Chapter 4: Technical Procedure for Balances

1. Purpose / Scope

This procedure provides direction for the calibration and use of balances (scales) in the Drug Chemistry Unit of the Wake County Bureau of Forensic Services.

2. Definitions

2.1. Calibration - Checking or adjusting (by comparison with a standard) the accuracy of a measuring instrument.
2.2. Quality control check - Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
2.3. Performance verification - The initial confirmation of the reliability of a previously or externally validated method or instrument.
2.4. Reference standard - Measurement standard designated for the calibration of other measurement standards (reference standards or equipment.)

3. Equipment and Materials

3.1. Equipment

3.1.1. A&D model HW-100KA1 digital platform scale
3.1.2. Mettler Toledo model XP205 balance
3.1.3. Mettler Toledo model XP6002S and XPE6002S balances
3.1.4. Laboratory environmental monitor - hygrometer, thermometer, NIST traceable
3.1.5. Balance draft shield
3.1.6. Marble slab/marble table

3.2. Materials

3.2.1. Paper, boxes, plastic bags, paper bags, metal pans or other weighing vessels

3.3. Reference Standards

3.3.1. NIST traceable reference standard weights: 10 mg, 100 mg, 1 g, 2 g, 20 g, 100 g, 200 g, 1 kg, 5 kg, 25 lb

4. Standards and Controls

4.1. A balance logbook shall be maintained on the shared drive. The balance logbook shall contain any non-routine measurements, comments, manufacturer's certificates, performance verification documentation and maintenance documentation.

4.2. Leave balances powered on.

4.3. When the balance has been placed out of service (e.g., maintenance, malfunction, leaving direct control of the Laboratory), a Monthly Quality Control Check must be successfully performed prior to placing the instrument back in service.

4.4. The Drug Chemist shall record any malfunctions or error messages in the balance log, notify the Drug Chemistry Technical Leader of any malfunctions or error messages and place the instrument out of service by marking the balance log "Out of Service."

4.5. The Drug Chemistry Technical Leader shall examine the effect(s), if any, of a malfunction or error message on analysis results and implement the Wake County Bureau of Forensic Services Laboratory Procedure for Corrective and Preventive Action as required.

4.6. Reference Standard Weights

4.6.1. A reference standard weight logbook shall be maintained on the shared drive. The reference standard weight logbook shall contain the calibration certificates demonstrating traceability to NIST.

4.6.2. Store reference standard weights in their manufacturer supplied storage container, if available, or other container in the Drug Chemistry Unit. Keep the container securely closed when not in use.

4.6.3. Use gloves, tweezers and / or weight handles to handle reference standard weights. Do not handle reference standard weights with bare hands. Ensure that all surfaces that reference standard weights may come in contact with are clean.

4.6.4. Reference standard weights shall be calibrated on a biennial basis by an approved vendor that meets the requirements specified by the accrediting body.

4.6.4.1. When reference standard weights are transported outside of the laboratory for calibration, they must be transported in their manufacturer supplied storage container, if available. If a manufacturer supplied storage container is not available, another container may be used. The container must be securely packaged to prevent damage.

4.6.4.2. Upon return to the laboratory the reference standard weight must be inspected for any damage. Clearly label any damaged reference standard weights "Out of Service" and notify the Drug Chemistry Technical Leader. Reference standard weights marked "Out of Service" shall not be used.

4.6.5. A list of reference standard weights, serial numbers and service/calibration due dates shall be maintained by the Drug Chemistry Unit Technical Leader on the shared drive in the Drug Chemistry Unit folder.

4.6.6. Certificates of calibration issued by the vendor must include the uncertainty and shall be maintained by the Drug Chemistry Unit Technical Leader in the Drug Chemistry Unit.

5. Calibrations

5.1. Calibration for all Drug Chemistry Unit balances shall be performed on an annual basis by an approved vendor that meets the requirements specified by the accrediting body.

5.2. Balances shall be labeled with the calibration due date of the next calibration. A list of balances, serial numbers and service/calibration due dates shall be maintained by the Drug Chemistry Unit Technical Leader on the shared drive in the Drug Chemistry Unit folder.

5.3. Certificates of calibration issued by the vendor must include the uncertainty and shall be maintained in the balance logbook on the shared drive.

6. Monthly QCC

6.1. The Drug Chemist shall perform a monthly QCC on each in service balance using reference standard weight(s).

6.2. If the balance is not level, follow manufacturer's recommendations for leveling.

6.3. For the Mettler Toledo balances, press the internal adjustment key and allow the balance to complete the internal adjustment function.

6.4. Zero the balance with nothing on the pan.

6.5. Place a reference standard weight on the pan.

6.6. Record the actual weight displayed.

6.7. If results are within the acceptable range listed for the model, the balance may be used for casework.

Mettler Toledo model # XP6002S and XPE6002S

Reference Standard Certified Weight	**Acceptable Range** (± 0.06 gram, Sensitivity Tolerance of the balance)
1000.00 and 100.00 grams	1099.94 – 1100.06 g
1000.00 grams	999.94 – 1000.06 g
200.00 grams	199.94 – 200.06 g
100.00 grams	99.94 – 100.06 g
20.00 grams	19.94 – 20.06 g
2.00 grams	1.94 – 2.06 g
1.00 gram	0.94 – 1.06 g
0.10 gram (100 mg)	0.04 – 0.16 g

Mettler Toledo model # XP205

Reference Standard Certified Weight	**Acceptable Range (± 0.00040 g, Sensitivity Tolerance of the balance**)
200.00000 grams	199.99960 – 200.00040 g
100.00000 grams	99.99960 – 100.00040 g

20.00000 grams	19.99960 – 20.00040 g
2.00000 grams	1.99960 – 2.00040 g
1.00000 gram	0.99960 – 1.00040 g
0.10000 gram	0.09960 - 0.10040 g
0.01000 gram (10 mg)	0.00960 – 0.01040 g

A&D model #HW-100KA1

Reference Standard Certified Weight	**Acceptable Range** (± two times repeatability of the balance)
5000 grams (11.02 lb)	10.98 – 11.06 lb
25 lb	24.96 – 25.04 lb

6.8. If the results are outside these parameters, the balance shall not be used until all necessary steps have been taken to bring the balance into compliance.

6.8.1. Steps may include cleaning, leveling, zeroing and performing the internal adjustment. If the problem cannot be corrected, clearly mark the balance logbook "Out of Service" and notify the Drug Chemistry Technical Leader. Service by an approved service contractor may need to be scheduled.

6.9. Record the results of the QCC and any action taken in the Balance QCC log on the shared drive.

7. Daily QCC

7.1. The Drug Chemist shall perform a daily QCC on each in service balance using a reference standard weight prior to use for casework each day.

7.1.1. Use a 2 g and a 1000 g weight for the Mettler Toledo XP6002S and XPE6002S. Use only the 25 lb weight for the AND HW-100KA1. Use only the 10 mg (0.01000 g) weight for the XP205.

8. Process Measurement Assurance (Balance Study)

8.1. Reference standard weights shall be maintained in the Drug Chemistry Unit for ongoing data collection on the weight determination process (Balance Study).

8.2. All in service balances should be included and all active chemists in the Drug Chemistry Unit must participate in data collection.

8.2.1. Data collection for common use balances (bulk balance and analytical balance) shall be collected on a rotating schedule to ensure all active chemist participate.

8.2.2. Data collection for balances used exclusively by an individual Drug Chemist need to only have data collected by that chemist.

8.3. Data collection should be conducted for a period of ten business days on an annual basis.

8.4. Data collection will be conducted in the morning and afternoon on each of the ten business days.

8.4.1. Measure and record the temperature and humidity at the balance (scale) location using a laboratory environmental monitor during the morning and afternoon weight collections.

8.5. A minimum of one reference standard weight will be used for each balance data collection.

8.5.1. Each reference standard weight will be weighed in triplicate during the morning and afternoon data collection.

8.6. Perform the balance study data collection measurements using tare vessels, as you would perform weighing in casework. (Example 1: Remove the tare vessel from the balance, place the reference standard weight on the tare vessel and return the tare vessel and reference standard weight to the balance together. Example 2: Place the reference standard weight directly on the tare vessel.) Tare vessels and reference standard weights are selected to mimic casework as closely as possible:

AND HW100KA1 scale:

Tare vessel: Cardboard box lined with a plastic or paper bag

Reference standard weight: 25 lb weight

Mettler XP205:

Tare vessel: Weigh paper or box

Reference standard weight: 20 g weight

Mettler XP6002S and XPE6002S:

Tare vessel: Rectangular metal pan or plastic bag

Reference standard weight: 1000 g weight

8.7. Record the measurements on the corresponding Balance Study Log located on the shared drive.

8.7.1. Evaluate the Balance Study measurements to ensure they fall within the acceptable ranges listed for the balance used.

8.7.1.1. If a balance study measurement is outside of the acceptable range, the measurement shall be repeated without a tare vessel and recorded in the Balance QCC log.

8.7.1.1.1. If the results are outside of the acceptable range listed for the balance, the balance shall not be used until all necessary steps have been taken to bring the balance into compliance.

8.7.1.1.2. Steps may include cleaning, leveling, zeroing and performing the internal adjustment. If the problem cannot be corrected, clearly mark the balance logbook "Out of Service" and notify the Drug Chemistry Technical Leader. Service by an approved service contractor may need to be scheduled.

9. Procedure

9.1. Record weights from the XP6002S and XPE6002S balances in grams to two decimal places. Record weights from the XP205 balance in grams to five decimal places. Record weights from the HW100KA1 balance in pounds to two decimal places.

9.1.1. For net weights of analyzed material use each balance only at or above the following minimum weights:

Balance	Readability	Minimum weight
XP205	0.00001 g	N/A

XP6002S and XPE6002S	0.01 g	N/A
AND HWK100KA1	0.02 lb	1.00 lb (0.45 kg)

9.1.2. Use each balance only at or below the following maximum weights:

Balance	Readability	Maximum Weight
XP205	0.00001 g	200 g
XP6002S and XPE6002S	0.01 g	1100 g
AND HWK100KA1	0.02 lb	220.46 lb (100 kg)

9.1.3. For net weights of material use the XP205 balance only at or below 20.00000 grams.

9.2. Ensure that the balance is level. Zero the balance and ensure that the balance displays zero to the appropriate number of decimal places.

9.3. Place the weighing vessel on the balance and allow the reading to stabilize. For the XP205 allow at least 10 seconds.

9.4. Tare the weighing vessel. Remove evidence from packaging material, if possible, and place in/on the tared vessel. If packaging is not removed record the weight as a gross weight in the case file. If packaging is removed record the weight as a net weight in the case file.

9.5. Record all digits displayed by the balance (to two decimal places for the XP6002S/XPE6002S and the A&D scale, to five decimal places for the XP205 balance) in the case file.

9.6. For the weight of the material to be returned, either replace the weighing vessel back on the undisturbed balance without taring or tare a new weighing vessel and transfer the evidence to the tared vessel.

9.7. Record all digits displayed by the balance in the case file.

10. Calculations

10.1. When conversion of units is needed, the following NIST Conversion factor shall be used and the result rounded:

1 pound = 0.45359237 kilograms

11. Reporting

11.1. Report the net weight, as recorded, along with the uncertainty of measurement, if applicable.

11.1.1. When the net weight to be reported was measured to two decimal places and is less than 0.10 g report the weight as *"less than 0.1 gram.*"

11.1.2. When the net weight to be reported was measured to five decimal places and is less than 0.01 g report the weight as "*less than 0.01 gram*."

11.2. When the numerical value is a gross weight report the gross weight without uncertainty of measurement.

11.3. When the weight to be reported is a sum of measured net weights, sum the uncertainty of measurement associated with each measured weight to determine the uncertainty of measurement to be included on the report.

12. Limitations

12.1. When a portion of the reference standard weights are unavailable for the Monthly QCC due to annual calibration, the remaining reference standard weights shall be used. When a portion of the reference standard weights are unavailable for the Daily QCC, use the next closest weight(s) available for each balance. Each weight must be weighed on the applicable balance prior to the reference standard weights becoming unavailable and be within the applicable Monthly QCC acceptable range. Each Daily and/or Monthly QCC performed while a portion of the reference standard weights are unavailable must be within the applicable Monthly QCC acceptable range.

13. Safety – NA

14. Records

14.1. AND Bulk Balance Logbook
14.2. XP205 Balance Logbook
14.3. XP6002S and XPE6002S Balance Logbook
14.4. Reference Standard Weights Logbook
14.5. Balance Study Logs

15. References

15.1. *Mettler Toledo B Balance Line Operating Instruction***s**, Mettler-Toledo, Switzerland, P11780194**.**

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15.3. Butcher, K.S, et al., ed. *The International System of Units (SI) – Conversion Factors for General Use*. National Institute of Standards and Technology, NIST Special Publication: U.S Department of Commerce, May 2006: 11.

15.4. *Mettler Toledo Excellence Plus Analytical Balances XP Models – Part 1*, 11781066, Mettler-Toledo, Switzerland, May 2012.

15.5. *Mettler Toledo Excellence Plus Precision Balances XP Models – Part 1*, 11781055, Mettler-Toledo, Switzerland, May 2012.

15.6. *Mettler Toledo Excellence Plus Balances XP Models – Part 2*, 11781077, Mettler-Toledo, Switzerland, October, 2010.

15.7. *Mettler Toledo Excellence Plus Balances XP Models – Part 3*, 11781338, Mettler-Toledo, Switzerland, October, 2010.

15.8. *Mettler Toledo Discharging Power Pack Operating Instructions,* Haug GmbH & Co. KG, D-032 V02, March 29, 2012.

15.9. *One Point Ionizer Operating Instructions,* Haug GmbH & Co. KG, D-0265, December 22, 2004.

15.10. *Guide for the Use of the International System of Units (SI).* NIST Special Publication 811, 2008 Ed., (March 2008; 2nd printing November 2008). pp. 43-44, 53.

15.11. *ASTM Standard E2587-12. "Standard Practice for Use of Control Charts in Statistical Process Control."* ASTM International: West Conshohocken, PA, 2009, www.astm.org.

15.12. *ASCLD/LAB Guidance on Measurement Traceability – Measurement Assurance,* ASCLD/LAB, AL-PD-3059 Ver 1.0

Document Revision History		
Revision Date	Prepared By	Revision
4/3/2023	L. Wiley	Revised wording (e,g., "measured" to "net") in 11.1 to clarify intent
7/10/2023	L. Wiley	3.1.4. Laboratory environmental monitor, removed barometer 6. Monthly QCC added "in service" to 6.1. 7. Daily QCC added "in service" to 7.1. 8.4.1. removed air pressure requirement
9/9/2024	L. Wiley	3.3. Reference Standards – updated to include 25 lb weight 4.6. Reference Standard Weights – updated 4.6.6. to biennial calibration 7.1. Daily QCC – updated to 25 lb weight 8. Process Measurement Assurance (Balance Study) – updated reference standard weight for bulk balance
11/6/2024	A. Abernethy	Document revised to reflect the agency name change from Raleigh/Wake City-County Bureau of Identification to Wake County Bureau of Forensic Services, effective December 1, 2024. No change to procedure content.