1.0 Purpose - This procedure specifies the required elements for the calibration and operation of electronic balances for use in casework, and for the yearly balance study used to collect data for the measurement assurance of weight determinations.

2.0 Scope – This procedure applies to electronic balances used in the Drug Chemistry and Blood Alcohol sections of the Pitt County Sheriff's Office Forensic Services Unit.

3.0 Definitions

- **Approved Vendor –** Supplier of a product or service that meets ISO/IEC 17025:2017 – Forensic Science Testing and Calibration Laboratories Accreditation Requirements
- **Calibration –** Checking or adjusting (by comparison with a standard) the accuracy of a measuring instrument. Calibrations are performed by approved vendors for all balances in the Pitt County Sheriff's Office Forensic Services Unit.
- **Calibration Verification (QC check) –** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
- **Performance Verification –** The initial confirmation of the reliability of a previously or externally validated method or instrument.
- **Primary Reference Standard Weight –** Reference standard weights which have documentation issued by an approved vendor authenticating the calibration status.
- **Reference Standard -** Measurement standard designated for the calibration of other measurement standards (reference standards or equipment)
- **Secondary Reference Standard Weight –** Reference standard weights, used in the course of casework, that have the calibration status verified by comparison to primary reference standard weights.

4.0 Equipment, Materials and Reagents

4.1 Equipment

- *Mettler* Electronic analytical balance - XS204-BAC only
- *Mettler* Electronic analytical balance - XS204DR
- *Mettler* Electronic table top balance - XS6002-S
- *Mettler* Electronic table top balance - XSR6002-S
- *Fisher* Electronic table top balance - Accu-2202
- *Ohaus* Electronic bulk scales - B300BX Base with T31P Indicator

4.2 Materials and Reagents

- Weighing paper and boats
- Plain paper, cardboard boxes, plastic bags, flasks or other appropriate weighing vessels
- Class 2 primary reference standard weights
- Class F primary reference standard weights (bulk scales only)
- Class 2 secondary reference standard weights (daily checks only)

5.0 Procedure

5.1 Standards and Controls

5.1.1 Primary Reference Standard Weights shall be used for monthly QC checks and for the balance study to determine the measurement assurance values for section balances. (See the Drug Chemistry Technical Procedure for Measurement Assurance.)

5.1.1.1 Class 2 primary reference standard weights shall be used for analytical and table top balances.

5.1.1.2 Class F primary reference standard weights shall be used for the bulk scales only.

5.1.1.3 Store primary reference standard weights in the Blood Alcohol (BAC) laboratory, in their manufacturer supplied storage container(s), if available. Keep the container(s) securely closed when not in use.

5.1.2 Secondary reference standard weights may be used for the one point daily QC checks.

5.1.2.1 The Forensic Scientist shall record the weights of the primary and secondary reference standard weights annually after the balance and primary weights have been calibrated by an approved vendor who meets the requirements of the accrediting body. Identifiers for the weights and balances used shall also be documented on data collection forms and stored in Document Management (DM).

5.1.2.2 A successful recheck will require the weights recorded for the secondary reference standard weights agree with expected values within the expanded uncertainty measurement as stated on the annual balance calibration certificate of the balance used.

5.1.2.3 Store secondary reference weights near the appropriate balance(s), in containers supplied by the Drug Chemistry Technical Leader. Keep the container(s) securely closed when not in use.

5.1.3 Use gloves or tweezers to handle primary and secondary reference standard weights. Do not handle primary or secondary reference standard weights with bare hands. Ensure that all surfaces that primary and secondary reference standard weights may come in contact with are clean.

5.1.4 Performance Verification of New Balances

5.1.4.1 All new balances shall be installed and leveled according to manufacturer's specifications prior to being used for casework.

5.1.4.2 All new balances shall be calibrated by an approved vendor who meets the requirements of the accrediting body prior to being used for casework. The certificate(s) of calibration shall be stored in DM.

5.1.4.3 Prior to being used for casework, data shall be collected according to the procedure for the yearly balance study (See **Balance Study** below). Values for the weights recorded shall be within the uncertainty of measurement value for the current year for the corresponding type of balance. Data collected shall be stored in DM.

5.2 Calibrations

5.2.1 All balances shall be calibrated yearly by an approved vendor who meets the requirements of the accrediting body.

5.2.2 Primary reference standard weights shall be calibrated yearly by an approved vendor who meets the requirements of the accrediting body.

5.2.3 Balance and primary reference standard weights calibration certificates shall be stored in DM.

5.3 Performance Verification (Daily QC Checks)

5.3.1 Daily, prior to each balance being used for casework, the Forensic Scientist(s) shall initiate the internal adjustment function (where applicable), and then perform a QC check using one reference standard weight (primary or secondary).

5.3.2 Tare vessels are not required for the daily QC check.

5.3.3 Acceptable ranges for reference standard weights used for daily QC checks shall be calculated by adding and subtracting the current values for Highest Expanded Uncertainty at 99.7 % Confidence Level for each model. (See the Measurement Assurance Yearly Report for current values.)

5.3.4 Record the use of the internal adjustment (where applicable), the results of the QC check, initials of the Forensic Scientist, and the identity of the reference standard weight used in the daily QC check log.

5.3.5 Daily QC check logs shall be archived yearly in DM.

5.4 Calibration Verification (Monthly QC Checks)

5.4.1 The Forensic Scientist shall perform a monthly QC check on all section balances using the primary reference standard weights and tare vessels listed below, according to the

model of the balance. Tare vessels and reference standard weights are selected to mimic casework as closely as possible.

5.4.1.1 *Mettler* XS204 (BAC use only)
Tare vessels: Not applicable
Primary reference standard weights: 0.01g, 0.02g, 0.05g, 0.1g, 0.5g, and 1 gram.

5.4.1.2 *Mettler* XS204DR (Calibrated for use in lower range ONLY)
Tare vessels: weigh paper or small weigh boat
Primary reference standard weights: 0.01g, 0.02g, 0.05g, 0.1g, 0.5g, and 1 gram.

5.4.1.3 *Mettler* XS6002S and XSR6002S, and *Fisher* Accu-2202
Tare vessels: weigh paper, weigh boat or plastic bag
0.1g, 1g, 2g, 5g, 10g, 20g, 50g, 100g, and 1000 gram primary reference standard weights.

5.4.1.4 *Ohaus* B300BX (Calibrated for use up to 30 kg ONLY)
Tare vessels: plastic bag (with or without cardboard box)
1kg, 2kg and 10 kilogram primary reference standard weights.

5.4.2 Ensure the balance is turned on, clean, level, and functioning properly.

5.4.3 Perform each weighing event using a tare vessel, as you would perform weighing in casework (See below).

5.4.4 Measure and record the temperature and relative humidity at the balance or bulk scales location using a laboratory environmental monitor.

5.4.5 Data from the monthly QC checks shall be recorded on a log, and archived yearly in DM.

5.4.6 Acceptable ranges for reference standard weights used for monthly QC checks shall be calculated by adding and subtracting the current values for Highest Expanded Uncertainty at 99.7 % Confidence Level for each model. (See the Measurement Assurance Yearly Report for current values.)

5.4.7 If results of the monthly and daily QC checks are within the current range for the model, the balance may be used for casework.

5.4.8 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.

5.4.8.1 The "internal adjustment" function may be used (where applicable) as needed to correct for temperature variations in the laboratory. A one point check (See **Daily**

QC Check above) shall be conducted following the internal adjustment to ensure the balance is functioning properly.

5.4.8.2 Steps may include cleaning, leveling, re-taring, or contacting an approved vendor who meets the requirements of the accrediting body.

5.5 Balance Study (Yearly Ten Day Measurement Assurance Data Collection)

5.5.1 The process to determine the uncertainty of measurement for balances (balance study) shall be conducted on a yearly basis for ten business days according to the procedure outlined below.

5.5.2 All balances being used for case analysis shall be included in the data collection.

5.5.3 If a Forensic Scientist is out of the office for a partial day or partial week during the data collection period, a substitute Forensic Scientist shall collect data on that individual's balance.

5.5.4 Perform the balance study data collection measurements using static weighing in conjunction with tare vessels, as you would perform weighing in casework. (See the **Calibration Verification (Monthly QC Checks)** section above regarding tare vessels and weights for each model of balance.)

5.5.5 During the ten day data collection the monthly QC check shall be performed at the start of each work day (see above), but shall be documented with the replicate weight determinations.

5.5.6 During the ten day data collection, in addition to the monthly QC check, each morning and afternoon three replicate weight determinations shall be obtained for at least two primary reference standard weights.

5.5.7 Record the values on a data collection sheet for the identified weight used for each balance.

5.5.8 Measure and record the temperature and relative humidity at the balance or bulk scales location using a laboratory environmental monitor during both the morning and afternoon weight collections.

5.6 Application of Procedure on Evidence

5.6.1 The user shall ensure the balance is turned on, clean, level and properly functioning before use each day it is used for casework.

5.6.2 Choose desired units of measure according to balance instructions.

5.6.3 Perform a daily QC Check using one secondary (or primary) reference standard weight. (See above for weights used based on model of balance). Tare vessels are not required.

5.6.4 The Drug Chemistry section uses static weighing for weighing of evidence and monthly QC checks:

- Tare the balance with a weighing vessel on the pan.
- Remove the tare vessel from the balance.
- Place the evidence (or reference standard weight) on the tare vessel and return the tare vessel and the evidence (or reference standard weight) to the balance together, and record the weight.

5.6.5 The BAC section uses dynamic weighing for monthly QC checks and weighing of control solutions:

5.6.5.1 For QC Checks:
- Tare the balance
- Place the reference standard weight directly on the balance and record the weight

5.6.5.2 For preparation of control solutions:
- Tare the balance with a weighing vessel on the pan
- Add reagent solution directly to a tared weighing vessel.

5.6.6 For the *Ohaus* bulk scales: Record weights from bulk scales in kilogram units only. Do not use the pound setting on the bulk scales. Do not use for weights above 30.00 kilograms, as this will exceed the calibrated range for this balance.

5.6.7 For initial and returned weights of suspected controlled substances, remove the evidence from the packaging material, if possible, and follow the procedure for static weighing (see above).

5.6.8 Gross weights of material received shall not be reported unless sample matrix prevents the complete removal of item packaging. (See below)

5.6.9 When a balance has been placed out of service (e.g., maintenance/calibration, or malfunction), correct operation shall be demonstrated by a successful monthly QC check prior to being returned to casework.

5.6.9.1 Forensic Scientists shall examine the effect(s), if any, of a malfunction on analysis results and implement the Procedure for Corrective Action as required.

5.7 Calculations

5.7.1 When a trafficking amount of Marijuana/Hemp is reported for a single item of evidence, the weight shall be reported in grams or kilograms with the appropriate uncertainty of measurement, and converted to pounds since the NC General Statutes are written with threshold levels of pounds.

5.7.2 When an estimated weight is needed, based on a hypergeometric sampling, the "ENFSI DWG Calculator for Qualitative Sampling of Seized Drugs" may be used. This Excel based document may be found in DM.

5.7.3 When conversion of grams or kilograms to pounds is needed, the following NIST conversion factors shall be used as needed:

1000 grams = 1 kilogram
1 pound = 0.45359237 kilograms

5.7.4 Truncate the value for pounds to the tenths of a decimal place and report original weight and uncertainty of measurement information in grams or kilograms.

Examples:

Item 1

Plant material belonging to the genus *Cannabis* containing Tetrahydrocannabinol (THC) and Cannabidiol (CBD).
Concentration of cannabinoid(s) not determined.
Net weight of material – 23.720 (+/- 0.XXX) kilograms (confidence level 99.7%). (52.2 pounds)

Item 1
1a) Three plastic bags
Plant material belonging to the genus *Cannabis* containing Tetrahydrocannabinol (THC) and Cannabidiol (CBD).
Concentration of cannabinoid(s) not determined.
Net weight of material – 2,216.31 (+/- 0.0X) grams (confidence level 99.7%).
1b) Four paper bags
Plant material belonging to the genus *Cannabis* containing Tetrahydrocannabinol (THC) and Cannabidiol (CBD).
Concentration of cannabinoid(s) not determined.
Net weight of material – 2,385.05 (+/- 0.0X) grams (confidence level 99.7%).
Total weight of all material analyzed for Item 1 = 10.1 pounds.

6.0 Reporting

6.1 When net weights are reported, the following shall be included on the report:

6.1.1 A notation that a net weight is being reported.

6.1.2 All digits displayed on the balance.

6.1.3 The corresponding calculated uncertainty of measurement for that measurement reported to the same number of decimal places as the readability of the balance used, and a statement of the level of confidence.

Example: Cocaine – Schedule II
Net Weight of Material – 1.25 (+/- 0.0X) gram(s) (confidence level 99.7%).
(See the Measurement Assurance Yearly Report for current values.)

6.2 Gross weights may be recorded as needed in case notes.

6.3 When only a gross weight can be obtained due to sample matrix, the following shall be included on the report:

6.3.1 A notation that a gross weight of contents and packaging is being reported.

6.3.2 The truncated value for the digits displayed on the balance.

6.3.3 No measurement assurance values (calculated or reported).

6.3.4 Example for sticky black substance wrapped in plastic:

Item 1:
Material containing Heroin – Schedule I.
Gross weight of contents and packaging – 1.2 grams.

6.4 The notation "Net weight of material - Less than 0.1 gram" is required to report all recordable weights less than 0.1 gram when a bench top balance or analytical balance is used to obtain the weight. Uncertainty of measurement does not apply in this situation.

6.4.1 When the net weight of a single pharmaceutical unit is less than 0.1 gram, it is acceptable to record an actual weight less than 0.1 gram in the casefile, and report the results as "Net weight of (tablet, etc.) – Less than 0.1 gram." Uncertainty of measurement shall not be reported.

6.4.2 When pharmaceutical tablets other than opiate preparations and amphetamine are identified, reporting of the net weight is not required.

6.5 An amount of material which does not register on a bench top balance, or an amount that cannot be readily removed from the container in which it was submitted may be reported as a residue.

7.0 Limitations

7.1 The bulk scales are calibrated yearly only up to a 30 kilogram capacity.

7.1.1 The bulk scales shall not be used to weigh any single item that weighs more than 30 kilograms.

7.1.2 A notice shall be posted near the bulk scales stating the range for which the scales have been calibrated and certified for use.

7.2 The *Mettler* XS204DR analytical balance is equipped with dual ranges. It shall have an uncertainty of measurement calculated for the lower range only. The upper range shall not be used for reported weights.

7.3 The analytical balance shall be used for weight determinations of material when hypergeometric or threshold sampling applies, AND the amount of material present in each unit prohibits reporting of measurement uncertainty if a bench top balance were used.

8.0 Safety – Make sure balance is plugged in and is not near a source of water.

9.0 References

Operator manuals for each balance model.

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.

Moffat, A.C., et al., eds. *Clarke's Isolation and Identification of Drugs.* 2nd Edition. London: Pharmaceutical Press, 1986.

Virginia Department of Forensic Sciences. Controlled Substances Procedure Manual. Document 221-D100 Revision 7, February 6, 2012.

10.0 Records

- Certificates of calibration for balances in DM
- Certificates of recertification for primary reference standard weights in DM
- Annual secondary reference standard weights recheck reports in DM
- Daily one point QC checks in logs near balances, archived yearly in DM
- Monthly QC checks in DM
- Balance study data (current year) in DM

- Measurement Assurance Yearly Report in DM

REVISION HISTORY		
CURRENT VERSION	**EFFECTIVE DATE**	**SUMMARY OF CHANGES**
1	2017/11/14	Original Document.
2	2018/04/01	**Header** – Added "Drug Chemistry" **Entire document** – Updated "Illicit Drugs" to "Drug Chemistry" sections
3	2018/10/22	**Definitions –** Added primary and secondary reference standard weights. **Equipment** – Added new balance currently on order. **Materials and Reagents** – Clarified primary and secondary reference standard weights. **5.2.1 –** Clarified which reference standard weights would be calibrated yearly by an approved vendor. **5.2.2 and 5.2.3** – Added recertification for primary and secondary reference standard weights. **5.3.1** – Clarified where QC check data is stored. **5.3.1.2** – Added new balance. **5.5.3 and 6.1.3** – Added confidence level to results examples.
4	2019/10/17	**Purpose** – Clarified. **Definitions** – Added approved vendor **4.1** – Clarified equipment **4.2** – Clarified weighing vessels and reference standard weights **5.1** – Added descriptions and use of primary and secondary reference standards. Added secondary reference recheck requirements to this section. **5.1.4.2** Reworded calibration requirements **5.1.4.3** – Clarified requirements for verification of new balances **5.2** – Reworded calibration requirements **5.3** – Moved procedure for Daily QC checks to this section **5.4** – Clarified procedure for Monthly QC Checks, added use of tare vessels, recording of temperature/relative humidity, and edited list of primary reference standard weights for each model. **5.5** – Added instructions for yearly balance study **5.6** – Clarified use of static weighing (Drug Chemistry) and dynamic weighing (BAC) with tare vessels. Included bulk scale instructions on use of gross weights, and out of service procedures. **5.7** – Added use of "ENFSI DWG Calculator for Qualitative Sampling of Seized Drugs" for estimated weights. **Original 6.4** "Uncertainty of Measurement" – Moved to

		Technical Procedure for Measurement Assurance **Records** – Clarified list
5	2020/01/15	**5.7** - Updated to match results wording for the new Technical Procedure for the Identification of Plant Material.