*
- Record weight measurements, maintenance and corrective action in a logbook
- Have the Class 1 weights re-certified annually or before certificate expires
- Have balance serviced by a professional yearly

Suggested process for verifying analytical balance accuracy and performance

1. If using an electronic balance, allow to warm up for at least 60 minutes.
2. Dust off the balance pan with a clean soft brush. Use a mild detergent, DI water and lint free wipe if necessary.

3. Check the balance leveling gauge to make sure bubble is inside the target.

4. Perform the internal calibration process if the balance has an on-board calibration function.

5. Zero the balance by pressing the "tare" bar (or button)

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6. Place the first Class 1 weight on the clean balance pan with plastic forceps..

….allow the balance to stabilize

...measure and record the observed weight in the logbook.

7. Repeat step 6 with the other weights

20 gram (example 2)

1 gram (example 1)

8. Compare the observed weights to the acceptance ranges for the Class 1 weights. If any weight exceeds the acceptable range, ***discontinue using the balance and take corrective action.***

Suggested corrective action if balance fails the accuracy check

- Double check to make sure both the balance and weights are clean and that the balance is level.

- Re-check the Class 1 weight measurements

- Check an alternative weight set from another lab or plant

- Call a professional service technician

Tips for Handling Class 1 Weights

☞*ALWAYS* handle weight using a plastic forceps
provided with weights. *NEVER* touch the weights
with your hands.

ALWAYS

NEVER

Tips for Handling Class 1 Weights - *Continued*

NEVER use metal forceps; they will damage
the weights

NEVER store weights loose in a vial.

ALWAYS store weights in the box or vial with
the packaging provided.

ALWAYS have your weights re-certified before
they expire

NEVER place weights on a dirty balance pan

What do we mean by re-certifying the Class 1 weights?

- You will need to send your weight to a metrology lab to have them tested and re-certified <u>every 5 years</u>

- Several types of certifications are available: Mass Value and NVLAP are common certifications.
  - Mass value-less expensive and generally satisfactory
  - NVLAP-very expensive and detailed. Not generally necessary.

- Important and necessary components of weight certification include:
  - The certification must be NIST traceable
  - The conventional mass correction data must be included with the certificate

Where can I have my weight Certified?

- Many metrology labs can offer this service.

  - Be sure their certification is NIST traceable and the conventional mass correction data are included on the certificate.

- Rice Lake Weighing Systems* in Rice Lake, WI. and Troemner* in Thorofare, NJ offer Mass Value Certificates that are satisfactory.

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What Class 1 weights should I use to check
my balance in the <u>gram</u> range?

Consider how you are using the balance before selecting the appropriate weights. If you use the balance primarily for TSS, do you:

• Use Gooch crucibles? *(tare weights from 20-30 grams)*

      ✏ *Suggested weights: 20 g or 50 g*

• Use 47 mm filters in aluminum weighing pans? *(tare weights about 1 gram)*

     ✏ *Suggested weights: 1 g*

What Class 1 weights should I use to check my balance in the <u>milligram</u> range?

Again, consider how you are using the balance before selecting the appropriate weights.

• Do you weigh 47 mm filters directly? *(tare weights about 50-100 mg)*

      ✏ *Suggested weight: 50mg or 100 mg*

• Alternatively, consider what minimum amount of residue you must obtain (1mg) *(challenge yourself!)*

      ✏ *Suggested weight: 1 mg or 10 mg*

How do I determine what is an acceptable range for my Class 1 weights?

- The weight manufacturer should provide a certificate that includes the nominal weight, conventional mass correction (as found and as left the metrology lab) and some type of NIST traceable report.

- *DO NOT USE* the weight manufacturer's tolerances to evaluate your balance accuracy. The manufacturer's tolerance do not take into account:
  - Balance condition
  - Balance repeatability and readability
  - The uncertainty of the balance calibration.

So…what should be used for acceptable tolerances?

- Weight Manufacturers generally recommend a method for determining acceptable tolerances using a statistical approach based on replicate weight measurements on your balance.

- In the meantime establish some reasonable tolerances, *USE* them and *TAKE* corrective action if they are exceeded.

- Establish statistical tolerances as time permits

Reasonable Class 1 Tolerance Guidelines

- Use the following guidelines as a starting point for tolerances if statistical limits have not yet been established:

  ‣ $\pm$ 0.3 mg* for weights <10mg

  ‣ $\pm$ 0.5 mg for weights from 10mg to 100mg

  ‣ $\pm$ 1-2% for weights >100 mg

* Please note that those using EPA method 1664 (HEM) for oil and grease analysis must check a 2 mg weight daily and the observed value must be within 10% ($\pm$ 0.2 mg).

Example Balance Log

Date	Initials	Class 1 Weight	Measured Weight	Acceptable Range	Pass/Fail?	Corrective Action
7/5/01	RM	50 mg	49 mg	45-55 mg	Pass	
7/5/01	RM	1 gm	0.9994 gm	0.9995-1.0005 gm	Fail	Re-calibrated balance & repeated test below.
7/5/01	RM	1 gm	0.9997 gm	0.9995-1.0005 gm	Pass	Repeat OK
7/5/01	RM	20 gm	19.9985 gm	19.9980-20.0010 gm	Pass	

Determining Acceptance Ranges for Class 1 Weights Using a Statistical Approach

- Make 20 replicate measurements of the class 1 weight

- Spread measurements out over several non-consecutive days for best results

- Determine the mean and standard deviation

- The *upper acceptable range* = certified weight + 3 standard deviations

- The *lower acceptable range* = certified weight - 3 standard deviations

Example 1
Determining the Acceptable Range for a 100 mg (0.1000 gm) Class 1 Weight*

Item	Weight (grams)
Mean of 20 measurements	0.09999
Standard Deviation	0.000064
3 Standard Deviations	0.00019
Certified Weight	0.099998
Upper Acceptable Range	0.1002
Lower Acceptable Range	0.0998

***Balance readability of at least 0.0001 g**

Example 2
Determining the Acceptable Range for
a 1 gram Class 1 Weight*

Item	Weight (grams)
Mean of 20 measurements	1.00003
Standard Deviation	0.000047
3 Standard Deviations	0.000141
Certified Weight	1.000026
Upper Acceptable Range	1.0001
Lower Acceptable Range	0.9999

*Balance readability of at least 0.0001 g

Example 3
Determining the Acceptable Range for
a 50 gram Class 1 Weight*

Item	Weight (grams)
Mean of 20 measurements	50.0013
Standard Deviation	0.000057
3 Standard Deviations	0.000171
Certified Weight	50.00009
Upper Acceptable Range	50.0003
Lower Acceptable Range	49.9999

*Balance readability of at least 0.0001 g

Summary of Balance Accuracy Verification

☞ **Calibrate balance daily if it is equipped with an on-board internal calibration feature**

☞ **Check your balance accuracy monthly in the g and mg range**

☞ **Use certified class 1 ("S") weights**

☞ **Have balance serviced yearly**

☞ **Have weights re-certified every 5 years or before the expiration date**

Summary of Balance Accuracy Verification Continued

☞ **Determine the acceptance range using a statistical approach or use the reasonable tolerance guidelines**

☞ **Always record weight measurements, whether they passed or failed and corrective action in the logbook**

☞ ***NEVER* use a balance that fails the verification check!!**