**Raleigh/Wake City-County**

**Bureau of Identification**

**Crime Laboratory Division**

**Drug Chemistry Unit**

**DRUG CHEMISTRY TECHNICAL PROCEDURES**



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# 1: Technical Procedures for Drug Chemistry Analysis

1. **Purpose/Scope -** This procedure provides direction for analysis for controlled substances in the Raleigh/Wake City-County Bureau of Identification. It includes the analysis schemes, sampling procedures, minimum requirements for identification and reporting of controlled substances.
2. **Definitions**
   1. **Sample Selection -** A practice of selecting items to test, or portions of items to test, based on training, experience and competence. In sample selection, there is no assumption about homogeneity.
   2. **Sampling Procedure -** A defined procedure used to collect a sample or samples from the larger whole, to ensure that the value obtained in the analysis is representative of the whole. The sampling procedure may include details about size and number of sample(s) to be collected, locations from which to collect the sample(s), and a method to ensure the homogeneity of the larger whole (or to make it so.)
   3. **Sampling -** Taking a part of a substance, material or product for testing in order to reach a conclusion, make an inference about, and report on the whole. Sampling should only be used when there is a reasonable assumption of homogeneity of the whole.
   4. **Sampling Plan** - For an item that consists of a multi-unit population (e.g., tablets, baggies, bindles), a sampling plan is a statistically valid approach to determine the number of sub-items that must be tested in order to make an inference about the whole population.
   5. **Administrative Sample Selection** - A sample selection method used for all multi-unit items containing pharmaceutical preparations without indications of tampering. This sample selection method is also used for multi-unit non-pharmaceutical items when a threshold does not apply. No inferences about unanalyzed material are made.
   6. **Threshold Sample Selection** - A sample selection method used when the material, dosage units or tablets present in a submission meet a threshold and the individual analysis of the packages, units or tablets is practicable. The practicability of analysis is determined by the analyzing Drug Chemist based on their training and experience. No inferences about unanalyzed material are made.
   7. **Hypergeometric Sampling Plan -** A statistically-based sampling plan that allows analysis of a portion of a population and a statistical inference about the whole population stating that the material was analyzed with a statistical sampling plan that demonstrates with 95 % confidence that at least 90 % of the material contains the identified controlled substance(s). The hypergeometric sampling plan is used when there are ten or more packages, units or tablets and the threshold sampling plan is not practicable. The practicability of analysis is determined by the analyzing Drug Chemist based on their training and experience.
   8. **Population -** A carefully inspected group of packages, units or tablets found to be homogenous.
   9. **Chemical Analogue -** a chemical substance that has a similar chemicalstructure to another chemical substance, but differs in chemical composition by addition, replacement, rearrangement, and/or deletion of functional group(s) while maintaining a common backbone structure**.**
3. **Abbreviations**
   1. Common chemical terminology and unit abbreviations may be used
   2. approx or apx - approximately
   3. bicarb - sodium bicarbonate
   4. coc - cocaine
   5. conc - concentration or concentrated
   6. or c/- containing
   7. d - dated
   8. diff - difference
   9. ext - extract / extraction
   10. GCMS, GC-MS, or GC/MS - gas chromatography–mass spectrometry
   11. gpm - green plant material
   12. hs - heat sealed
   13. hex - hexane
   14. IR - infrared spectroscopy
   15. i - initialed
   16. init - initial
   17. Iso - isothermal
   18. k - knotted
   19. LTC - labeled to contain
   20. lg - large
   21. Macro - Macroscopic
   22. mat’l - material
   23. me - manila envelope
   24. med - medium
   25. Meth - methamphetamine
   26. Micro - Microscopic
   27. MS - Mass spectrometer/spectrum
   28. NIST - National Institute of Standards and Technology
   29. NQCC - negative quality control check
   30. NCS - no controlled substances
   31. NSR - no significant reaction
   32. ow - off-white
   33. owhm **-** off-white hard material
   34. owm - off-white material
   35. owp - off-white powder
   36. pg - page
   37. pm - plant material
   38. pb - plastic bag
   39. pbc - plastic bag corner
   40. pos - positive
   41. PQCC - positive quality control check
   42. prelim(s) - preliminary testing(s)
   43. QCC - quality control check
   44. rgt - reagent
   45. rec’d - received
   46. ref - reference
   47. ret’d - returned
   48. RT - retention time
   49. Seb - sealed evidence bag
   50. sch - schedule
   51. SCRN - Screen
   52. s - sealed
   53. sm - small
   54. std(s) - standard(s)
   55. STR - straight
   56. sub - subtract
   57. tab(s) - tablet(s)
   58. tp - tan powder
   59. TIC - Total Ion Chromatogram
   60. temp - temperature
   61. tran(s) - transfer(s)
   62. u - unsealed
   63. vs - vacuum sealed
   64. wt - weight
   65. we - white envelope
   66. wp - white powder
   67. w/ or - with
   68. zpb - ziploc plastic bag
4. **Equipment, Materials and Reagents**
   1. Refer to the Drug Chemistry Unit Technical Procedures
5. **Procedure**
   1. Laboratory facilities are subjected to environmental monitoring, refer to the Drug Chemistry Unit Technical Procedure for General Laboratory Equipment.
   2. The analyzing Drug Chemist shall have this procedure readily available at the location of any sampling.
   3. Use good laboratory practices at all times to maintain evidence integrity and minimize the risk of cross contamination.
      1. Material from individual packages, units or tablets shall not be combined.
      2. Have only one item of evidence open for analysis at a time.
      3. Remove evidence to be weighed from its packaging and return it to its packaging as close as practicable to the balance in use.
      4. Handle evidence carefully to minimize the risk of loss, contamination of other evidence and contamination of the work area.
         1. Change gloves and / or wash hands between evidence items.
         2. Ensure that the work area is clean prior to opening an evidence item and after analysis of each evidence item.
      5. If any evidence is spilled or dropped, immediately check the evidence to ensure that all material / units are present.
         1. Record the occurrence in the case file.
         2. Clean the area thoroughly to ensure that contamination of other evidence and the work area does not occur.
      6. Maintain materials used in analysis that come in direct contact with evidence in closed boxes, cabinets or drawers. These materials include but are not limited to weigh papers, pipettes, test tubes, vials, beakers, microscope slides, autosampler vials and caps.
      7. Drug Chemists are responsible for laboratory housekeeping which ensures a clean and safe working environment.
         1. Refer to the Health and Safety Manual and the included Chemical Hygiene Plan.
         2. Label all extraction vessels with identifying information such as case number / item number and dispose of the contents and the vessels properly prior to the end of each workday.

* + - 1. Keep the laboratory work benches, fume hoods and floors free of all items unnecessary for analysis activities at all times.
      2. Perform cleaning as needed to ensure that dust and debris do not accumulate and items unnecessary for analysis are removed. The floors, fume hoods and laboratory work benches should be visibly free from dust and debris at all times.
  1. Label analyzed individual packages, units or tablets and data generated to ensure that analysis data can be matched with the material it represents.
  2. Record notes which will allow another Drug Chemist to repeat the analysis under conditions as close as possible to the original, evaluate the data, interpret the results, and form an independent conclusion.
  3. Observations, data and calculations shall be recorded at the time they are made.
     1. Note all examinations and results on a Drug Chemistry worksheet form.
     2. The CCBI Additional Notes form may be used if additional space is needed.
     3. Use the Drug Chemistry Hypergeometric Weight Estimation Worksheet form when Hypergeometric Sampling is used and the weight of a population is estimated.
     4. The Drug Chemistry Summed Weight Worksheet form may be used when multiple weights are added for reporting.
  4. Prior to examination, ensure that the OSSI RMS entry is accurate. Notify the Quality Manager of any discrepancies.
  5. Record a complete description of the evidence received for each submission. Include a description of the material, number of units or dosage units (including any blotter paper perforations), all packaging, condition of seals, and submitting agency item numbers.
     1. If a threshold applies to the number of units, have another individual independently verify the count and record the verification in the case file. (i.e. – more than 100 dosage units of a Schedule II, III, or IV, or dosage units associated with Hypergeometric Sampling when an estimated weight is used.)
     2. Evaluate the evidence received against the submission form. If a discrepancy occurs, refer to the Crime Laboratory Administrative Procedure Manual for Evidence Handling and Review of Requests, Tenders and Contracts for Laboratory Services.
        1. When an individual with evidence in their immediate custody leaves the work area during the workday for a short time (e.g., restroom break, meal break) the evidence in the work area must be secured by locking it in a locked cabinet in the work area.
        2. When evidence is to be left unattended for an extended period (i.e., longer than a meal break) the evidence must be secured by returning it to the unit secure area for evidence storage, room C1398.
        3. When the work area is to be left unattended it must be secured by locking the hallway door for room C1399. Additionally, the door for room C1401 must be locked when the work area is to be left unattended.
        4. The hallway door for room C1400 must remain locked at all times.
  6. Evaluate submissions containing multiple items and/or multiple types of material in a single item (sub-items) to determine which items to analyze. At a minimum evaluate the submission and information received or contained in the submission, the type of charge, the location found, the possibility of elevated charges if multiple items are analyzed and the nature of the item (biohazard, sharps hazard, amount of material present.) If necessary, record information from the submission on the Drug Chemistry worksheet.
     1. Typically, do not analyze residues if another item in the submission has been found to contain a controlled substance that is the same or higher schedule than suspected in the residue.
     2. Typically, do not analyze more than two items from the same schedule or suspected schedule for each subject or group of subjects unless the analysis of additional items will shift the charge from a misdemeanor to a felony or to a trafficking charge.
     3. Typically, do not analyze misdemeanor items in felony cases.
     4. Do not analyze residues on US currency or stomach contents.
     5. Do not analyze syringes with attached needles unless accompanied by a specific communication (letter, email, phone call, etc.) from the District Attorney.
  7. Evaluate the number of packages, units or tablets present in an exhibit carefully. If an item to be analyzed contains multiple units other than residues (whether from pipes, baggies, scales, razors, etc.), partially consumed hand-rolled cigarettes or material packaged such that it is impracticable to separate (for analysis purposes, each intact piece of blotter paper is a unit) determine the population. If the item to be analyzed contains a residue or a single package, unit or tablet, proceed to 5.16.
     1. **Population Determination**
        1. Visually inspect each of the packages, units or tablets in the exhibit carefully as well as any contents for uniformity of size, weight, color, packaging, markings, labeling, indications of tampering and other characteristics.
        2. If after careful visual inspection it is determined that the packages, units or tablets are uniform, the population shall consist of all of the packages, units or tablets.
        3. If there are differences, segregate the packages, units or tablets into individual groups, based upon such observed differences. Analyze each group as separate populations.
        4. If in the course of analysis it becomes apparent that the population is not uniform, new populations may be formed based upon individual chemical test results. For hypergeometric sampling, samples which are no longer available for indiscriminate selection may not be considered a part of the new population.
        5. If no groups can be formed based upon visual examination, then sampling shall not be performed, proceed to 5.16.
  8. If the population contains pharmaceutical preparations without indications of tampering, Administrative Sample Selection shall be utilized.
  9. If the amount of material, dosage units or tablets present does not meet a threshold, Administrative Sample Selection shall be utilized.
  10. If there is material, dosage units or tablets present in a population to meet a threshold and the individual analysis of the packages, dosage units or tablets is practicable, Threshold Sample Selection shall be utilized.
  11. If there is material, dosage units or tablets present in a population to meet a threshold and the individual analysis of the packages, dosage units or tablets is not practicable, then the Hypergeometric Sampling Plan shall be utilized.
  12. Record the sample selection method or sampling plan utilized on the Drug Chemistry worksheet form being used.
      1. **Administrative Sample Selection**
         1. **Pharmaceutical Preparations – Initial Submissions, Non-felony/trafficking**
            1. If the physical characteristics do not indicate tampering, sample selection and a chemical analysis are not required.
         2. **Pharmaceutical Preparations – Resubmission or Felony/Trafficking Chemical Analysis**
            1. If the physical characteristics indicate a controlled substance with no indications of tampering, the complete analysis of one indiscriminately selected unit is required. If the physical characteristics indicate a non-controlled substance, sample selection and chemical analysis are not required.
            2. For preparations that are weighed, separate weights shall be recorded for the analyzed portion and the unanalyzed portion.
         3. **Non-pharmaceutical Exhibits**
            1. Analyze a single package, unit or tablet.

In the event that the analysis of the single package, unit or tablet identifies a controlled substance, no further analysis is required.

In the event that the analysis of the single package, unit or tablet does not identify a controlled substance, preliminary testing selected to screen for controlled substances shall be performed on two (or on one for populations consisting of only two) packages, units or tablets. If the preliminary testing indicates the presence of a controlled substance, complete analysis of that package, unit or tablet is required. If the preliminary testing does not indicate the presence of a controlled substance, no further analysis is required.

* + - * 1. For weighed material, weights shall be recorded for the analyzed portion of the population.
        2. Net weight(s), gross weight(s) or an estimated weight shall be utilized for the unanalyzed portion of the population if a threshold applies.

If no threshold applies, then a weight is not required for the unanalyzed portion of the population.

An estimated weight may only be used when the packaging in the population is uniform.

Estimated weight shall be calculated using the gross weight, the number of units, and the weight of an empty package.

* + 1. **Threshold Sample Selection** 
       1. Refer to State and Federal Laws for thresholds.
       2. Perform separate and complete analysis of the number of packages, dosage units or tablets to satisfy the threshold. The net weight minus any uncertainty of measurement should exceed the threshold when possible.
       3. For weighed material, weights shall be recorded for the analyzed portion of the population.
       4. Net weight(s), gross weight(s) or an estimated weight shall be utilized for the unanalyzed portion of the population if an additional threshold applies.
       5. If no additional threshold applies, then a weight is not required for the unanalyzed portion of the population.
       6. An estimated weight may only be used when the packaging in the population is uniform.
          1. Estimated weight shall be calculated using the gross weight, the number of units, and the weight of an empty package.
    2. **Hypergeometric Sampling Plan**
       1. Perform separate and complete analysis of the number of indiscriminately selected packages, dosage units or tablets as determined from the table below.
          1. The selection of samples shall be conducted in a manner that prevents the Drug Chemist from consciously selecting a specific unit from the population.

| **Population Size** | **Samples** |
| --- | --- |
| 10-11 | 8 |
| 12-13 | 9 |
| 14-15 | 10 |
| 16-17 | 11 |
| 18-20 | 12 |
| 21-23 | 13 |
| 24-26 | 14 |
| 27-30 | 15 |
| 31-34 | 16 |
| 35-39 | 17 |
| 40-45 | 18 |
| 46-52 | 19 |
| 53-61 | 20 |
| 62-73 | 21 |
| 74-88 | 22 |
| 89-108 | 23 |
| 109-138 | 24 |
| 139-184 | 25 |
| 185-270 | 26 |
| 271-474 | 27 |
| 475-1619 | 28 |
| 1620-10000 | 29 |

* + - 1. To report results with the Hypergeometric sampling plan, the results of analysis to be reported for each individually analyzed unit of a population must be identical and identify the presence of a controlled substance. If non-identical or “no controlled substances” results are obtained, abandon the hypergeometric sampling plan and follow administrative or threshold sample selection if practicable.
      2. For weighed material, weights shall be recorded for the analyzed portion and the of the population.
      3. Net weight(s), or an estimated weight shall be utilized for the unanalyzed portion of the population if a threshold applies**.**
      4. To satisfy a weight threshold that is not met by the weight of the analyzed portion, obtain a net weight or individual net weight(s) of enough additional indiscriminately chosen samples to meet the weight threshold, if practicable. The net weight minus any uncertainty of measurement should exceed the threshold when possible.
         1. When the analyzing Drug Chemist determines, based on their training and experience, that it is impracticable to obtain the weight of the required number of individual weights to satisfy a weight threshold, the weight of the population shall be estimated at 95% confidence.
         2. The Student-t distribution is used to estimate the total weight of the population with a confidence of 95%.

When n/N is greater than 0.1 calculate the estimated total weight as follows using the student-t distribution table below to find the value of tα. Record the values of n/N, N and .

Where:

W = estimated total weight at 95 % confidence

N = number of units in the population

= average weight of the samples (sum of sample weights / n)

*x* = individual sample weights

n = number of samples

s = standard deviation of the weights of the samples =

tα = the solving value of the Student-t distribution with degrees of freedom*, df* = n-1 within the confidence coefficient α, see table below for values when α = 0.05, confidence = 100%(1 – α) = 95%

When n/N is less than 0.1 calculate the estimated total weight as follows using the student-t distribution table below to find the value of tα. Record the values of n/N, N and .

Where:

W = estimated total weight at 95 % confidence

N = number of units in the population

= average weight of the samples (sum of sample weights / n)

*x* = individual sample weights

n = number of samples

s = standard deviation of the weights of the samples =

tα = the solving value of the Student-t distribution with degrees of freedom*, df* = n-1 within the confidence coefficient α, see table below for values when α = 0.05, confidence = 100%(1 – α) = 95%

|  |  |
| --- | --- |
| **Student-t Distribution** | |
| (tα values for given degrees of freedom, *df*, with threshold index, α**,** of 0.05) | |
| ***df* = degrees of freedom = n-1** | **tα** (when α = 0.05) |
| 9 | 2.262 |
| 10 | 2.228 |
| 11 | 2.201 |
| 12 | 2.179 |
| 13 | 2.160 |
| 14 | 2.145 |
| 15 | 2.131 |
| 16 | 2.120 |
| 17 | 2.110 |
| 18 | 2.101 |
| 19 | 2.093 |
| 20 | 2.086 |
| 21 | 2.080 |
| 22 | 2.074 |
| 23 | 2.069 |
| 24 | 2.064 |
| 25 | 2.060 |
| 26 | 2.056 |
| 27 | 2.052 |
| 28 | 2.048 |

* 1. Based upon training and experience, determine the most appropriate analysis scheme of the four general analytical schemes for each unit to be analyzed.Perform analyses using only current CCBI Drug Chemistry Unit Technical Procedures.
     1. Sample size or other circumstances may require a rearrangement or modification of one or more steps of the analytical schemes.
     2. Use the analytical scheme for general unknowns when a submission is determined by the Drug Chemist to require specialized analysis.

**Pharmaceutical Preparation Analysis Scheme**

Physical Examination of Drug Form

Pharmaceutical Preparation

Tampering Visually Indicated No Visual Indications of Tampering

Proceed to Analysis Scheme for Pharmaceutical Identifiers

General Unknowns / Powders

Initial Submission Resubmission or felony/trafficking Chemical Analysis

Report Controlled

Single unit Multiple units

Sample Selection

Weigh, if applicable

Extraction, if needed

(Refer to Unit Technical Procedures)

IR and/or MS/GC-MS

Report

**Residue/Liquids Analysis Scheme**

Physical Examination of Drug Form

Residue/Liquid

Obtain portion for analysis

(Physically remove or solvent wash – refer to Unit Technical Procedures)

Color Tests and/or Microcrystalline Tests

Extraction, if needed (refer to Unit Technical Procedures)

IR and/or MS/GC-MS

Report

**General Unknowns/Powders Analysis Scheme**

Physical Examination of Drug Form

General Unknowns/Powders/Clandestine Tablets

Single Unit or Sample Selection/Sampling, then for each unit

Weigh if applicable

Obtain portion for analysis

Color Tests and/or Microcrystalline Tests

Extraction, if needed (refer to Unit Technical Procedures)

IR and/or MS/GC-MS

Report

**Cannabis Plant Material and Extracts Analysis Scheme**

Physical Examination of Drug Form

Single Unit or Sample Selection/Sampling, then for each unit

Weigh if applicable

Obtain portion for analysis

Record gross morphological (if applicable) and

microscopic (if applicable) examination

Duquenois-Levine Color Test

Extraction, if needed

GC-MS

Report

* 1. **Minimum Requirements for Identification** 
     1. Analytical techniques are listed in order of decreasing discriminatory power from

Category A to C:

|  |  |  |
| --- | --- | --- |
| **Category A** | **Category B** | **Category C** |
| Infrared Spectroscopy | Gas Chromatography | Color Tests |
| Mass Spectroscopy | Cannabis Only:  Macroscopic Examination  Microscopic Examination  (Counts as one each) | Microcrystalline Tests  (Used in conjunction with a Category A Test) |
|  | Pharmaceutical Identifiers |  |
|  |  |  |

* + 1. When a Category A technique is incorporated into an analytical scheme, then at least one other technique (from either Category A, B, or C) shall be used for identification of a controlled substance.
       1. This combination shall identify the specific drug(s) present, preclude a false positive identification and minimize false negatives.
       2. When sufficient material is present, the second technique shall be applied on a separate portion of material. When the amount of material present prohibits an additional portion from being obtained hyphenated techniques (gas chromatography – mass spectrometry) may be considered as separate techniques.
       3. All Category A techniques shall have reviewable data.
    2. When a Category A technique is not used, then at least three different techniques shall be used for identification of a controlled substance.
       1. This combination shall identify the specific drug(s) present, preclude a false positive identification and minimize false negatives.
       2. Two of the three methods shall be based on uncorrelated techniques from Category B that have reviewable data.
       3. A minimum of two separate portions for analysis shall be used in these three tests.
    3. Reviewable data includes:
       1. Printed spectra, chromatograms, and digital images.
       2. Reference to published data for pharmaceutical identifiers.
       3. Descriptions of microcrystalline test results, if used in conjunction with aCategory A Test.
       4. For cannabis and botanical materials only: recording of detailed descriptions of morphological characteristics. Refer to the Drug Chemistry Unit Technical Procedure for the Identification of Cannabis Plant Material and Extracts for descriptions used in conjunction with the Drug Chemistry Worksheet.
    4. For the use of any method to be considered of value in the identification of the controlled substance, the test shall be considered positive. While negative tests provide useful information for ruling out the presence of a particular drug or drug class, these results have no value toward establishing the positive identification of a drug.
    5. Macroscopic and microscopic examination of cannabis shall be considered as two separate Category B techniques when observations include documented botanical features as described in the Drug Chemistry Unit Technical Procedure for Identification of Cannabis Plant Material and Extracts.
    6. For Cannabis related exhibits that lack observable macroscopic and microscopic botanical detail, i.e., extracts and residues, any controlled substances shall be identified utilizing the principles in **5.17.2** or **5.17.3** set forth in this procedure.
  1. **Analytical Techniques**
     1. **Color tests** may be used to screen for the presence of controlled substances or aid in the identification of a controlled substance as a Category C test. Refer to the Drug Chemistry Unit Technical Procedure for Color Tests.
        1. Choose color tests based upon usefulness, i.e., modified sodium nitroprusside for methamphetamine, Marquis for heroin.
     2. **Microcrystalline tests** may be used to screen for the presence of controlled substances or aid in the identification of a controlled substance as a Category C test. Refer to the Drug Chemistry Unit Technical Procedure for Microcrystalline Tests.
        1. When a microcrystalline test is used as a Category C test, i.e., in conjunction with a Category A test, a description of the crystals shall be recorded on the Drug Chemistry worksheet form being used.
     3. **Pharmaceutical Identifiers** - The markings and physical characteristics of pharmaceutical preparations may be used to determine the consistency of units, to screen for the presence of controlled substances or aid in the identification of a controlled substance as a Category B test. For the pharmaceutical identifiers to be considered of value in the identification of the controlled substance there must not be any indications of tampering. Carefully inspect and record the markings and physical characteristics, including shape and color. Record any indications of tampering. Use only credible reference materials, i.e., *Pillbox/NIH Micromedex*, *The Physician’s Desk Reference, The Logo Index for Tablets and Capsules* and manufacturer’s published data.
     4. **Extractions –** Extractions may be used to isolate controlled substances from mixtures for analysis and / or prepare material for analysis techniques. Refer to the Drug Chemistry Unit Technical Procedure for Extractions.
     5. **Infrared Spectroscopy** may be used to screen for the presence of controlled substances, determine the salt form of a controlled substance and aid in the identification of a controlled substance as a Category A test, refer to the Drug Chemistry Unit Technical Procedure for Infrared Spectroscopy.
        1. IR may be used as a Category A test only when the spectrum of submitted material, straight or extracted, has a positive comparison to primary or secondary reference material.
        2. IR may be used to determine the salt form of a controlled substance only when the areas of the spectrum necessary to identify the salt form have a positive comparison to primary or secondary reference material.
     6. **Gas Chromatography - Mass Spectrometry** may be used to screen for the presence of controlled substances in properly prepared materials. Gas chromatography may be used to aid in the identification of a controlled substance as a Category B test. Mass Spectrometry may be used to aid in the identification of a controlled substance as a Category A test. Refer to the Drug Chemistry Unit Technical Procedure for Gas Chromatography - Mass Spectrometry and the Drug Chemistry Unit Technical Procedure for Extractions.
        1. Gas chromatography may be used to aid in the identification of a controlled substance as a Category B test only when the retention time of a of submitted material, straight or extracted, has a positive comparison to primary or secondary reference material, refer to the Drug Chemistry Unit Technical Procedure for Gas Chromatography - Mass Spectrometry.
        2. Mass Spectrometry may be used to aid in the identification of a controlled substance as a Category A test only when the mass spectrum of a submitted material, straight or extracted, has a positive comparison to primary or secondary reference material, refer to the Drug Chemistry Unit Technical Procedure for Gas Chromatography – Mass Spectrometry.
     7. **Similarity Determination for Chemical Analogues**
        1. A chemical analogue may be identified by evaluating the similarity between the chemical structure of two chemical substances.
        2. Record in the casenotes:

The chemical name of each chemical substance

Achemical structure of each chemical substance

Identification of the addition, replacement, rearrangement, and/or deletion of functional group(s) between the two chemical substances

Results statement clarifying the similarity between the chemical substance**s**

* + 1. **Structural Class Determination** 
       1. For chemical substances that are controlled based upon structural class definitions, a chemical structure of the substance shall be visually evaluated and assigned to one of the legally defined structural classes.
       2. Record in the case notes:

Chemical name of the chemical substance

Chemical name of the structural class to be assigned

A chemical structure of both the chemical substance and assigned structural class

Identification of sufficient features as required for structural class assignment

* 1. Record the weight received and returned of analyzed material other than residues and liquids less than approximately one milliliter, refer to the Drug Chemistry Unit Technical Procedure for Balances.
  2. For each unit to be analyzed, obtain the material for analysis. Although visual homogeneity is considered when obtaining the material for analysis, no assumption about homogeneity of the material is made for reporting purposes, i.e., controlled substance results are reported as “found to contain.”
     1. If the material is visually homogenous, obtain the portion needed for analysis.
        1. For larger, compressed, visually homogenous materials (e.g., kilos of suspected cocaine, bricks of suspected cannabis) obtain multiple portions of the material from different areas and combine for analysis. Select a number of portions appropriate to allow portions to be collected throughout the material.
     2. If the material is not visually homogenous, perform one of the following:
        1. Render the material homogenous by crushing, grinding, etc. and record in the case record. Obtain a portion of the homogenous material for analysis.
        2. Describe each portion of the material and analyze each individually.
     3. If the material is a residue a portion for analysis may be obtained by physically removing a portion by scraping or by performing a wash with a suitable solvent. Record the method used to obtain material for analysis in the case record.
     4. If the material is a liquid, mix thoroughly and observe for any layering as the liquid settles. If only a single layer is observed, remove an aliquot for analysis. If multiple layers are observed, the analyst will use their training and experience to determine the layer or layers to be analyzed. Use pipettes and / or additional containers to separate the layers.
  3. All Drug Chemistry submissions analyzed shall be reported on a Drug Chemistry Unit Report, refer to the CCBI report writing manual. While Chemists may utilize self-prepared templates containing commonly used report wording for use in preparation of reports, the templates shall not contain case specific information such as weights, case numbers, dates, etc.
     1. The report shall include the submitting agency item number(s), a detailed description of the item(s) including the number of units or dosage units and the condition of the item(s) for each item submitted for Drug Chemistry analysis in the “Item(s) Submitted” field.
     2. The report shall include “Controlled Substances” in the “Type Analysis Requested” field.
     3. The report shall include a “Disposition” field. The disposition of the submitted items shall be stated in this field.
     4. The report shall include a “Results and Conclusions” field. The results and conclusions of each analysis shall be included in this field along with the associated submitting agency item number(s).
        1. Items which are not analyzed shall be included in this field along with the associated submitting agency item number(s) followed by “No analysis.”
        2. When a net weight of analyzed material is reported, include the expanded uncertainty and the coverage probability. Refer to the Drug Chemistry Unit Technical Procedure for Uncertainty of Measurement.
        3. For substances which are only federally controlled, modify the report statement to include: *“a federally controlled substance, (insert schedule) according to Title 21 Code of Federal Regulations.”*
        4. For substances for which the CCBI Drug Chemistry Unit is unable to determine the assigned schedule or controlled substance status of a substance the circumstances preventing the determination shall be recorded in the casenotes and reported as “(insert chemical substance) – schedule not determined.”
        5. For substances which have been determined to have a chemical structure substantially similar to that of a controlled substance in schedule I or II, the reporting result statement shall be “(insert name of chemical analogue) has a chemical structure which is substantially similar to the chemical structure of (insert scheduled controlled substance) schedule (insert schedule)”
        6. For substances that are controlled based upon structural class definitions, the result statement shall include the name of the chemical substance, the assigned structural class, schedule of the chemical substance, and reference to the appropriate law.
        7. Plant material items that have the macroscopic, microscopic, and Duquenois-Levine results specified in Identification of Cannabis Plant Material and Extracts procedures, shall be reported as “*Plant material belonging to the genus Cannabis. Found to contain:”* followed by the name(s) of the substance(s) and the assigned schedule (if applicable) according to the law.
        8. Items found to contain cannabinoids (delta-9-THC, CBD, etc) shall include the following additional statement of the report *“Concentration of cannabinoid(s) not determined.”*

* + 1. **Results and Conclusions Reporting for Single Unit Items** **and Initial Submissions of Non-felony/trafficking Pharmaceutical Preparations**
       1. The result for a unit found to contain identified controlled substance(s) shall contain the item number, *“Found to contain:”* followed by the name(s) of the substance(s) and the assigned schedule of the substance according to the laws.
          1. If a net weight was recorded, the results shall be followed by *“Net weight of the (insert description):”* followed by the net weight of the material.
          2. If the material was recorded to be a residue, include *“Residue Amount.”*
       2. For multiple units with identical results, identify the analyzed portion in the “Results and Conclusions” section of the Laboratory Report with the submitting agency item number, any additional information required for unique identification and the following statement

*“(insert number of packages, units or tablets)(insert description) were individually analyzed and were each found to contain” followed by the identity of the controlled substance(s) identified and the assigned schedule of the substance according to the current laws*.

Include the weight with the following statement:

*“Net weight of the (insert description):” followed by the net weight of the material*.

* + - 1. The result for a unit in which a controlled substance was not identified shall be reported as *“No controlled substances identified.”*
         1. If a net weight was recorded, the results shall be followed by *“Net weight of the (insert description):”* followed by the net weight of the material.
         2. If the material was recorded to be a residue, an amount of material which could not be readily removed from the container in which it was submitted, include *“Residue Amount.”*
      2. The result for an initial submission consisting of a pharmaceutical preparation (non-felony/trafficking amount) found to be consistent with a controlled preparation that has not been tampered with may be reported as follows:

*“The physical characteristics, including shape, color and manufacturer's markings of the (insert description), were visually examined and found to be consistent with a pharmaceutical preparation that contains:” followed by the identity of the controlled substance(s) identified and the assigned schedule according to the appropriate law, if applicable.*

*There were no visual indications of tampering.*

*No chemical analysis was performed.”*

For weighed material include the weight with the following statement:

*“Net weight of the (insert description):” followed by the net weight of the material.*

* + - 1. The result for a submission consisting of a pharmaceutical preparation found to be consistent with a non-controlled preparation that has not been tampered with shall be reported as follows:

***“****The physical characteristics, including shape, color and manufacturer's markings of the unit, were visually examined and found to be consistent with a pharmaceutical preparation that does not contain a controlled substance.*

*There were no visual indications of tampering.*

*No chemical analysis was performed.”*

* + - 1. The result for a unit that did not contain a sufficient amount of material for a complete analysis shall be reported as:

*“Insufficient material for analysis.”*

* + 1. **Results and Conclusions Reporting for Multi-Unit Items**
       1. **Reporting Identified Substances – Administrative Sample Selection – Pharmaceutical Preparation**
          1. Each population shall be sufficiently described in the “Items Submitted” section of the Laboratory Report to substantiate the grouping of the preparations into the population.
          2. The analyzed portion shall be identified in the “Results and Conclusions” section of the Laboratory Report with the submitting agency item number, any additional information required for unique identification and the following statement:

*“One (insert description) was analyzed and found to contain” followed by the identity of the controlled substance(s) identified, the assigned schedule according to the appropriate law, if applicable.*

Include the weight with the following statement:

*“Net weight of the (insert description):” followed by the net weight of the material.*

* + - * 1. The unanalyzed portion of the population shall be identified in the “Results and Conclusions” section of the Laboratory Report with the following statement

*“(insert number of packages, units or tablets)(insert description) (was/were) visually examined; however, no chemical analysis was performed.”*

If applicable, include the weight with the following statement

*“(insert Net or Gross) Weight of (insert description) – followed by the net or gross weight of the material.*

* + - * 1. Include the following statement in the “Results and Conclusions” section of the Laboratory Report on the line directly below the line generated in **5.21.6.1.3.**

*“The physical characteristics, including shape, color and manufacturer’s markings of all (insert description) were visually examined and found to be consistent with a pharmaceutical preparation containing (insert substance(s) indicated and schedule(s)). There were no visual indications of tampering.”*

* + - 1. **Reporting Identified Substances – Threshold Sample Selection and Administrative Sample Selection with Non-Pharmaceuticals** 
         1. Each population shall be thoroughly described in the “Items Submitted” section of the Laboratory Report to substantiate the grouping of the packages, units or tablets into the population.
         2. For each portion of the population with identical results, identify the analyzed portion in the “Results and Conclusions” section of the Laboratory Report with the submitting agency item number, any additional information required for unique identification and the following statement

*“(insert number of packages, units or tablets)(insert description) were individually analyzed and were each found to contain” followed by the identity of the controlled substance(s) identified and the assigned schedule of the substance according to the current laws*.

Include the weight with the following statement:

*“Net weight of the (insert description):” followed by the net weight of the material.*

* + - * 1. The unanalyzed portion of the population shall be identified in the “Results and Conclusions” section of the Laboratory Report with the following statement

*“(insert number of packages, units or tablets)(insert description): “No chemical analysis was performed.”*

If applicable, include the weight with the following statement:

*“(insert Net, Gross, or estimated) weight of (insert description) – followed by the net, gross, or estimated weight of the material.*

* + 1. **Reporting Identified Substances – Hypergeometric Sampling Plan**
       1. Each population shall be sufficiently described in the “Items Submitted” section of the Laboratory Report to substantiate the grouping of the packages, units or tablets into the population.
       2. The analyzed portion shall be identified in the “Results and Conclusions” section of the Laboratory Report with the submitting agency item number, any additional information required for unique identification and the following statement

*“(insert number of packages, units or tablets)(insert description) were individually analyzed and were each found to contain” followed by the identity of the controlled substance(s) and the assigned schedule of the controlled substance according to the law, if applicable*.

Include the weight of the analyzed portion with the following statement:

*“Net weight of (insert description):” followed by the weight of the material.*

* + - 1. The unanalyzed portion shall be identified in the “Results and Conclusions” section of the Laboratory Report with the following statement (if the unanalyzed portion contains un-weighed material, it shall be listed separately from any weighed material)

*“(insert number of packages, units or tablets)(insert description): “No chemical analysis was performed.”*

If applicable, include the weight with the following statement

*“(insert Net) weight of (insert description):” followed by the weight of the material*.

* + - 1. Include the following statement

*“This material was analyzed with a statistical sampling plan that demonstrates with 95 % confidence that at least 90 % of the individual units contain the identified substance(s).”*

* + - 1. If the total weight of the population is estimated, the estimated weight shall be identified in the “Results of Examination” section of the Laboratory Report with the following statement:

*“(insert number of packages, units or tablets)(insert description)” were individually weighed. The total weight of the (insert total number of packages, units or tablets in the population) (insert description) was estimated with 95% confidence to be (insert estimated total weight of the population, N) ± (insert estimated weight adjustment for 95% confidence, either or .)*

* + 1. **Reporting Non-Controlled Substances – Administrative Sample Selection – Pharmaceutical Preparations**
       1. Each population shall be thoroughly described in the “Items Submitted” section of the Laboratory Report to substantiate the grouping of the preparations into the population.
       2. The population shall be identified in the “Results and Conclusions” section of the Laboratory Report with the item number, any additional information required for unique identification and the following statement

*“The physical characteristics, including shape, color and manufacturer’s markings of all (insert description) were visually examined and found to be consistent with a pharmaceutical preparation that does not contain a controlled substance.*

*There were no visual indications of tampering.*

*No chemical analysis was performed.”*

* + 1. **Reporting Non-controlled Substances – Hypergeometric Sampling, Threshold Sample Selection and Administrative Sample Selection with Non-Pharmaceuticals** 
       1. Each population shall be thoroughly described in the “Items Submitted” section of the Laboratory Report to substantiate the grouping of the packages, units or tablets into the population.
       2. The portion subjected to complete analysis shall be identified in the “Results and Conclusions” section of the Laboratory Report with the submitting agency item number, any additional information required for unique identification and the following statement:

*“(insert number of packages, units or tablets)(insert description) (was / were) individually analyzed: No controlled substances identified.”*

Include the weight with the following statement:

*“(insert Net or Gross) weight of (insert description) – followed by the net or gross weight of the material.*

* + - 1. The portion subjected to preliminary testing shall be identified in the “Results and Conclusions” section of the Laboratory Report with the following statement:

*“(insert number of packages, units or tablets)(insert description) were individually subjected to preliminary testing that did not indicate the presence of a controlled substance.”*

Include the weight with the following statement

*“(Net or Gross) weight of (insert description) – followed by the net or gross weight of the material.*

* + - 1. The unanalyzed portion shall be identified in the “Results of Examination” section of the Laboratory Report with the following statement

*“(insert number of packages, units or tablets)(insert description): No chemical analysis.”*

If applicable, include the weight with the following statement

*“(Net or Gross) weight of (insert description) – followed by the net or gross weight of the material.*

* + - 1. No statistical inferences shall be made.
  1. **Review**
     1. All cases shall be subjected to administrative and technical review prior to the release of the report.
     2. The reviews shall be performed in accordance with the CCBI Crime Laboratory Administrative Procedure for Technical and Administrative Reviews.
     3. Technical Review
        1. The technical review shall be performed by a Drug Chemist other than the analyzing Drug Chemist.
        2. The technical review shall include a review of the report and all examination records to ensure:
           1. Appropriate analyses have been performed and are in conformance with CCBI Drug Chemistry Unit policies and procedures as well as CCBI Crime Laboratory policies and procedures.
           2. Calculations and data transfers are accurate.
           3. The conclusions of the analyzing Drug Chemist are reasonable, supported by the examination records and within the constraints of validated scientific knowledge.
           4. The report is clear, accurate and complete.
        3. The Technical Reviewer shall document the review on the CCBI Laboratory Technical and Administrative Review/Coversheet.
           1. Record any comments in the Comments section and initial and date the form.
     4. Administrative Review

* + - 1. The administrative review shall include:
         1. A review of the report for spelling and grammatical accuracy.
         2. A review of all administrative and examination records to ensure that the records are uniquely identified according to CCBI policy and procedure.
         3. A review of the report to ensure that it is clear, accurate and complete.
      2. The administrative review shall be performed by either the Crime Laboratory Deputy Director or a Drug Chemist other than the analyzing Drug Chemist.

1. **Limitations –** Refer to the Drug Chemistry Unit technical procedures.
2. **Safety –** Refer to the CCBI Health and Safety Manual.
3. **References** 
   * 1. ASTM Standard E2329-14. “Standard Practice for Identification of Seized Drugs.” ASTM International: West Conshohocken, PA, 2014, [www.astm.org](http://www.astm.org).
     2. “Part III B – Methods of Analysis/Drug Identification.” *Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations.* 7th Edition. June 9, 2016.
     3. *Guidelines on Representative Drug Sampling*. United Nations, New York: United Nations Office on Drugs and Crime, 2009.
     4. Frank, Richard S., et. al."Representative Sampling of Drug Seizures in Multiple Containers." *Journal of Forensic Sciences,* Volume 36, Issue 2 (March 1991), 350-357.
     5. “PART III A - Methods of Analysis/Sampling Seized Drugs for Qualitative Analysis.” *Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations.* 7th ed.: June 9, 2016.
     6. “PART IIID – Methods of Analysis/Analogues and Structural Class Determination.”

*Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations.* 7th ed.: June 9, 2016.

* + 1. “Measurement Uncertainty for Extrapolations of Net Weight and Unit Count” SD-6.

*Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) July 10, 2017*

* + 1. North Carolina General Statutes Chapter 90 <https://www.ncleg.net/EnactedLegislation/Statutes/PDF/ByArticle/Chapter_90/Article_5.pdf>
    2. United States Sentencing Commission Guidelines Manual

<https://www.ussc.gov/guidelines>

* + 1. Title 21 Code of Federal Regulations, Part 1308 – Schedule of Controlled Substances

<https://www.deadiversion.usdoj.gov/21cfr/cfr/2108cfrt.htm>

* + 1. Title 21 United States Code (USC) Controlled Substance Act, Subchapter I – Control and Enforcement

<https://www.deadiversion.usdoj.gov/21cfr/21usc/801.htm>

1. **Records** 
   1. CCBI Laboratory Technical and Administrative Review/Coversheet
   2. Drug Chemistry Worksheet
   3. CCBI Additional Notes form
   4. Drug Chemistry Hypergeometric Weight Estimation Worksheet
   5. Drug Chemistry Summed Weights Worksheet

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| --- | --- | --- |
| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | Compliance with ASCLD/LAB requirements |
| 8/7/13 | 2 | Incorporation of Uncertainty of Measurement and reduce Administrative Sampling |
| 7/14/14 | 3 | Include use of Agency item numbers, ref LAPM 14, and addition of abbreviation “ow” |
| 2/16/15 | 4 | Additions to section 5.3 and line 5.15.2.1. Addition of weekly cleaning log to records section 9. |
| 3/31/16 | 5 | Addition to 5.21. Remove stricken text in 5.15.3.4.2.2. Insert ending parenthesis in 5.21.7.5. Updated references 8.1.1, 8.1.2 and 8.1.5. |
| 10/7/16 | 6 | Addition of chemical analog definition, Addition of 5.18.8 and 5.18.9 to address chemical analog evaluations and structural class determinations. Addition of 5.21.4.4, 5.21.4.5, 5.21.4.6 to address reporting of chemical substances in which schedule or controlled status cannot be determined, reporting of chemical analogs, and reporting of substances that are controlled based on structural class |
| 6/28/17 | 7 | Removed Ultraviolet Spectroscopy |
| 9/27/17 | 8 | Review of Technical Procedure |
| 4/9/18 | 9 | Remove reference to North Carolina Controlled Substance Act and US Sentencing Guidelines Manual in content of procedure; Add North Carolina General Statutes Ch 90, US Sentencing Guidelines Manual , Title 21 CFR Part 1301, and Title 21 USC Subchapter I (along with hyperlinks) to references; Add Iso, Meth, SEB as approved abbreviations; Reword 5.6 to comply with ISO standard; Change “Drug Chemistry Case Notes Coversheet” to “CCBI Laboratory Technical and Administrative Review/Coversheet”; Change “CCBI Crime Laboratory Safety Manual” to “CCBI Health and Safety Manual”; Correct formatting throughout document |
| 9/12/18 | 10 | Removed %RSD requirement due to %RSD validation |
| 10/11/18 | 11 | Removed 5.22.3.3.1.1 and 5.22.3.3.1.2 (Conflict Resolution is now addressed in LAPM Ch 2); Changed 5.6.2 and 9.3 to CCBI Additional Notes form |
| 1/7/19 | 12 | Revised 5.15.1.3.2 through 5.15.3.4 and 5.21.6.2.3 to allow for estimated weights and to clarify when a net, gross, or estimated weight in required. Added digital images to 5.17.4.1. Removed 5.17.4.3. Revised 5.21.9.2. and 5.21.5.3. to report no controlled substances identified. Updated references 8.1.2. and 8.1.5. to the current version. Added reference 8.1.6. and 8.1.7. Removed 9.4. Drug Chemistry Additional Weight Worksheet from records. Corrected Formatting throughout. |
| 7/8/19 | 13 | Removed sentences 3-4 in 5.7 due to inclusion in LAPM |
| 1/21/20 | 14 | 3. Abbreviations - Added Macro, micro, MS, RT, SCRN, tab, TIC. Deleted p.  5.16 - Changed Marijuana Analysis Scheme to Cannabis Plant Material and Extract Analysis Scheme  5.17 - Replaced Marijuana with Cannabis plant material and extract  5.20 - Replaced marijuana with cannabis  5.21.4.7 and 5.21.4.8 - added to specify reporting language for cannabis |

# 2: Technical Procedure for the Identification of Cannabis Plant Material and Extracts

1. **Purpose/Scope -** This procedure provides direction for the identification of Cannabis as defined in NC General Statute §90-87 (16) in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification.
2. **Definitions**
   1. **Reference material** – Material sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
4. **Equipment, Materials and Reagents**
   1. **Equipment**
      1. Leica S9i stereomicroscope(s) equipped with 10X eyepiece and 9:1 zoom capability to produce magnification of 6.1-55X with digital camera and Leica Application Suite (LAS) software.
      2. Nikon Eclipse E400 Pol polarizing microscope equipped with 10X eyepiece and 10X objective to produce magnification of 100X
      3. Gas Chromatograph/Mass Spectrometer (GC-MS)
   2. **Materials and Reagents**
      1. Cannabis or Delta-9-Tetrahydrocannabinol reference material
      2. Chloroform, ACS grade
      3. Vanillin, NF
      4. Acetaldehyde, 99.5%
      5. Ethanol, ACS
      6. Culture tube or spot plate
5. **Procedure**
   1. Refer to the Drug Chemistry Analysis Technical Procedure for sampling.
   2. For exhibits with a gross weight of less than 5 grams consisting of hand-rolled cigarettes or partial hand-rolled cigarettes, the paper may be included in the weight recorded and reported. The evidence may be cut open to expose the plant material for viewing and analysis. Use the following statement to report the weight when the paper is included:

*“Weight of paper and plant material:”*

* 1. Observe plant material macroscopically and microscopically to verify the presence of visually recognizable morphological characteristics. Macroscopic and microscopic morphological characteristics shall be consistent with cannabis reference material characteristics.
  2. Record the lot number or Drug Chemistry designation of the cannabis reference material used for comparison on the Drug Chemistry Worksheet.
  3. **Macroscopic characteristics** – Record the observed macroscopic characteristics present in the exhibit on the Drug Chemistry Worksheet. Include any additional details as needed.
     1. An exhibit must contain sufficient macroscopic characteristics described and referenced in this procedure to be macroscopically consistent with cannabis or be visually consistent with cannabis reference material for the macroscopic examination to be considered as a positive Category B test, refer to the Drug Chemistry Drug Analysis Technical Procedure.
     2. Macroscopic Characteristics
        1. Upright stalk attains a height of 3-16 feet, usually 4-6 feet.
        2. Stalk varies in diameter up to two inches, usually one-half inch or less.
        3. Stalks and stems are longitudinally grooved.
        4. Nodes occur on the stalk at intervals of 4 to 20 inches. The plant branches at the nodes – a branch appearing immediately above each leaf. The branches occur at opposite points on the stalk with alternate pairs situated at approximately right angles except at the top of the plant, where the arrangement becomes alternate rather than opposite.
        5. Plant has compound palmate leaves with 5-11 leaflets (usually seven), and odd in number.
        6. Leaflets are pointed at both ends and vary up to about 6 inches length and to about 1.5 inches in width. They are characteristically hair covered, veined and serrated (with notched edges.)
           1. The veins run out obliquely from the midrib to the tips of the teeth.
           2. The teeth point towards the tips.
           3. The upper surface is darker than the lower surface.
        7. Distinction between male and female plants is difficult except at maturity.
           1. Male: flowers are very prominent; mature ones shed pollen profusely.
           2. Female: flowers are inconspicuous and are found hidden among the small leaves at the ends of the stalk and branches.
        8. Seeds are about 2 – 5 mm long, greenish-yellow to brown, mottled, covered with lacy markings, ovoid in shape and divided into two segments by a ridge extending around the greatest circumference.
        9. Seeds are enclosed in hulls or pods which are green, hairy and sticky to the touch.
        10. Seeds contain a white, oily, meaty substance similar to coconut meat.
        11. The root system consists of one main tap root up to eight inches long, from which spring a number of comparatively tiny branches.
        12. Plant has a characteristic odor and is sticky to the touch.
  4. **Microscopic Characteristics**
     1. Observe the microscopic characteristics using the stereomicroscope and record the observations on the Drug Chemistry Worksheet by checking the box beside the characteristics, if applicable, or recording a written description of the observation. An exhibit must contain leaves that meet the requirements of 5.6.1.3.3 and 5.6.1.3.4. for the microscopic examination to be considered as a positive Category B test, refer to the Drug Chemistry Drug Analysis Technical Procedure. Digital images of these leaf characteristics shall be taken. Additional images may be taken of additional plant characteristics.
        1. The plant has glandular (related to a cell or group of cells that produces a secretion) trichomes (hair-like projections) where the cannabis resin is produced and stored. They are mainly associated with the flower structures but they can also be found on the lower surface of the leaves and occasionally on the stems of young plants. They occur as:
           1. Sessile glands, i.e. trichomes without stalk
           2. Small bulbous glandular trichomes with one-celled stalks
           3. Long multicellular stalks on female flowers
        2. The plant has non-glandular trichomes which are unicellular, rigid and curved with a slender pointed apex.
        3. Required characteristics for identification of cannabis leaves:
           1. Green, brown or brown-spotted in color
           2. Characteristically veined and serrated, refer to 5.5.2.6.1 – 5.5.2.6.2.
           3. Non-glandular cystolithic hairs on the upper side with a characteristic bear claw shape with cystoliths, calcium carbonate crystals, visible at their bases. Some hairs may be broken and the cystolith freed. Dilute hydrochloric acid may be added to produce effervescence with the calcium carbonate cystolith
           4. Non glandular, non-cystolithic hairs on the lower surface which are longer, more slender and more sharply pointed than the hairs on the upper surface.
        4. Required characteristics for identification of cannabis stems:
           1. Green, brown or brown-spotted in color
           2. Longitudinally grooved.
        5. Required characteristics for identification of cannabis seeds**:**
           1. Greenish-yellow to brown, mottled
           2. Covered with lacy markings
           3. Ovoid in shape
           4. Ridge around the greatest circumference
        6. Required characteristics for identification of cannabis hulls:
           1. Green, brown or brown-spotted in color
           2. Characteristically shaped, ovoid
           3. Non-glandular cystolithic hairs on outer surface
           4. Glandular hairs which are shaped like clubs with flattened spherical heads
  5. **Color Test**
     1. **Duquenois-Levine (Modified)**
        1. Reacts with cannabis/cannabinoids to produce a violet blue color that transfers to the chloroform layer.
        2. Preparation: Dissolve 2.0 grams of vanillin and 2.5 milliliters of acetaldehyde in 100 milliliters of ethanol.
           1. Storage: Amber glass.
           2. Expiration: Stock container: Three years

Use container: Three months

* + - * 1. Lot number: Eight digit format year/month/day/Duq/initials of preparer**.**

Example: 20120131DuqXXX

* + - * 1. PQCC:

Reference material: Cannabis or Δ9-Tetrahydrocannabinol.

Acceptable result: A violet blue color observed after the addition of acid and the violet color transfers to the chloroform layer, i.e., Positive.

* + 1. Procedure
       1. Place a small amount of sample in a culture tube or spot plate.
          1. An evaporated petroleum ether or chloroform extract may be used. Record the preparation of the sample on the appropriate Drug Chemistry Worksheet.
       2. Add at least three drops of the Duquenois reagent and mix thoroughly.
          1. The liquid may be decanted from plant material and used to proceed. Record the preparation of the sample on the appropriate Drug Chemistry Worksheet.
       3. Add an equal volume of concentrated hydrochloric acid and mix.
       4. Observe any color changes.
       5. Add three volumes of chloroform and mix.
       6. Allow phases to separate and observe the color in the chloroform (bottom) layer.
       7. Record results and any observations.
    2. Limitations
       1. Wet or fresh plant material, old plant material and residues may need preparation as described in 5.8.2.1.1 or 5.8.2.2.1.
  1. **Gas Chromotography-Mass Spectrometry (GC-MS)**
     1. Prepare sample(s) for GC-MS analysis utilizing an appropriate solvent and or extraction based on the sample to be analyzed.
     2. Analyze sample(s) according to the Drug Chemistry Technical Procedure for Gas Chromotography/Mass Spectrometry.

1. **Limitations**
   1. Morphological characteristics and variation in color of cannabis plants are influenced by the seed strain as well as by environmental factors such as light, water, nutrients and space.
   2. Not every cannabis exhibit contains every plant characteristic. The Drug Chemist shall identify and document those that are present. Digital images should be taken to illustrate the characteristics.
   3. Immature seedlings may not exhibit sufficient morphological characteristics for identification.
   4. This procedure does not determine the quantitation or concentration of cannabinoids present in a suspected cannabis sample.
2. **Safety**
   1. Use proper personal protective equipment when handling moldy cannabis/plant material.
   2. Refer to the CCBI Health and Safety manual.
3. **References**
   1. *Marihuana Its Identification*. Washington, D.C.: U.S. Treasury Department Bureau of Narcotics, United States Printing Office, 1948.
   2. *Recommended Methods for the Identification and Analysis of Cannabis and Cannabis Products.* New York: Laboratory and Scientific Section United Nations Office on Drugs and Crime, United Nations, 2009. <https://www.unodc.org/documents/scientific/ST-NAR-40-Ebook_1.pdf>
   3. *North Carolina General Statutes* §90-87 (16) and §90-95(d)(4). <https://www.ncleg.net/EnactedLegislation/Statutes/PDF/ByArticle/Chapter_90/Article_5.pdf>
   4. Bailey, Keith, M.A. and D. Phil. “The Value of the Duquenois Test for Cannabis – A Survey.” *Journal of Forensic Sciences.* Volume 24, Issue 4 (October, 1979): 817-841.
   5. Pitt, C.G. et. al. “The Specificity of the Duquenois Color Test for Marijuana and Hashish.” *Journal of Forensic Sciences*. Volume 17, Issue 4 (Oct. 1972): 693-700.
4. **Records**
   1. Prepared Reagent Log
   2. Drug Chemistry Worksheet

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| --- | --- | --- |
| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/2013 | 1 | ISO Compliance |
| 2/16/2015 | 2 | Corrected numbering throughout |
| 9/27/17 | 3 | Added Duquenois-Levine color test. Review of Technical Procedure. |
| 2/1/18 | 4 | Updated 4.1 Equipment to include new stereomicroscope. |
| 3/1/19 | 5 | Updated 4.1.1 with current stereomicroscope(s), camera, and software. Removed Stereomicroscope in 4.1.2. Revised 5.3. Combined 5.6.1 and 5.6.2 and added digital image requirements. Removed 5.8.1 and 5.8.2 reference to DCTP07 for color tests. Updated Health and Safety Manual in 7.2. Added hyperlinks to references in 8.2 and 8.3. |
| 1/21/20 | 6 | Changed title to Identification of Cannabis Plant Material and Extracts.  Replaced “marijuana” with “Cannabis” throughout the procedure  3. Abbreviations - removed abbreviations.  4.1 Equipment - Added GC-MS  5.7 removed hashish criteria  5.8 Gas Chromatography-Mass Spectrometry (GC-MS) section added.  6. Limitations - added 6.4 regarding quantitation of cannabinoids. |

**3:** **Technical Procedure for General Laboratory Equipment**

1. **Purpose / Scope** - This procedure provides direction for the use of general laboratory equipment in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification.
2. **Definitions –** N/A
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
4. **Equipment**
   1. Refrigerators
   2. Polarizing Light Microscope
   3. Stereomicroscope(s)
   4. Laboratory environmental monitor – barometer, hygrometer, thermometer, NIST traceable
5. **Procedure for Microscopes**
   1. New microscopes shall be installed by an approved vendor.
   2. Microscopes should be turned off and covered when not in use.
   3. Replace microscope lamps as needed. Record the service in the microscope log.
   4. The Polarizing Light Microscope will be serviced annually by an approved vendor. The service will include cleaning, lubricating and alignment. The stereomicroscope(s) will be serviced as needed. Record the service in the microscope log.
   5. If the amount of light passing through the optics decreases significantly so that a sample cannot be seen, place the microscope out of service and notify the Drug Chemistry Technical Leader for service scheduling.
   6. See references for manufacturer’s instructions.
   7. Microscope logs will be maintained in the Drug Chemistry folder on the shared drive.
6. **Laboratory environmental monitor** 
   1. The building environmental controls generally provide adequate laboratory environmental conditions for analysis. When environmental conditions are outside of acceptable levels they are apparent to a Drug Chemist based on their sensory perception of the environment. When a Drug Chemist perceives an abnormally high or low temperature or abnormally high humidity level the Drug Chemist shall:

* Notify General Services Administration that there is an environmental control problem and provide the applicable room number
* Notify the Drug Chemistry Technical Leader and Crime Laboratory Quality Manager of the environmental control issue
* Measure the laboratory environmental conditions using a hygrometer and thermometer.
  1. Record the humidity, temperature and air pressure on the environmental log.
  2. If the humidity exceeds 80% or the temperature is not in the range of 60 – 90 °F (15.6–32.2 °C), stop all analyses until environmental conditions return to acceptable levels.
     1. All instruments shall be subjected to any post shutdown checks as described in the Drug Chemistry Unit Technical Procedures.

1. **Safety –** Refer to the CCBI Health and Safety Manual
2. **Records**
   1. Microscope log
   2. Refrigerator log
   3. Environmental log
3. **References** 
   1. *Nikon Polarizing Microscope Eclipse E400Pol Instructions*, Nikon Inc, Melville, NY, M216E 98.8.VF.1.
   2. *Leica S Series User Manual.*
   3. *Circular Fluorescent Microscope Illuminator Model 9 Operator Manual,* Stocker & Yale, Salem, NH, #09910009 Rev, A.

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 11/6/2015 | 2 | Update Millipore maintenance in 5.4 and 9.3.1. Update environmental monitoring in 7.1. |
| 3/1/19 | 3 | Added Polarizing light microscope and Stereomicroscope(s) to 4. Equipment. Removed Milipore Elix system (section 5., Section 9., and Section 12. Changed microscope service requirements in 5.4. Removed performance verification for microscopes in 5.1. Updated 5.7 to allow for electronic entry for microscope log. Updated safety in 7. Removed Nikon stereomicroscope instructions and added Leica S Series User Manual to References. |
|  |  |  |

# 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 Raleigh/Wake City-County Bureau of Identification
2. **Definitions** 
   1. **Calibration -** Checking or adjusting (by comparison with a standard) the accuracy of a measuring instrument.
   2. **Quality control check -** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   3. **Performance verification -** The initial confirmation of the reliability of a previously or externally validated method or instrument.
   4. **Reference standard -** Measurement standard designated for the calibration of other measurement standards (reference standards or equipment.)
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
4. **Equipment and Materials** 
   1. **Equipment**
      1. A&D model HW-100KA1 digital platform scale
      2. Mettler Toledo model XP205 balance equipped with antistatic unit
      3. Mettler Toledo model XP6002S and XPE6002S balances
      4. Laboratory environmental monitor - barometer, hygrometer, thermometer, NIST traceable
      5. Balance draft shield
      6. Marble slab/Marble table
   2. **Materials**
      1. Paper, boxes, plastic bags, paper bags, metal pans or other weighing vessels
   3. **Reference Standards**
      1. NIST traceable reference standard weights: 10 mg, 100 mg, 2 g, 1 g, 20 g, 100 g, 200 g, 1 kg, 5 kg, 20 kg
5. **Standards and Controls** 
   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.
   2. Leave balances powered on.
   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, refer to section 7.
   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.”
   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 CCBI Laboratory Procedure for Corrective and Preventive Action as required.
   6. **Reference Standard Weights** 
      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.
      2. Store reference standard weights and 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.
      3. Use gloves, tweezers and / or weight handles to handle reference standard weights and weights. Do not handle reference standard weights and weights with bare hands. Ensure that all surfaces that reference standard weights and weights may come in contact with are clean.
      4. Reference standard weights shall be calibrated on an annual basis by an approved vendor that meets the requirements specified by the accrediting body.
         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.
         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.
      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.
      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.
6. **Calibrations** 
   1. Calibration for all Drug Chemistry Unit balances, refer to 4.1, shall be performed on an annual basis by an approved vendor that meets the requirements specified by the accrediting body.
   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.
   3. Certificates of calibration issued by the vendor must include the uncertainty and shall be maintained in the balance logbook on the shared drive.
7. **Monthly QCC**
   1. The Drug Chemist shall perform a monthly QCC on each balance using reference standard weight(s).
   2. If the balance is not level, follow manufacturer’s recommendations for leveling.
   3. For the Mettler Toledo balances, press the internal adjustment key and allow the balance to complete the internal adjustment function.
   4. Zero the balance with nothing on the pan.
   5. Place a reference standard weight on the pan.
   6. Record the actual weight displayed.
   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 | 199.99690 – 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 (s)  of the balance) |
| 5000 grams (11.02 lb) | 10.98 – 11.06 lb |
| 20000 grams (44.09 lb) | 44.05 – 44.14 lb |

* 1. 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.
     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.
  2. Record the results of the QCC and any action taken in the Balance QCC log on the shared drive.

1. **Daily QCC**
   1. The Drug Chemist shall perform a daily QCC on each balance using a reference standard weight prior to use for casework each day.
   2. Follow the procedure in 7. Use a 2 gram and a 1000 g weight for the Mettler Toledo XP6002S and XPE6002S. Use only the 20 kg weight for the AND HW-100KA1. Use only the 10 mg (0.01000 g) weight for the XP205.
2. **Process Measurement Assurance (Balance Study)**
   1. Reference standard weights shall be maintained in the Drug Chemistry Unit for ongoing data collection on the weight determination process (Balance Study).
   2. All in service balances should be included and all active chemists in the Drug Chemistry   
      Unit must participate in data collection.
      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.
      2. Data collection for balances used exclusively by an individual Drug Chemist need to only have data collected by that chemist.
   3. Data collection should be conducted for a period of ten business days on an annual basis.
   4. Data collection will be conducted in the morning and afternoon on each of the ten business days.
      1. Measure and record the temperature, humidity and air pressure at the balance (scale) location using a laboratory environmental monitor during the morning and afternoon weight collections.
   5. A minimum of one reference standard weight will be used for each balance data collection.
      1. Each reference standard weight will be weighed in triplicate during the morning and afternoon data collection.
   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: 20 kg weight (44.10 lbs).

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.

* 1. Record the measurements on the corresponding Balance Study Log located on the shared drive.
     1. Evaluate the Balance Study measurements to ensure they fall within the acceptable ranges listed for the balance used.
        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.
           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.
           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.

1. **Procedure** 
   1. Record weights on the XP6002S and XPE6002S balances in grams to two decimal places. Record weights on the XP205 balance in grams to five decimal places. Record weights on the HW100KA1 balance in pounds to two decimal places. Refer to 11.1 for conversion of units.
      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, refer to 12.1.2 |
| XP6002S and XPE6002S | 0.01 g | N/A, refer to 12.1.2 |
| AND HWK100KA1 | 0.02 lb | 1.00 lb (0.45 kg) |

* + 1. 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) |

* + 1. For net weights of material use the XP205 balance only at or below 20.00 grams.
  1. Ensure that the balance is level, refer to 7.3. Zero the balance and ensure that the balance displays zero to the appropriate number of decimal places, refer to 10.1.
  2. Place the weighing vessel on the balance and allow the reading to stabilize. For the XP205 allow at least 10 seconds.
  3. 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 on the appropriate Drug Chemistry Worksheet. If packaging is removed record the weight as a net weight on the appropriate Drug Chemistry Worksheet.
  4. Record all digits displayed by the balance (to two decimal places for the XP6002S and the A&D scale, to five decimal places for the XP205 balance) on the appropriate Drug Chemistry Worksheet, refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis.
  5. 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.
  6. Record all digits displayed by the balance on the appropriate Drug Chemistry Worksheet.

1. **Calculations** 
   1. When conversion of units is needed, the following NIST Conversion factor shall be used and the result rounded as directed in Reference 16.10:

1 pound = 0.45359237 kilograms

1. **Reporting** 
   1. Report the measured weight, as recorded, along with the uncertainty of measurement, refer to the Drug Chemistry Unit Technical Procedure for Uncertainty of Measurement.
      1. When the measured weight to be reported was measured to two decimal places and is less than 0.10 gram report the weight as *“less than 0.1 gram.*”
      2. When the measured 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*.”
   2. When the numerical value is a weight associated with unanalyzed material the EU need not be included on the report.
   3. When the weight to be reported is a sum of measured weights, sum the uncertainty of measurement associated with each measured weight to determine the uncertainty of measurement to be included on the report.
   4. For estimated total weights, refer to the Drug Chemistry Analysis Technical Procedure.
2. **Limitations**

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.

1. **Safety –** Refer to the CCBI Health and Safety Manual
2. **Records**
   1. AND Balance Logbook
   2. XP205 Balance Logbook
   3. XP6002S and XPE6002S Balance Logbook
   4. Reference Standard Weights Logbook
   5. Balance Study Log
3. **References** 
   1. *Mettler Toledo B Balance Line Operating Instruction***s**, Mettler-Toledo, Switzerland, P11780194**.**
   2. *HV/HW Series Instruction Manual***,** A&D Engineering Inc., Milpitas, CA, V.1.C-95.04.03.
   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.
   4. *Mettler Toledo Excellence Plus Analytical Balances XP Models – Part 1*, 11781066, Mettler-Toledo, Switzerland, May 2012.
   5. *Mettler Toledo Excellence Plus Precision Balances XP Models – Part 1*, 11781055, Mettler-Toledo, Switzerland, May 2012.
   6. *Mettler Toledo Excellence Plus Balances XP Models – Part 2*, 11781077, Mettler-Toledo, Switzerland, October, 2010.
   7. *Mettler Toledo Excellence Plus Balances XP Models – Part 3*, 11781338, Mettler-Toledo, Switzerland, October, 2010.
   8. *Mettler Toledo Discharging Power Pack Operating Instructions,* Haug GmbH & Co. KG, D-032 V02, March 29, 2012.
   9. *One Point Ionizer Operating Instructions,* Haug GmbH & Co. KG, D-0265, December 22, 2004.
   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.
   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](http://www.astm.org).
   12. *ASCLD/LAB Guidance on Measurement Traceability – Measurement Assurance,* ASCLD/LAB, AL-PD-3059 Ver 1.0.

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 3/27/13 | 2 | Reference standard weight modification |
| 8/7/13 | 3 | Incorporation of Uncertainty of Measurement and Measurement Assurance |
| 9/16/13 | 4 | Change to acceptable range |
| 2/19/14 | 5 | Removal of Mettler PB3002 |
| 4/25/14 | 6 | Addition of 1kg and 1mg reference standard weights |
| 11/7/14 | 7 | Update QCC acceptable range and add additional daily QCC weight for XP6002S balances |
| 2/16/15 | 8 | Added model XPE6002S balance and corrected reference in table in 10.1.1. |
| 2/25/15 | 9 | Added reference to 1 kg weight in 4.3.1 and updated certified weight values and acceptable ranges in 7.7 |
| 11/6/15 | 10 | Added 5 kg weight conversion in 7.7 and updated minimum weight to be reported in 12.1 to 0.2 gram. |
| 2/25/16 | 11 | Updated certified weight values and acceptable ranges in 7.7 |
| 11/21/16 | 12 | Update 5.1, 7.9, 9.6 and remove 9.5 in order for balance QCC and measurement assurance data to be recorded only on the shared drive. Update 12.1.1 to change reporting values to less than 0.1 gram. |
| 2/14/17 | 13 | Update certified weight values and acceptable ranges in 7.7 |
| 11/06/17 | 14 | Updated 5.6.4 and 6.1. Removed number 13.2. |
| 2/19/18 | 15 | Removed 100 mg and 1 g weights from 4.2.2. Updated 4.3.1. to include 10 mg, 1 g, and 20 g weights. Updated certified weighs and acceptable ranges in 7.7. Updated weight in 8.2 for Daily QCC. Updated 12.1.2. Updated 13.1. |
| 5/23/18 | 16 | Added Balance draft shield to 4.1 Equipment. Added paper bags to 4.2.1. Removed non-NIST traceable weight at 4.2.2. Removed 1 mg weight from 4.3.1. Edited 5.1. 5.6.1. 6.3. 7.9. 9.7. to allow for electronic storage of material on the shared drive.  Removed tracking requirement in 5.6.4.2. Removed 1 mg weight from 7.7. Removed check standard surrogate process from section 9 and replaced with Balance study requirements. Revised limitations in 13.1. Updated Safety Manual in section 14. Updated records in section 15. |
| 10/17/18 | 17 | Added balance readability to 10.1.1 and 10.1.2. Added marble slab/table to 4.1 Equipment. |
| 1/7/19 | 18 | Removed 6000 g and 5000.00 g from 7.7 for monthly QCC for XP6002S and XPE6002S. Added 1100 g for monthly QCC for XP6002S and XPE6002S. Added box as tare vessel for XP205 and plastic bag for XP6002S and XPE6002S in 9.6. Changed max weight for XPE6002S and XPE6002S to 1100 g. |
| 10/25/2019 | 19 | Changed minimum in 9.5 to one. Adjusted weights collected in 9.6 for each balance. Changed max net weight for the XP205 in 10.1.3. Clarified weights to be used when weights are out for calibration in Section 13. Limitations. |
| 7/08/20 | 20 | 3. Abbreviations - removed abbreviations  9. Process Measurement Assurance (Balance Study) - removed 1 g for Mettler XP6002S, XPE6002S and XP205  9. Process Measurement Assurance (Balance Study) - Added additional instructions for balance study measurements that are outside of the acceptable range for the balance used. |

# 5: Technical Procedure for Uncertainty of Measurement

1. **Purpose / Scope** - This procedure is utilized to estimate the uncertainty of measurement for test methods for which a numerical value is reported on a Laboratory Report in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification Crime Laboratory.
2. **Definitions** 
   1. Uncertainty of measurement - a parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand.
   2. Coverage probability (Level of confidence) - probability that the set of true quantity values of a measurand is contained within a specified coverage interval.
   3. Coverage factor - numerical factor used as a multiplier of the combined uncertainty in order to obtain an expanded uncertainty.
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
   2. UOM – uncertainty of measurement
   3. CU – combined uncertainty
   4. EU – expanded uncertainty
4. **Procedure**
   1. The Drug Chemistry Technical Leader shall determine an estimation of the UOM for each test method for which a numerical value is reported on a laboratory report. The specific measuring device or instrument used for a reported test result must be evaluated in the estimation of the UOM for that test method.
   2. When established, the estimation of the UOM shall be performed annually, at a minimum, or when a change in measurement conditions occurs that may have a significant effect on the UOM.
   3. Laboratory environmental conditions shall be monitored and any additional effect on UOM shall be evaluated upon collection of data. Refer to the Drug Chemistry Unit Technical Procedure for General Laboratory Equipment.
   4. Each test method requiring UOM shall be evaluated for contributions from sources of uncertainty, u. The contributions shall be evaluated using Type A methods (by a statistical analysis of measured values obtained under defined measurement conditions such as repeatability and / or reproducibility, including measurement assurance data) and Type B methods (by other means of analysis of components from such things as instrument readability, calibration certificate reported uncertainty, etc.)
   5. Evaluate the identified sources of uncertainty and combine them to obtain the combined uncertainty of measurement, CU, using the formula

CU = √(u12 + u22 + u32…. )

where

CU = combined uncertainty

u1, u2, etc. = individual identified sources of uncertainty

* 1. The combined uncertainty of measurement is an estimation of the uncertainty of measurement, UOM. Individual sources of uncertainty that are not significant contributors may be excluded.
  2. The expanded uncertainty, EU, shall be calculated to provide a minimum 95.45% coverage probability (or approximately 95%) by multiplying the CU by the appropriate coverage factor, k.
  3. The reported EU shall contain at most two significant digits and be reported to the same level of significance as the measurement result. The reported EU shall be rounded up.
  4. The EU shall be reported for each test method where a numerical value is reported on a laboratory report. When numerical results are added to produce a combined result the respective EU’s shall also be added. When conversion of units is necessary, perform the conversion after any summing and use the appropriate NIST conversion factor with the result rounded up: 1 pound = 0.45359237 kilograms. When the numerical value is a gross weight the EU need not be included on the report.
  5. The laboratory report shall identify the measured quantity value, *y*, along with the associated EU. The result shall be reported as *y* ± *EU*, with the units of *EU* consistent with the units of *y*. The coverage probability shall be included.

*Examples:*

*Net weight of the material: 4.00 grams ± 0.08 gram at a coverage probability of 99.5%.*

*Net weight of the material: 1000.02 grams ± 0.27 gram at a coverage probability of 99.5%.*

*Net weight of the material: 0.01875 gram ± 0.00058 gram at a coverage probability of 99.5%.*

*Net weight of the material: 10.27 pounds ± 0.07 pound at a coverage probability of 99.5%.*

* 1. The Drug Chemistry Unit Technical Leader shall maintain records of the estimation of the uncertainty of measurement in the Drug Chemistry Unit.The records shall:
* Define the measurand
* State how traceability is established for the measurement
* State the equipment (measuring device(s)) used
* State all uncertainty components considered
* Identify all uncertainty components of significance and how they were evaluated
* Contain the data used to estimate repeatability and / or reproducibility
* Contain all calculations performed
* State the combined standard uncertainty, CU, the coverage factor, k, the coverage probability, C, and the resulting expanded uncertainty, EU
* The minimum due date for the review/recalculation of the measurement uncertainty, refer to 4.2.

1. **Calculations** 
   1. CU = √(u12 + u22 + u32…. )
   2. EU = CU \* k
2. **Records**
   1. Measurement Uncertainty for Drug Chemistry Weight Determination
   2. Uncertainty of Measurement Budgets
3. **References**
   1. *ASCLD/LAB Level 100A Traceability presentation*, Copyright 2011; Heusser Neweigh, LLC & ASCLD/LAB.
   2. *ASCLD/LAB Level 100B Measurement Assurance presentation*, Copyright 2011; Heusser Neweigh, LLC & ASCLD/LAB.
   3. *ASCLD/LAB Level 100C Measurement Uncertainty Concepts presentation*, Copyright 2011; Heusser Neweigh, LLC & ASCLD/LAB.
   4. *ASCLD/LAB Level 200 Measurement Confidence for the Forensic Laboratory: Measurement Uncertainty in Drug Chemistry presentation*, Copyright 2011; Heusser Neweigh, LLC & ASCLD/LAB.
   5. *ASCLD/LAB Level 200 Measurement Confidence for the Forensic Laboratory: Measurement Uncertainty in Toxicology Testing presentation***,** Copyright 2011; Heusser Neweigh, LLC & ASCLD/LAB.
   6. *Introduction to Measurement Uncertainty course***,** LeBeau, Marc A., Ph.D., 2009, RTI International
   7. *Introduction to Measurement Uncertainty – Practical Examples Part II course***,** LeBeau, Marc A., Ph.D., 2010, RTI International
   8. *Introduction to Measurement Uncertainty – Practical Examples Part III course***,** LeBeau, Marc A., Ph.D., 2010, RTI International
   9. *Evaluation of measurement data - Guide to the expression of uncertainty in measurement, JCGM 100:2008 GUM 1995 with minor corrections***,** First edition September 2008**,** JCGM 2008**,** Working Group 1 of the JointCommittee for Guides in Metrology (JCGM/WG 1)
   10. *“Supplemental Document SD-3, Part IVC - Measurement Uncertainty for Weight Determinations in Seized Drug Analysis.”* Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG)*.* July 7, 2011*.*
   11. *ASCLD/LAB Policy on Measurement Uncertainty*, ASCLD/LAB, AL-PD-3060 Ver 1.1.
   12. *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – Overview,* ASCLD/LAB, AL-PD-3061 Ver 1.0.
   13. *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – ANNEX A*, *Details on the NIST 8-Step Process*, ASCLD/LAB, AL-PD-3062 Ver 1.0.
   14. *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – ANNEX B*, *Drug Chemistry Discipline Three Examples – Weight, Volume and Purity Determination*, ASCLD/LAB, AL-PD-3063 Ver 1.0.
   15. *Guide for the Use of the International System of Units (SI).* NIST Special Publication 811, 2008 Ed., (March 2008; 2nd printing November 2008), p. 53.

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 8/7/13 | 2 | Incorporation or Uncertainty of Measurement and Measurement Assurance |
| 2/16/15 | 3 | Added lines 4.10.1, 5.2, 6.15. Addition to line 4.9. |
| 11/06/17 | 4 | Removed a weight associated with unanalyzed material from 4.9 Updated 4.10 uncertainty examples with current values. Removed 4.10.1. Added section 6. Records. |

# 6: Technical Procedure for Quality Assurance

1. **Purpose / Scope** – This procedure provides direction for the receipt and quality assurances of laboratory supplies, equipment, reagents, reference collections, reference standards and reference materials that affect casework in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification Crime Laboratory.
2. **Definitions**
   1. **Quality control check –** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   2. **Performance verification** – The initial confirmation of the reliability of a previously or externally validated method or instrument.
   3. **Commercial reagent -** A purchased solvent or chemical.
   4. **Certified Reference Material (CRM)** –Reference material characterized by a metrologically valid procedure for one or more specified properties, accompanied by a certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability.
   5. **Critical reagent** - Chemicals or reagents which critically affect the quality of tests which do not have their reliability verified as part of the quality control checks in a Drug Chemistry Unit Technical Procedure.
   6. **Prepared reagent -** Mixture of two or more reagents or a dilution.
   7. **Reference standard -** Measurement standard designated for the calibration of other measurement standards (reference standards or equipment.)
   8. **Reference material -** Material sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.
   9. **Primary reference material** - Any reference material obtained from a commercial source which has documentation issued by the manufacturer certifying its chemical composition or has documentation stating the manufacturer’s specifications for the material. This material may be certified reference material if available and practicable.

**2.10. Secondary reference material** - Reference material from a non-commercial source or from a commercial source which does not have authenticating documentation from the manufacturer or is derived from reference material.

**2.11. Authenticating documentation** - A certificate of analysis provided by the manufacturer certifying chemical composition or a statement of the manufacturer’s specifications or any published spectral data from an informed treatise generally accepted in the field that identifies a chemical substance.

**2.12. Stock Container -** A container of reagent prepared to serve as a reserve source of the reagent from which Use Containers are prepared. Stock containers shall not be used directly for analysis.

**2.13. Use Container -** A container of reagent used directly for analysis.

**2.14. Training standards -** Controlled substances and non-controlled substances used solely for training purposes.

1. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis.
2. **Procedure for Laboratory Supplies and Commercial Reagents** 
   1. Update the Drug Chemistry Unit Chemical Inventory log maintained in the Drug Chemistry Unit folder on the shared drive when a commercial reagent is received and when it is emptied / disposed.
   2. Upon being opened, commercial reagent containers shall be marked as opened along with the initials of the Drug Chemist and the date.
      1. When a commercial reagent is transferred to another container it shall be labeled with the following:
         1. Identity
         2. Supplier and lot number
         3. Initials of the Drug Chemist
         4. Date
         5. Expiration date, if applicable
         6. Any additional information as required by the CCBI Health and Safety Manual.
3. **Procedure for Prepared Reagents**
   1. Reagents may be prepared in any amount provided that the component ratios in the Drug Chemistry Unit Technical Procedure are kept constant.
   2. A stock containerisa container of reagent prepared to serve as a reserve source of the reagent from which use containers are prepared. Stock containers shall not be used directly for analysis.

* 1. A use containerisa container of reagent used directly for analysis.
  2. Labeling
     1. Lot numbers for stock containers and use containers of prepared reagents shall be assigned using lot number designations as specified in the Drug Chemistry Unit Technical Procedure.
     2. Stock containers of prepared reagents shall be labeled “Stock”.
     3. Stock containers of prepared reagents shall be labeled with the following:
        + 1. Identity of the reagent
          2. Initials of preparer
          3. Date of preparation
          4. Lot number
          5. Expiration date
          6. Any additional information as required by the CCBI Health and Safety Manual.
     4. Use containers of prepared reagents shall be labeled with the following:
        + 1. Identity of the reagent
          2. Initials of preparer
          3. Date of preparation
          4. Lot number
          5. Expiration date
          6. QCC due date
          7. Any additional information as required by the CCBI Health and Safety Manual.
     5. Each new container of prepared reagent shall be documented in the reagent log with the following:
        + 1. Identity of the reagent and lot number
          2. Reference to the Drug Chemistry Unit Technical Procedure followed for

preparation

* + - * 1. Initials of preparer
        2. Date of preparation
        3. Expiration date
        4. QCC result and supplier and lot number of any reference material used
        5. Component(s) and supplier and lot number
  1. Storage
     1. Reagents shall be stored in closed containers.
     2. All stock containers shall be stored in a chemical storage refrigerator in a secure location.
     3. All use containers shall be stored on the countertop or under the hood, unless otherwise specified in the Drug Chemistry Unit Technical Procedure.
  2. Expiration Dates
     1. Stock Containers have a three year expiry unless otherwise specified in the Drug Chemistry Unit Technical Procedure.
     2. Use containers have a one year expiry date unless otherwise specified in the Drug Chemistry Unit Technical Procedure.
     3. Use Containers with an expiry greater than six months must be have QCC(s) repeated every six months to ensure reagent reliability.
  3. Quality Control Checks
     1. Prepared reagents shall be quality control checked according to the Drug Chemistry Unit Technical Procedure prior to initial use and use containers with an expiry of greater than six months shall have QCC(s) repeated every six months to ensure reagent reliability.

* + 1. Document quality control checks in the reagent log with the following:
       1. Date performed
       2. Initials of Drug Chemist (performing and/or observing)
       3. Reference material, supplier and lot number
       4. QCC result
       5. Due date for next QCC
    2. The next QCC due date shall be listed on the use container, if applicable.

1. **Procedure for Reference Materials**
   1. Store Reference Materials that have not been approved for use in a location that is clearly labeled “Pending Approval.” Update the Drug Chemistry Unit Reference Material Inventory log maintained in the Drug Chemistry Unit folder on the shared drive when the material is received and when it is emptied / disposed.
      1. If material is to be obtained from a submission for use as a reference material a drug acquisition form must be completed by the Drug Chemist and approved by the Drug Chemistry Technical Leader. The Drug Chemist must record the amount removed and the purpose on the Drug Chemistry worksheet for inclusion in the case file. The Drug Chemistry Technical Leader must verify, with initials and date, this entry in the case file. The drug acquisition form shall be maintained in the Drug Chemistry Unit folder on the shared drive.
   2. Reference materials used in the Drug Chemistry Unit for the identification of controlled substances and in quality control checks are critical reagents.
   3. Prior to initial use in laboratory examinations, new reference material will be analyzed utilizing the instrumental techniques for which the Reference Material will be used for analytical purposes and any other analytical techniques necessary to verify chemical composition. Data produced from the initial evaluation may be used in casework if determined to be acceptable.
   4. Reference material will be suitable for use if the analytical data is comparable to available authenticating documentation provided by the supplier and authenticating data from another source. If authenticating documentation is unavailable from one of these sources, the Technical Leader may approve the reference material for use based on available authenticating documentation and a documented evaluation describing the reasoning why the analytical data appropriately corresponds to the chemical characteristics of the reference material. Reference materials that do not have authenticating documentation from a source other than the supplier will be indicated in the Chemistry Reference Material Log. Reference material that does not meet these requirements may not be used in laboratory examinations. During the Chemical Substances Inventory Audit, the Technical Leader will attempt to locate any additional authenticating documentation that may have become available after the reference material approval process.
      1. New reference material received from a supplier which bears a lot number which has been previously evaluated according to these requirements does not need to be re-evaluated for suitability of use.
   5. All authenticating documentation and analytical data will be maintained on the CCBI shared drive (i.e., S: drive). The date and the analyst who acquired the analytical data will be documented in the instrument logbook.
      1. Reference material that has does not have an expiration date or has passed the manufacturer’s expiration date will be re-evaluated prior to use using the intended analytical technique to ensure its stability. It is not required to repeat all instrumental techniques to ensure chemical stability.
   6. Reference materials shall be maintained in a secure location and stored according to the manufacturer’s instructions, if applicable.
   7. Reference materials approved for use in laboratory examinations shall be documented in the Chemistry Reference Material Log. The Chemistry Reference Material Log will be maintained on the CCBI shared drive (i.e., S: drive). The Chemistry Reference Material Log will reflect the date of approval for use in laboratory examinations, the initials of the person approving use, and the confirmatory instrumental techniques (i.e., Infra-red Spectrophotometry and Mass Spectrometry) for which a Reference Material has been determined to be suitable.
      1. The Chemistry Reference Material Log will reflect the current inventory of Reference Materials. Chemists will record the date, their initials, and the purpose on the Chemistry Reference Material Log when a Reference Material is removed for use. Chemists will record the amount removed according to the units listed in the Chemistry Reference Material Log.
   8. An audit of the Drug Chemistry reference materials shall be conducted annually according to the CCBI Administrative Procedure for Annual Quality Audits.
2. **Procedure for Training Standards**
   1. Training standards shall be marked as such and maintained separately from reference materials. Training standards shall be maintained in room C1401 and stored according to the manufacturer’s instructions, if applicable.

1. **Procedure for In-house Generated Reference Collections**
   1. Spectral reference collections generated within the Laboratory will be traceable to primary reference materials, if practicable, otherwise secondary reference materials may be used. Data and authenticating documentation shall be maintained in the Drug Chemistry Unit folder on the shared drive.
   2. When reference collections are updated they shall be renamed to include the date of revision. The previous version shall be archived. Current and archived in-house generated spectral reference collections shall be maintained by the Drug Chemistry Technical Leader.
2. **Procedure for Reference Standards**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Balances
3. **Safety –** Refer to the CCBI Health and Safety Manual
4. **Records** 
   1. Reagent log
   2. Drug acquisition form
   3. Chemistry reference material log
5. **References**
   1. *ASCLD/LAB Policy on Measurement Traceability,* ASCLD/LAB, AL-PD-3057 Ver 1.1.
   2. *ASCLD/LAB Guidance on Measurement Traceability,* ASCLD/LAB, AL-PD-3058 Ver 1.0.
   3. Part IVA.6.2 – Assessment of Drug Reference Materials.*Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations.* 7th ed.: June 9, 2016.

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 8/7/13 | 2 | Incorporation of Uncertainty of Measurement and Measurement Assurance |
| 2/2/14 | 3 | Changes to reference material storage |
| 2/16/15 | 4 | Additions to lines 4.2 and 6.1. Added reference material log to section 11. |
| 6/28/17 | 5 | Changed storage location for reference material and stock solutions. |
| 11/1/17 | 6 | Removed 4.2.2, 4.2.3, 7.2, 7.3. Changed 6.1.2, 6.2.1.2 and 6.2.2.2 to allow for electron storage. Added 6.2.1.4 to allow for standards to be able to be used past expiration or retest if a successful QCC is completed. |
| 1/16/18 | 7 | Section 4: Procedure for Laboratory Supplies and Commercial Reagents – Made reference to LAPM for purchasing, receiving, and storage procedures; removed specific requirements for purchasing and receiving already addressed in LAPM; Added reference to Health and Safety Manual to labeling requirements; Removed labeling requirements for reference material containers. |
| 01/06/20 | 8 | 2. Definitions - added Certified Reference Material, removed purchasing documentation.  3. Abbreviations - removed abbreviations  Removed any instructions which are already included in other laboratory procedures.  6. Reference Material - revised content  7. Procedure for Training Standards - removed inventory and audit requirements  8. Procedure for in-house generated reference collections -revised naming requirements  10. Safety - updated safety manual name  11. Records - added Chemistry reference material log |

**7: Technical Procedures for Color Tests**

1. **Purpose / Scope** - This procedure provides direction for the preparation and the use of color test in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification Crime Laboratory.
2. **Definitions** 
   1. **Prepared reagent –** Mixture of two or more reagents or a dilution.
   2. **Commercial reagent –** A purchased solvent or chemical.
   3. **Performance verification** – The initial confirmation of the reliability of a previously or externally validated method or instrument.
   4. **Quality control check** – Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   5. **Reference material –** Material sufficiently homogenous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.
   6. **Stock container –** a container of reagent prepared to serve as a reserve source of the reagent from which Use Containers are prepared. Stock containers shall not be used directly for analysis.
   7. **Use container –** a container of reagent used directly for analysis.
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
   2. Gamma-Hydroxybutyric acid (GHB)
   3. *p*DMAB *- para*-Dimethylaminobenzaldehyde
4. **Equipment, Materials and Reagents** 
   1. **Equipment** 
      1. Balance
   2. **Materials** 
      1. Beakers or other glass vessels
      2. Test tubes
      3. Funnel
      4. Glass stirring rod
      5. Graduated cylinder, class A
      6. Pipettes with bulb
      7. Spot plates
      8. Reagent bottles and stock bottles, including amber
      9. Spatula
      10. Weigh boats, paper or other weigh vessels
      11. Filter paper
      12. Scissors
      13. Deionized water
   3. **Commercial Reagents**
      1. Sulfuric acid, ACS
      2. Formaldehyde, approximately 40% aqueous, ACS
      3. Acetaldehyde, 99.5%
      4. Chloroform, Optima
      5. Cobalt (II) Thiocyanate
      6. Ferric Chloride, anhydrous
      7. Colbalt(II) Acetate, tetrahydrate
      8. Methanol, Optima or GC Resolv
      9. Isopropylamine, 99%
      10. *Para-*Dimethylaminobenzaldehyde, ACS
      11. Hydrochloric acid, ACS
      12. Molybdic acid, ACS or Sodium Molybdate, dihydrate, ACS
      13. Selenious acid, 98%
      14. Cupric Sulfate, pentahydrate, ACS
      15. Pyridine, ACS
      16. Sodium Nitroprusside, dihydrate, ACS
      17. Sodium Carbonate, anhydrous, ACS
      18. Cobalt (II) Nitrate, hexahydrate, ACS
      19. Glacial acetic acid, ACS grade
   4. **Reference materials** 
      1. Heroin
      2. Cocaine hydrochloride
      3. Phenobarbital
      4. Lysergic acid diethylamide
      5. *Gamma*-hydroxybutyric acid (GHB)
      6. Methamphetamine
      7. Oxycodone
5. **Standards and Controls** 
   1. Reagents shall be prepared, labeled and stored in accordance with the Drug Chemistry Unit Technical Procedure for Receipt and Quality Assurance of Laboratory Supplies, Reagents, Reference Collections, Reference Standards and Reference Materials.
   2. Perform positive and negative quality control checks on all use containers of color test reagents prior to use for analysis. The quality control checks must have acceptable results prior to the use of the reagent for analysis. Refer to the CCBI Crime Laboratory Administrative Procedure for Corrective and Preventive Action if necessary.
   3. Perform negative quality control checks (NQCC) according to the procedure listed for each color test with no sample present.
      1. Acceptable result is no significant color formation, i.e., Negative.
      2. If a significant color develops, take steps to ensure that the spot well is clean or use a new spot well or use a new culture tube.
      3. If the significant color formation persists, dispose of the reagent and prepare a new lot of reagent.
   4. Perform positive quality control checks (PQCC) according to the procedure listed for each color test using the specified reference material.
      1. Refer to each color test for acceptable results.
         1. If acceptable results are not observed, take steps to ensure that the spot well is clean or use a new spot well or use a new culture tube and repeat the PQCC. If the problem persists, dispose of the reagent and prepare a new lot of reagent.
      2. Record any observations, the reference material identification and the results of the positive quality control check in the Reagent Log.
6. **Color Tests**
   1. **Marquis**
      1. Useful for general screening mostly with opium alkaloids, opioids, methylenedioxy substituted cathinones, and amphetamines.
      2. Selected Characteristic Results:

Opiates, some opioids (morphine, codeine, heroin, buprenorphine) - purple

Guaifenesin - purple

(Meth)amphetamine - orange

MDA/MDMA - purple/black

Aspirin - slow cherry red

Bufotenine and psilocin - green-brown

Methylenedioxy substituted cathinones – bright yellow

Fentanyl - orange

* + 1. Preparation: Add 10 drops of 40% aqueous formaldehyde solution to 10 ml of concentrated sulfuric acid.
       1. Storage: Amber glass.
       2. Expiration: Stock container: NA

Use container: One month.

* + - 1. Lot number: Eight digit format year/month/day/Mq/initials of preparer.

Example: 20120131MqXXX

* + - 1. PQCC
         1. Reference material: Heroin
         2. Acceptable result: Purple color observed
    1. Procedure:
       1. Add 1-2 drops of the reagent to a clean spot well or a new test tube and observe any reaction or color produced.
          1. If a significant color develops, take steps to ensure that the spot well is clean or use a new spot well or use a new test tube.
          2. If the significant color formation persists prepare a new lot of reagent.
       2. Add a small amount of sample to the reagent.
       3. Observe any reaction or color produced.
       4. Record observations.
  1. **Cobalt Thiocyanate**
     1. Reacts with secondary and tertiary amines as well as some alkaloids to produce a blue color.
     2. Selected characteristic results: Cocaine – blue

PCP – blue

Ketamine - blue

* + 1. Preparation: Dissolve 2.0 g cobalt (II) thiocyanate in 100 ml of deionized water.
       1. Storage: Glass
       2. Expiration: Stock container: Three years.

Use container: Three months

* + - 1. Lot number: Eight digit format year/month/day/CoSCN2/initials of preparer. Example: 20120131CoSCN2XXX
      2. Positive Quality Control Check (PQCC):
         1. Reference Material: Cocaine hydrochloride.
         2. Acceptable result: A blue color is observed, i.e., Positive.
    1. Procedure
       1. Add 1-2 drops of the reagent to a clean spot well or a new test tube and observe any reaction or color produced.
          1. If a significant color develops, take steps to ensure that the spot well is clean or use a new spot well or use a new test tube.
          2. If the significant color formation persists prepare a new lot of reagent.
       2. Add a small amount of sample to the reagent.
       3. Observe any reaction or color produced.
       4. Record observations.
  1. **Ferric Chloride**
     1. Reacts with phenols, enols, and GHB to produce color.
     2. Selected characteristic results: GHB - red/brown
     3. Preparation: Dissolve 1.5 grams of ferric chloride in 29.0 milliliters of deionized water to produce a 5% w/v solution.
        1. Storage: Glass
        2. Expiration: Stock container: Three years

Use container: Three months

* + - 1. Lot number: Eight digit format year/month/day/FeCl3/initials of preparer. Example: 20120131FeCl3XXX
      2. Positive Quality Control Check (PQCC):
         1. Reference material: GHB
         2. Acceptable result: A red/brown color is observed.
    1. Procedure
       1. Add 1-2 drops of the reagent to a clean spot well or a new test tube and observe any reaction or color produced.
          1. If a significant color develops, take steps to ensure that the spot well is clean or use a new spot well or use a new test tube.
          2. If the significant color formation persists prepare a new lot of reagent.
       2. Add a small amount of sample to the reagent.
       3. Observe any reaction or color produced.
       4. Record observations.
  1. **Dille-Koppanyi (modified)**
     1. This color test reacts with barbiturates to produce a red-violet color.
     2. Selected characteristic results: Barbiturates – red-violet.
     3. Preparation
        1. Dille-Koppanyi Paper
           1. Dissolve 0.1 gram cobalt (II) acetate in 100 milliliters of methanol.
           2. Add 0.2 milliliter glacial acetic acid.
           3. Soak filter paper in the solution and allow to dry completely.
           4. Cut filter paper into small pieces for use. (Approximate one inch squares suggested.)
           5. Store filter paper in a wide mouth bottle with top.
           6. Storage: Amber glass
           7. Expiration: Use container: Three years
           8. Lot number: Eight digit format year/month/day/DKPap/initials of preparer.

Example: 20120131DKPapXXX

* + - * 1. Positive Quality Control Check (PQCC)

Reference material: Phenobarbital

Acceptable result: Red-violet color produced

* + - 1. 5% Isopropylamine
         1. Mix 5 milliliters isopropylamine and 95 milliliters methanol.
         2. Storage: Amber glass.
         3. Expiration: Stock container: Three years

Use container: Three months

* + - * 1. Lot number: Eight digit format year/month/day//initials of preparer.

Example: 20101231IPAm5%XXX

* + - * 1. Positive Quality Control Check (PQCC)

Reference material: Phenobarbital

Acceptable result: Red-violet color produced

* + 1. Procedure
       1. Place a small amount of sample on a piece of the Dille-Koppanyi paper.
       2. Press the sample onto the paper with a spatula (optional).
       3. Place a drop of the 5 % Isopropylamine solution on the edge of the Koppanyi paper and tilt to allow the drop to meet the sample.
       4. Record observations.
  1. ***para*-Dimethylaminobenzaldehyde (*p*DMAB)**
     1. This color test uses a filter paper soaked with the reagent. This test reacts with indoles (e.g., LSD), primary aromatic amines (e.g., procaine), and carbamates to produce colored intermediates.
     2. Selected Characteristic Results: Carbamate – yellow

LSD – purple

Psilocin – dark purple

Procaine, Benzocaine – orange/yellow

Dimethyltryptamine - purple

* + 1. Preparation: *p*DMAB Paper
       1. Dissolve 1.0 gram of *p*DMAB in 100 milliliters of methanol.
       2. Soak the filter paper in the solution and allow it to dry completely.
          1. Cut filter paper into small pieces for use.
          2. Storage: Amber glass
          3. Expiration: Use container: Three years
          4. Lot number: Eight digit format year/month/day/*p*DMAB/initials of preparer.

Example: 20120131*p*DMABXXX

* + - 1. Positive Quality Control Check (PQCC) QC check:
         1. Reference material: LSD
         2. Acceptable results: Purple color produced
    1. Procedure
       1. Place a small amount of sample on a piece of the *p*DMAB paper.
       2. Press the sample onto the paper with a spatula. (optional)
       3. Place a drop of methanol on top of the sample to help it dissolve into the paper.
       4. Add a drop of concentrated hydrochloric acid to the filter paper by one of the following methods:
          1. Adding the drop directly on the methanol spot.
          2. Adding the acid drop to the edge of the paper and allowing the acid and methanol spots to meet (e.g., LSD and Psilocin.)
          3. Allowing the fumes of the acid to contact the paper (e.g., procaine and benzocaine)
       5. Heated air may be applied.
       6. Record observations.
  1. **Froehde**
     1. This color test reacts with a wide range of aromatic compounds to produce colored intermediates.
     2. Selected Characteristic Results: Heroin – purple

Morphine – purple

Bufotenine – yellow/brown

Oxycodone - yellow

* + 1. Preparation: Prepare a 1% (w/v) solution of molybdic acid (or sodium molybdate) in concentrated sulfuric acid with heating and stirring.
       1. Storage: Amber glass
       2. Expriation: Stock container: One month

Use container: One month

* + - 1. Lot Number: Eight digit format year/month/day/Fro/initials of preparer. Example: 20120131FroXXX
      2. Positive Quality Control Check (PQCC):
         1. Reference material: Oxycodone
         2. Acceptable results: Oxycodone produces a yellow color.
    1. Procedure
       1. Add 1-2 drops of the reagent to a clean spot well or a new test tube and observe any reaction or color produced.
          1. If a significant color develops, take steps to ensure that the spot well is clean or use a new spot well or use a new test tube.
          2. If the significant color formation persists prepare a new lot of reagent.
       2. Add a small amount of sample to the reagent.
       3. Observe any reaction or color produced.
       4. Record observations.
  1. **Mecke**
     1. This color test reacts with a wide range of aromatic compounds to produce colored intermediates.
     2. Selected Characteristic Results: Bufotenine – brown to black/purple

Psilocin - green

Heroin – green/blue

Hydrocodone bitartrate – dark blue

Methadone – green/brown

Oxycodone - green

* + 1. Preparation: Prepare a 1% (w/v) solution of selenious acid in concentrated sulfuric acid with stirring.
       1. Storage: Amber Glass
       2. Expiration: The expiration date for this reagent shall be one month after preparation.
       3. Lot number: Eight digit format year/month/day/Mec/initials of preparer. Example: 20120131MecXXX
       4. Positive Quality Control Check (PQCC):
          1. Reference material: Oxycodone
          2. Acceptable results: Green color is produced
    2. Procedure
       1. Add 1-2 drops of the reagent to a clean spot well or a new test tube and observe any reaction or color produced.
          1. If a significant color develops, take steps to ensure that the spot well is clean or use a new spot well or use a new test tube.
          2. If the significant color formation persists prepare a new lot of reagent.
       2. Add a small amount of sample to the reagent.
       3. Observe any reaction or color produced.
       4. Record observations.
  1. **Cobalt Nitrate**
     1. This color test reacts with GHB to produce a pink to violet color.
     2. Selected Characteristic Results: GHB - pink to violet
     3. Preparation: Dissolve 0.2 gram of cobalt (II) nitrate in 20 milliliters of water (1 % w/v solution.)
        1. Storage: Glass
        2. Expiration: Stock container: Three years.

Use container: One year.

* + - 1. Lot number: Eight digit format year/month/day/CoNO3/initials of preparer. Example: 20120131CoNO3XXX
      2. Positive Quality Control Check (PQCC):
         1. Reference material: GHB
         2. Acceptable results: pink to violet color
    1. Procedure
       1. Add a few drops of the reagent to a new test tube and observe any reaction or color produced.
          1. If a significant color develops, use a new test tube.
          2. If the significant color formation persists prepare a new lot of reagent.
       2. Add 0.5 mL of the liquid sample.
       3. Observe any reaction or color produced.
       4. Record observations on the appropriate Drug Chemistry Worksheet form.
  1. **Zwikker**
     1. This color test reacts with barbiturates to produce a purple color that transfers to the organic layer of the reagent.
     2. Selected Characteristic Results: Barbiturates – purple or bright green color that transfers to the organic layer
     3. Preparation:
        1. 0.5% Cupric Sulfate
           1. Dissolve 0.12 gram cupric sulfate pentahydrate in 25 milliliters of deionized water.
           2. Storage: Glass
           3. Expiration: Stock container: Three years

Use container: One year

* + - * 1. Lot number: Eight digit format year/month/day/CuSO4/initials of preparer. Example: 20120131CuSO4XXX
        2. Positive Quality Control Check (PQCC):

Reference material: Phenobarbital

Acceptable results: Phenobarbital produces a purple color that transfers to the organic layer.

* + - 1. 5% Pyridine
         1. Add 1 milliliter of pyridine to 19 milliliters of chloroform.
         2. Storage: Amber glass
         3. Expiration: Stock Container: Three years

Use container: One year

* + - * 1. Lot number: Eight digit format year/month/day/Pyr5%/initials of preparer. Example: 20120131Pyr5%XXX
        2. Positive Quality Control Check (PQCC):

Reference material: Phenobarbital

Acceptable results: Phenobarbital produces a purple color that transfers to the organic layer.

* + - 1. Procedure
         1. Place a small amount of sample in a culture tube.
         2. Add a drop of 0.5 % cupric sulfate and observe any reaction or color change.
         3. Add a drop of 5 % pyridine and observe any reaction or color change.
         4. Record observations.
  1. **Simon’s Test (Modified Sodium Nitroprusside)**
     1. This color test reacts with secondary amines to produce a blue-violet color and it reacts with primary amines to produce a slow pink to cherry red color.
     2. Selected characteristic results: Methamphetamine and secondary amines: blue-violet

Amphetamine and primary amines : slow pink to cherry red

* + 1. Preparation:
       1. 1 % (w/v) Sodium Nitroprusside / 10 % by volume of acetaldehyde
          1. Dissolve 0.9 gram of sodium nitroprusside in 90 milliliters of water.
          2. Add 10 milliliters of acetaldehyde.
          3. Storage: Refrigerate in amber glass
          4. Expiration: Stock container: one month

Use container: One month

* + - * 1. Lot number: Eight digit format year/month/day/SNP/initials of preparer. Example: 20120131SNPXXX
        2. Positive Quality Control Check (PQCC)

Reference material: Methamphetamine

Acceptable results: Blue-violet color

* + - 1. 2 % (w/v) Sodium Carbonate
         1. Dissolve 2 grams of sodium carbonate in 100 milliliters of water.
         2. Storage: Closed container
         3. Expiration: Stock container: Three years

Use container: One year

* + - * 1. Lot number: Eight digit format year/month/day/Na2CO3/initials of preparer. Example: 20120131Na2CO3XXX
        2. Positive Quality Control Check (PQCC)

Reference material: Methamphetamine

Acceptable results: Blue-violet color

* + - 1. Procedure
         1. Place a small amount of sample in a culture tube or clean spot well and add one drop of the sodium nitroprusside reagent then add 2 drops of 2 % sodium carbonate.
         2. Observe any reaction or color produced.
         3. Record observations.

1. **Limitations** 
   1. The size, color or form (i.e. liquid) of the material may inhibit the color result observed.
   2. Some of the chemicals in color test reagents are hazardous. Refer to the MSDS of the chemicals prior to use.
2. **Safety –** Refer to CCBI Health and Safety Manual.
3. **References** 
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     7. Jungreis, Ervin. *Spot Test Analysis - Clinical, Environmental, Forensic, and Geochemical Applications*, New York: John Wiley & Sons, 1985, 80.
     8. Liu, Ray H. and Daniel E. Gadzala. *Handbook of Drug Analysis: Applications in Forensic and Clinical Laboratories*. Washington, D.C.: American Chemical Society, 1997: 58.
     9. Toole, K.E. et. al. “Color Tests for the Preliminary Identification of Methcathinone and Analogues of Methcathinone.” *Microgram Journal.* Volume 9, Number 1: 27-32.
     10. O’Neal, C.L. et. al. “Validation of Twelve Chemical Spot Tests for the Detection of Drugs of Abuse.” *Forensic Science International.* Volume 109 (2000): 189-201.
     11. Saferstein, Richard et. Al. “Reagents for Spot Tests” *Forensic Science Handbook.*Volume II (2005): 169.
     12. Morris, Jeremiah. “Modified Cobalt Thiocyanate Presumptive Color Test for Ketamine Hydrochloride”. *Journal of Forensic Sciences*, Volume 52. No. 1 (January 2007).
4. **Records** 
   1. Prepared reagent log
   2. Drug Chemistry worksheets

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/2013 | 1 | ISO Compliance |
| 2/16/15 | 2 | Added glacial acetic acid, ACS grade to commercial reagents |
| 10/02/17 | 3 | Added substituted cathinones to Marquis and updated Marquis preparation. Removed Duquenois Levine color test. Removed salt designation from heroin and oxycodone. |
| 07/08/19 | 4 | Removed SNP and added GHB to 3. Abbreviations. Removed acetaminophen as reference material in 4.4 Reference materials. Added Methylenedioxy to substituted cathinones in 6.1.1 and 6.1.2. Added codeine, buprenorphine and Fentanyl and removed oxycodone from Marquis results in 6.1.2. Added Ketamine to Cobalt Thiocyanate results in 6.2.2. Removed Acetaminophen from Ferric Chloride results in 6.3.2 and PQCC in 6.3.3.4. Added Dimethyltryptamine to pDMAB results in 6.5.2. Added storage for Mecke in 6.7.3.1. Added 7.1 and 7.2 to 7. Limitations. Updated Health and Safety Manual in 8. Safety. Added reference 9.1.12. |
| 4/8/20 | 5 | 5. Standards and Controls - removed 5.3.4. and revised 5.4.2. |

# 8: Ultraviolet Spectroscopy

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| --- | --- | --- |
| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 11/26/13 | 2 | Updated UV Procedures and Daily QCC Log |
| 3/31/16 | 3 | Updated for use of WinLab UV software. |
| 6/28/17 | 4 | Removed procedure due to instrumentation no longer being used for casework. See archived version dated 6/28/17. |

# 9: Technical Procedure for Infrared Spectroscopy

1. **Purpose / Scope** - This procedure provides direction for the initial setup, performance checks and usage of an Infrared Spectrometer (IR) in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification.
2. **Definitions** 
   1. **Performance verification -** The initial confirmation of the reliability of a previously or externally validated method or instrument.
   2. **Quality control check -** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   3. **Reference Material** - Material sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis.
4. **Equipment, Materials, and Reagents** 
   1. **Equipment**
      1. Frontier Fourier Transform Infrared Spectrometer (FTIR) with Universal Attenuated Total Reflectance (ATR) Sampling Accessory and Spectrum Software version 10 with printer.
   2. **Reference Material** 
      1. Frontier FTIR Filter Wheel Polystyrene
      2. Polystyrene Traceable Reference Material
   3. **Materials**
      1. Spatula
      2. Water, deionized
      3. Desiccant packs, PerkinElmer
      4. Fuses - 2A, 250V, PerkinElmer
   4. **Commercial Reagents**
      1. Methanol or other suitable organic solvent, Optima or ACS grade
5. **Standards and Controls** 
   1. An electronic IR logbook folder shall be maintained on the computer near the instrument. The IR logbook folder shall contain the IR Activity Log, IR Daily QCC Log, the IR Maintenance Log and any manufacturer’s certificates, performance verification documentation, QCC and maintenance documentation.
   2. When the IR has been placed out of service (e.g., maintenance, malfunction, leaving direct control of the Laboratory), a Daily Quality Control Check must be successfully performed prior to placing the instrument back in service, refer to 5.6.
   3. The Drug Chemist shall record any malfunctions or error messages in the IR Activity Log, notify the Drug Chemistry Technical Leader of any malfunctions or error messages and place the instrument out of service by marking the IR Activity Log “Out of Service.”
   4. The Drug Chemistry Technical Leader shall examine the effect(s), if any, of a malfunction or error message on analysis results and implement the CCBI Laboratory Procedure for Corrective and Preventive Action as required.
   5. **Negative Quality Control Check**
      1. Prior to collecting each sample scan, collect a negative QCC scan, using the Instrument Settings in Section 7.1, with no sample present.
         1. A macro may be used to collect the spectrum and perform data handling.
         2. Perform the following functions on the collected spectrum: Normalize (1.5), ATR correction, auto baseline.
      2. Evaluate the acquired spectrum, it must be free from any significant peaks.
         1. If significant peaks are present, repeat the cleaning of the crystal, background collection and the negative QCC scan with no sample present.
         2. If the presence of significant peaks persists, mark the instrument “Out of Service” on the IR activity log. Notify the Drug Chemistry Technical Leader.
            1. The Drug Chemistry Technical Leader shall either correct the problem or schedule service.
            2. A successful Daily Quality Control Check, refer to 5.6., shall be performed prior to placing the instrument back in service.
      3. Record all negative QCC’s and results (pass/fail) on the IR activity log.
      4. Print the negative QCC spectrum and mark it with initials, date, instrument serial number, case number, item number and any other information needed to uniquely identify the preceded sample and place in the case record.
   6. **Daily Quality Control Checks** 
      1. The desiccant check and the daily polystyrene quality control check shall be performed daily, prior to casework and following any shutdown, by a Drug Chemist each day the instrument is in use.
      2. Desiccant check - observe the desiccant indicator on top of the instrument.
         1. Observe the desiccant indicators on top of the instrument. All sectors should be blue in color.
         2. If a sector is white, the desiccant should be replaced soon, refer to 6.3.2. Desiccant.
         3. If any of the sectors are pink, place the instrument out of service by marking the IR Activity Log “Out of Service.” The desiccant must be replaced, refer to refer to 6.3.2. Desiccant.
         4. Record the Desiccant check in the IR Daily QCC Log by recording the color of the sectors as pink (P), white (W), or blue (B).
      3. Daily Polystyrene Quality Control Check
         1. Collect a negative QCC using the procedure in Section 5.5.
         2. After completing the negative QCC, place the polystyrene in the beam path:
            1. Choose “Setup”.
            2. Choose “Instrument”.
            3. Select the “Setup Instrument Beam Path” tab.
            4. Under Settings, Filter Wheel, select “Polystyrene”.
         3. Collect a polystyrene scan using the Instrument Settings in Section 7.1 with the Polystyrene in the beam path.
            1. Perform the following functions on the collected spectrum: Normalize (1.5), ATR correction, auto baseline.
            2. A macro may be used to collect the spectrum with polystyrene in the beam path and perform data handling.
         4. Choose the “Labels” hot key to display peak data.
         5. Save the acquired spectrum and mark it with initials, date, instrument serial number, and “Daily QCC – internal polystyrene.”
         6. Remove the polystyrene from the beam path:
            1. Choose “Setup”.
            2. Choose “Instrument”.
            3. Select the “Setup Instrument Beam Path” tab.
            4. Under Settings, Filter Wheel, select “None”.
         7. Compare the peaks identified to the list below. Peaks must be identified near the wavenumbers listed within +/- 1.0 cm-1:
            1. 3082.22 cm-1
            2. 3060.14 cm-1
            3. 1601.38 cm-1
            4. 1583.04 cm-1
            5. 1028.42 cm-1
         8. Ensure all peaks are within the above ranges. Indicate pass or fail for each peak on the IR Daily QCC log.
         9. If any peaks are outside of the acceptable range, place the instrument out of service by marking the IR Activity Log “Out of Service.”
            1. The Drug Chemistry Technical Leader shall correct any problems with the instrument or request service. The Drug Chemistry Technical Leader shall examine the effect(s), if any, on analysis results and implement the CCBI Laboratory Procedure for Corrective and Preventive Action as required.
            2. The daily polystyrene QCC must be successfully completed prior to placing the instrument back in service.
         10. Place all QCC spectra in the IR Logbook folder.
   7. **Performance Verification for New Instrument**
      1. New FT-IR instruments shall be installed by a manufacturer representative or approved vendor according to the manufacturer’s guidelines.
         1. The installation shall include a demonstration of traceability of the instrument using polystyrene traceable reference material according to the manufacturer’s requirements and a demonstration of the traceability of the internal polystyrene using the universal ATR sampling accessory according to the requirements in 5.6.3.7.
      2. Prior to use, collect spectra of three controlled substance reference materials, e.g., methamphetamine, phentermine, and cocaine base, according to the procedure, refer to Section 7. Compare the spectra to previously obtained spectra for the reference materials or published data. The data obtained must be substantially the same as the previously obtained data or published data for each compound.
      3. Label the instrument printouts with the lot numbers of the reference materials, initials and date. Record the Performance Verification in the IR Logbook and save the files in the IR Logbook folder.
      4. The performance verification must be reviewed and approved by the Drug Chemistry Technical Leader prior to the instrument being used for casework. The Drug Chemistry Technical Leader shall record the review and approval in the IR logbook.
6. **Maintenance**
   1. Record all maintenance, other than cleaning, in the IR Maintenance Log at the time it is performed with the name of the person performing the maintenance or repairs, the initials of the Drug Chemist recording the maintenance or repairs, the date, a description of the maintenance or repairs and a list of any parts replaced.
   2. Place the instrument out of service prior to performing any maintenance other than daily cleaning by marking the IR activity log “Out of Service.” When the instrument is ready to be returned to service, mark the IR activity log “Back in Service.”
   3. Suggested Routine Maintenance Schedule
      1. Annual Maintenance
         1. Yearly preventive maintenance will be performed by an approved vendor.
         2. In order to demonstrate NIST traceability, a scan of a Polystyrene Traceable Reference Material shall be collected annually. The Drug Chemistry Technical Leader shall compare the current Daily QCC spectrum to the Traceable Reference Material spectrum for the peaks listed in 5.6.3.7. The acceptable range is ± 1.0 cm-1 of the nominal value.
         3. Maintain the spectra in the IR Logbook.
         4. Required post-maintenance checks prior to placing the instrument back in service: Negative QCC, refer to 5.5

Daily QCC, refer to 5.6

* + 1. Desiccant
       1. Desiccant packs shall be changed at approximately twelve month intervals, or sooner when needed.
       2. Remove the ATR accessory from the sample compartment. Pull lever underneath to release before removing.
       3. Loosen the two captive screws securing the desiccant cover.
       4. Open the cover and remove all the desiccant packs, noting how they were installed.
       5. Place the six packs of desiccant in the desiccant holder. Ensure that when the packs have been installed they do not extend above the level of the black rubber purge seal.
          1. The desiccant packs may be new or recharged packs. Recharge desiccant packs immediately before use by placing them in an oven at approximately 250 °C for approximately 8 hours and cooling in a desiccator.
       6. Close the cover and tighten the screws.
       7. Carefully refit the ATR accessory into the sample compartment area.
       8. Change the desiccant alert clock in the software:
          1. Choose “Setup Instrument”.
          2. Choose “Setup Instrument Beam Path”.
          3. In settings choose “Desiccant change due in (days)”.
          4. Select days and “Changed”
       9. Required post-maintenance checks prior to placing the instrument back in service: Negative QCC, refer to 5.5

Daily QCC, refer to 5.6

* + 1. Cleaning
       1. If necessary, clean the outside of the instrument with a damp cloth. Mild detergent may be used.
       2. Required post-maintenance checks prior to placing the instrument back in service: None.
       3. Cleaning need not be recorded in the IR Maintenance Log.
  1. Non-Routine Maintenance
     1. Fuse change
        1. If repeated fuse failures occur, there is an electrical fault. Disconnect the power supply and notify the Drug Chemistry Technical Leader for service scheduling. Place the instrument out of service by marking the IR activity log “Out of Service.”
        2. Switch off the power, wait for at least 60 seconds, and disconnect the power cable.
        3. A spare fuse is stored in the left side of the fuse drawer located at the rear of the instrument between the power switch and the power socket.
        4. Open the fuse drawer so that it swings down over the power socket.
        5. Remove the old fuse located on the right side.
        6. Remove the spare fuse located on the left side and fit it into the slot on the right.
        7. Close the fuse drawer.
        8. Connect the power cable and switch the instrument on.
     2. Required post maintenance checks prior to placing the instrument back in service: Negative QCC, refer to 5.5

Daily QCC, refer to 5.6.

1. **Procedure**
   1. **Instrument Settings**
      1. Scan range - 4000.00 to 550.00 cm-1
      2. Number scans - 4
      3. Resolution - 4 cm-1
      4. Atmospheric (CO2/H2O) Suppression - On
      5. Diamond/Zinc Selenide crystal - one bounce
   2. **Shutdown/Startup**
      1. The power switch to the infrared instrument shall be left ON at all times to ensure the optics stay warm and excess moisture does not build up in the instrument.
      2. The software and computer may be shut down at the end of each business day.

* + 1. If a shutdown occurs, i.e., power failure, correct operation shall be demonstrated prior to casework by performing a Daily QCC, refer to 5.6.
  1. **Procedure for solid and liquid samples**
     1. Clean the ATR sampling accessory crystal by wiping with a lintless paper wipe wetted using water or an organic solvent while firmly holding the accessory in place. Wipe dry with a lintless paper wipe while firmly holding the accessory in place or allow to air dry completely. When cleaning, do not apply liquids directly to the top of the ATR sampling accessory, volatiles may be introduced into the beam path and interfere with sample analysis.
     2. Collect a background scan daily and as needed.
     3. Perform and evaluate the negative QCC as described in 5.5.
     4. Place approximately 1 milligram or 1 drop of sample onto the ATR crystal.
     5. Apply force using the ATR force arm to ensure good contact between the sample and the surface of the crystal, taking care to not apply excessive force. The instrument display indicates the force applied and indicates when excessive force is detected.
     6. Scan to acquire data, a macro may be used to collect the spectrum and perform data handling.
        1. The amount of sample on the ATR crystal may be adjusted to produce better a quality (too much sample indicated by intense, broad peaks; too little sample indicated by weak, noisy peaks) spectrum and the scan repeated.
        2. Perform the following functions on the collected spectrum: normalize (1.5), ATR correction, auto baseline.
     7. Print the acquired spectrum.
        1. Label the spectrum with the initials, date, instrument serial number, case number, item number and any other information needed to uniquely identify the sample, e.g. extraction.
        2. Record the acquired spectrum in the case record.
     8. Spectral subtractions may be performed using the instrument software and spectra of primary or secondary reference material identified with supplier and lot number.
        1. Print the resulting subtracted spectrum and any spectra used for subtraction.
        2. Label the spectrum with the initials, date, instrument serial number, case number, item number, a marking to indicate that it was produced from a subtraction and any other information needed to uniquely identify the sample.
        3. Label the spectrum used for subtraction with initials, date, instrument serial number, identification and supplier/lot number.
        4. Record the spectra in the case record.
     9. The spectrum may be compared to primary and secondary reference material and / or library searched / compared to aid in interpretation.
     10. The IR spectrum of a substance must be compared to primary or secondary reference material and found to be substantially comparable, i.e., equivalent, to the IR spectrum of the reference material in both its overall appearance and in the presence of major peaks to be considered a positive Category A technique in the identification of a controlled substance, refer to the Drug Chemistry Technical Procedure for Drug Chemistry Analysis.
         1. The reference material spectrum must be marked with initials, date, case number, identity, supplier and lot number and included in the case record.
     11. When using IR to determine the salt form of a controlled substance, the areas of the spectrum necessary to identify the salt form must be compared to primary or secondary reference material and found to be substantially comparable, i.e., equivalent, to the IR spectrum of the reference material in both its overall appearance and in the presence of major peaks.
         1. The reference material spectrum must be marked with initials, date, case number, identity, supplier and lot number and included in the case record.
     12. The Drug Chemistry Unit Technical Procedure for Extractions may be used to isolate substances from mixtures.
     13. Record the results on the appropriate Drug Chemistry Worksheet form.
     14. Record the date, initials, sample identification, and any comments on the IR activity log.

1. **Limitations** 
   1. Compounds may exist in different crystal forms, polymorphs, which may produce unique spectra, e.g., mannitol.
   2. Due caution shall be exercised when using the search or compare function of the instrument software. The Chemist shall evaluate the data and not rely on the computer software for identification.
2. **Safety**
   1. Refer to the CCBI Health and Safety Manual.
   2. Do not perform any maintenance or alteration to the instrument that is not described in this procedure. Placing an eye directly in the beam path will cause injury to the eye.
3. **References** 
   1. Skoog, D. A., Holler, F. J., Nieman, T. A., *Principles of Instrumental Analysis*. 5th ed. Harcourt, Brace & Company, 1998: 299-354.
   2. Anthony C. Moffat et al., *Clarke’s Analysis of Drugs and Poisons*. 4th ed. London, UK: Pharmaceutical press, 2011.
   3. Mills, III, Terry and J. Conrad Roberson. *Instrumental Data for Drug Analysis*. 2nd Edition. CRC Press, Inc.: Volumes 1-5, 1993.
   4. Mills, III, Terry, et al. *Instrumental Data for Drug Analysis*. 3rd Edition. CRC Press, Inc.: Volumes 6-7, 1996.
   5. Sliverstein, Robert M., et al. *Spectrometric Identification of Organic Compounds*. 7th Edition. New York: Wiley, 2005.
   6. *Frontier IR Single-range Systems User’s Guide*, Perkin-Elmer, Inc., UK: 2011.
   7. *Instrument Performance Validation Kit User’s Guide,* Perkin-Elmer, Inc., UK: 2011.
   8. *Universal ATR Sampling Accessory User’s Guide,* Perkin-Elmer, Inc., UK: 2011.
4. **Records** 
   1. IR Maintenance Log
   2. IR Daily QCC Log
   3. IR Activity Log
   4. Case record

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 2/16/15 | 2 | Updated cleaning instructions in 7.3.1 |
| 7/14/17 | 3 | Updated to use electronic activity log, maintenance log, and IR daily QCC log. |
| 10/2/17 | 4 | Technical procedure review. |
| 2/5/18 | 5 | Added abbreviation to 3.6. Updated software version in 4.1.1. Added 5.5.1.1. and 5.5.1.2. Updated 5.6.2.1 -5.6.2.4. Updated 5.6.3.2.1.-5.6.3.2.4. for placing polystyrene in the beam path with the new software. Removed 5.6.3.2.5. and 5.6.3.2.6. Added 5.6.3.3.1. and 5.6.3.3.2. Updated 5.6.3.4. to reflect new title. Updated 5.6.3.6.1.-5.6.3.6.4. for removing polystyrene from the beam path with the new software. Removed 5.6.3.6.5. and 5.6.3.6.6. Updated 7.3.2. and 7.3.5. |
| 12/23/2019 | 6 | 3. Abbreviations – removed abbreviations.  4.2 Reference Material – added Polystyrene Traceable Reference Material.  5.5 Negative Quality Control Check – removed 5.5.2.2.1 and 5.5.2.2.2.  6.3.1. Annual Maintenance – revised 6.3.1.1 and 6.3.1.2 to reflect annual Polystyrene Traceable Reference Material collection.  6.3.2. Desiccant - updated 6.3.2.8.1 through 6.3.2.8.4. to reflect changing the desiccant alert clock in the current software. 9.Safety - Updated Health and Safety Manual  Formatting and typographical correction throughout procedure |

# 10: Technical Procedure for Extractions

1. **Purpose / Scope** - This procedure provides direction for the extraction techniques used in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification.
2. **Definitions** 
   1. **Quality control check -** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   2. **Reference Material** – Material sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
   2. QCC – Quality control check
   3. PQCC – Positive quality control check
   4. EXT – extraction
   5. **“+”**  or “↑” – used to indicate a fraction collected
   6. “-” or “↓” – used to indicate a fraction disposed
   7. “→” – used to indicate movement to the next step
   8. Evap – evaporated
   9. ∆ – used to indicate heat
   10. X – recrystallize
   11. Amm - ammoniated
4. **Materials and Reagents**
   1. **Materials**
      1. Heat source
      2. Beakers, vials, test tubes
      3. Vortex mixer
      4. Filter Paper
      5. Funnel
      6. Glass stirring rod
      7. Graduated cylinder
      8. Mortar and pestle
      9. Pipettes with bulb
      10. Bottles
      11. pH Test paper
      12. Litmus paper
      13. Separatory funnel (optional)
      14. Spatula
      15. Water (Deionized)
   2. **Commercial Reagents** 
      1. Acids, ACS grade
         1. Hydrochloric acid
         2. Sulfuric acid
         3. Glacial acetic acid
      2. Organic solvents - ACS, Optima or GC Resolv grade
         1. Methanol
         2. Chloroform
         3. Acetone
         4. Hexanes
         5. Diethyl ether
         6. Petroleum ether
         7. Ethyl Acetate
         8. Isopropanol
         9. n-Heptane
         10. Ethanol
         11. Methylene chloride
         12. Cyclohexane
      3. Bases, ACS grade
         1. Sodium hydroxide pellets
         2. Sodium bicarbonate
         3. Ammonium hydroxide
      4. Drying agents, ACS or certified grade
         1. Sodium sulfate, anhydrous
         2. Magnesium sulfate, anhydrous
   3. **Prepared Reagents -** Reagents may be prepared in any amount provided that the component ratios are kept constant. Reagents shall be labeled and stored according to the Drug Chemistry Unit Technical Procedure for Receipt and Quality Assurance of Laboratory Supplies, Reagents, Reference Collections, Reference Standards and Reference Materials.
      1. Dilutions or preparations of acids and bases may be prepared in the molarity or normality desired. Use the molarity or normality and the identity of the acid or base in the lot number. Label the container clearly with the identity of the acid or base and the molarity or normality.

Example: 5 ml of concentrated HCl is added to 95 ml of water

The initial normality of the HCl is 12N

The final normality is determined: (5 ml)(12 N) / (100 ml) = 0.6 N HCl

The lot number is 20120101HCl0.6NXXX

The container is clearly labeled: 0.6 N HCl

Example: 5 grams of sodium hydroxide pellets are dissolved in 100 ml of water

The formula weight of sodium hydroxide is 39.997

The normality (molarity) is determined:

(5 g / 0.1 L) (1 mol / 39.997 g) = 1.25 N NaOH

The lot number is 20120101NaOH1.25NXXX

The container is clearly labeled: 1.25 N NaOH

* + 1. Storage: closed container.
    2. Expiration: Stock container: Three years

Use container: One year

* + 1. Lot number: Eight digit format year/month/day/identity/concentration/initials of preparer.
    2. PQCC: Acceptable result: acidic or basic to litmus or pH paper
  1. **Ammoniated Organic Solvents**
     1. Preparation
        1. Shake 10 milliliters ammonium hydroxide with 100 milliliters of organic solvent, e.g., hexane, chloroform or a prepared solvent mixture, e.g., 4:1 chloroform:hexane.
        2. Allow layers to separate and draw off organic solvent for use.
     2. Storage: closed glass container.
     3. Expiration: stock container: One month

use container: One month

* + 1. Lot number: eight digit format year/month/day/Amm/solvent identification (ratio) /initials of preparer.

Example: 20120101AmmHex1:10XXX

* + 1. PQCC: Acceptable result: basic to litmus or pH paper
  1. **Acidified Organic Solvents**
     1. Preparation
        1. Shake 10 milliliters concentrated hydrochloric acid with 100 milliliters of organic solvent, e.g., diethyl ether, chloroform or a prepared solvent mixture, e.g., 4:1 diethyl ether:hexane.
        2. Allow layers to separate and draw off organic solvent for use.
     2. Storage: closed glass container.
     3. Expiration: stock container: One month

use container: One month

* + 1. Lot number: eight digit format year/month/day/ Acidic/solvent identification (ratio) /initials of preparer.

Example: 20120101AcidicHex1:10XXX

* + 1. PQCC: Acceptable result: acidic to litmus or pH paper
  1. **Organic solvent mixture**
     1. Preparation
        1. Mix desired solvents in ratio desired. Mix prior to each use.
     2. Storage: closed glass container.
     3. Expiration: Stock container: Three years

Use container: One year

* + 1. Lot number: Eight digit format year/month/day/solvent identification and ratio/initials of preparer.

Example: 20120101CHCl3IPA3:1XXX

* + 1. PQCC: Observe for complete mixing.

Acceptable result: Only one layer is present.

* 1. **Procedure**
     1. Samples may be extracted to isolate the compound of interest.
     2. Consider the chemical properties, e.g., solubility, partition coefficient and dissociation constant, of the sample and the medium, e.g., pH, and determine the extraction technique. Consider the stability and volatility, especially when applying heat and/or strong acids or bases. Typically basic and acidic drugs are extracted at a pH 2 to 3 units above and below, respectively, the pKa values of the drugs.
        1. Example for an organic basic drug:
        + Dissolve the sample in a dilute acid reagent and verify acidity with litmus or pH paper.
        + Wash the aqueous solution with an organic solvent chosen based upon the solubilities of the sample and medium to aid in the removal of any unwanted compounds in the medium.
        + Repeat the wash if necessary.
        + Add a basic reagent to the aqueous solution and verify basicity with litmus or pH paper.
        + Wash the aqueous solution with an organic solvent chosen based upon the solubilities of the sample and medium to aid in the removal of any unwanted compounds in the medium.
        + Evaporate the solvent in the fume hood, apply heat if desired and the compound of interest is compatible.
          - If excess moisture is a concern, dry the organic solvent over a drying agent, e.g., sodium or magnesium sulfate.
          - If the compound of interest is volatile, add an acidified organic solvent prior to evaporation or evaporate without heat.
        + Add a few drops of organic solvent if recrystallization is desired. Apply heat if desired and the compound of interest is compatible.
        1. Example for cocaine hydrochloride and inositol:
* Place sample in filter paper over beaker.
* Wash sample in filter paper with chloroform and collect chloroform.
* Evaporate chloroform.
  + - 1. Example for hydrocodone and acetaminophen pharmaceutical tablet:
* Crush tablet and place in filter paper.
* Wash sample with diethyl ether and allow material in filter paper to dry.
* Wash sample in filter paper with ammoniated hexane and collect ammoniated hexane.
* Evaporate ammoniated hexane.
  + - 1. Example for low dosage pharmaceutical tablet:
* Soak tablet in organic solvent.
* Draw off solvent and filter for GC/MS analysis, refer to the Drug Chemistry Unit Technical Procedure for Gas Chromatography / Mass Spectrometry.
  + 1. Record the extraction technique used in sufficient detail to allow the technique to be repeated. Record the lot number of any prepared reagents used. When a specific target pH is desired check the pH with pH test paper and record the observed pH (ie. acidic, basic, pH-8).
    2. **Negative Control for GC/MS extractions**
       1. Each extraction analyzed by GC/MS shall be accompanied by a negative control extraction performed immediately prior to or concurrent with the sample extraction using the same techniques, reagents and materials as the sample extraction in approximately the same amounts.
          1. When using disposable vessels the negative control extraction may be performed in separate glassware from the sample extraction.
          2. When using reusable vessels, perform the negative control extraction in the vessel immediately prior to performing the sample extraction.
          3. When filtering, use the filter medium from the negative control extraction for the sample extraction. Do not obtain new filter medium for the sample extraction.

1. **Limitations**
   1. Solvents and pH’s must be chosen as directed in 4.7.2.
2. **Safety –** Refer to the CCBI Crime Laboratory Safety Manual
3. **Records**
   1. Drug Chemistry worksheets
   2. Reagent log
4. **References** 
   1. Liu, R. H. and Gadzala, D. E. Handbook of Drug Analysis. Washington DC: American Chemical Society, 1997.
   2. Butler, William P. *Methods of Analysis for Alkaloids, Opiates, Marihuana, Barbiturates, and Miscellaneous Drug, Publication #341.* Washington, D.C.: U.S. Treasury Department, Internal Revenue Service, December, 1966: 64.
   3. Casale, J. “An Aqueous-Organic Extraction Method for the Isolation and Identification of Psilocin from Hallucinogenic Mushrooms.” *Journal of Forensic Science* (January, 1985).
   4. Casale, J.F., and R.F.X. Klein. “Illicit Production of Cocaine.” *Forensic Science Review,* Volume 5, Issue 2 (1993): 95-107.
   5. Chiong, D.M., E. Consuegra-Rodrigues and J.R. Almirall. “The Analysis and Identification of Steroids.”*Journal of Forensic Science,* Volume 37. Issue 37, (March, 1992): 488-502.
   6. Clarke, E.G.C. and R.G. Todd, eds. *Isolation and Identification of Drugs*. 1st Edition. London: Pharmaceutical Press, 1969.
   7. Moffat, A. C., et al., eds. *Clarke’s Isolation and Identification of Drug.* 2nd Edition. London: Pharmaceutical Press, 1986.
   8. Moffat, A. C., et al., eds. *Clarke’s Isolation and Identification of Drug.* 4th Edition. London: Pharmaceutical Press, 2011.
   9. Sarwar, Mohammad and John McDonald. “A Rapid Extraction and GC-MS Methodology for the Identification of Psilocyn in Mushroom/Chocolate Concoctions.” *Microgram Journal,* Volume , Issue 3-4 (July-December 2003).
   10. Suzuki, E.M. and W.R. Gresham. “Identification of Some Interferences in the Analysis of Clorazepate.” *Journal of Forensic Sciences,* Volume 28, Issue 3 (July 1983): 655-682.
   11. O’Neil, M. J. ed. *The Merck Index*, 14th Edition. Whitehouse Station, NJ: Merck & Co., Inc. 2006.

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 2/16/15 | 2 | Added solvents to section 4.2.2 and negative control requirements for GC/MS analysis to section 4.7.4 |
| 11/1/17 | 3 | Added a ratio to examples in 4.4.4 and 4.5.4. Added examples to 4.7.3. |
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**11: Technical Procedure for Microcrystalline Tests**

1. **Purpose / Scope** - This procedure provides instruction for the performance of microcrystalline tests in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification.
2. **Definitions** 
   1. **Quality control check -** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   2. **Reference Material** – Material sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties.
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
4. **Equipment, Materials and Reagents**
   1. **Equipment**
      1. Nikon Eclipse E400 Pol polarizing microscope equipped with 10X eyepiece and 10X objective to produce magnification of 100X
      2. Balance
   2. **Materials** 
      1. Beakers or other glass vessels
      2. Graduated cylinder
      3. Glass stirring rod
      4. Reagent bottle(s)
      5. Microscope slides
      6. Spatula
      7. Weigh boats or other weigh vessels
      8. Water
   3. **Reference Material**
      1. Cocaine
      2. Heroin
      3. Caffeine
   4. **Reagents**
      1. Mercuric chloride, ACS grade
      2. Gold chloride trihydrate, ACS grade
      3. Glacial acetic acid, ACS grade
5. **Standards and Controls**
   1. Reagents shall be prepared, labeled and stored in accordance with the Drug Chemistry Unit Technical Procedure for Receipt and Quality Assurance of Laboratory Supplies, Reagents, Reference Collections, Reference Standards and Reference Materials.
   2. Perform positive and negative quality control checks on all Use Containers of microcrystalline test reagents prior to use for analysis. The quality control checks must have acceptable results prior to use of the reagent for analysis.
   3. Perform negative quality control checks (NQCC) according to the procedure with no sample present.
      1. Acceptable result is no crystal formation, i.e., Negative.
      2. If crystals do form, steps will be taken until no crystals are formed. These steps may include retesting with a new microscope slide, re-cleaning any utensils used, or making a new reagent.
   4. Perform positive quality control checks (PQCC) according to the using the specified reference material.
      1. Refer to each microcrystalline test for acceptable results.
         1. If acceptable results are not observed, steps will be taken until acceptable results are obtained. These steps may include retesting with a new microscope slide, re-cleaning any utensils used, or making a new reagent.
         2. Record any observations and the results of the positive quality control check on the prepared reagent log.
6. **Operation of the Polarizing Microscope**
   1. Refer to the Drug Chemistry Unit Technical Procedure for General Laboratory Equipment.
      1. Turn on the light source.
      2. Place the specimen slide on the stage.
      3. Adjust the desired light intensity with the control lever.
      4. Make sure the field diaphragm is open to the edge of the field view.
      5. Focus with the coarse and fine adjustments for the desired objective.
      6. Move the microscope slide around to view the entire specimen, adjusting the focus accordingly.
      7. Push the filter in to view the specimen with polars crossed, or pull it out to view with uncrossed polars.
7. **Procedure**
   1. Place a small portion of the sample, a few particles of material, on a microscope slide and add a drop of the microcrystalline reagent (A), refer to section 8, and mix with the sample.
   2. If dilution is necessary, mix the sample with a drop of reagent (B), refer to section 8, on the microscope slide prior to adding reagent (A), refer to section 8.
   3. Samples that have evaporated to dryness shall not be used for evaluation of crystals.
   4. Observe any crystals on the polarizing microscope under non-polarized and/or polarized light.
      1. If no crystals are observed record on the Drug Chemistry Worksheet form.
   5. If the crystal observed is that of a reference material used for a PQCC recorded by the Drug Chemist performing the microcrystalline test then the reference material need not be analyzed contemporaneously with the sample.
      1. A positive comparison occurs when the observed sample crystal is morphologically the same as the observed reference material crystal.
         1. Record a description, drawn and / or described in words, of the crystals observed for the sample and the reference material, if applicable, on the Drug Chemistry Worksheet form.
      2. If the observed sample crystal and the observed reference material crystal are not morphologically the same then the comparison is negative.
         1. Record a description, drawn and / or described in words, of the crystals observed for the sample and the reference material, if applicable, on the Drug Chemistry Worksheet form.
8. **Microcrystalline Reagents**
   1. **5 % Mercuric Chloride**
      1. This reagent is used for heroin and caffeine.
      2. Selected characteristic results:
         1. Heroin – fans / dendrites
         2. Caffeine – dendrites which are longer and less dense than heroin dendrites
      3. Preparation
         1. 5 % Mercuric Chloride, w/v (A)
            1. Dissolve 1.5 grams of mercuric chloride in 30 milliliters of water
            2. Storage: closed container
            3. Expiration: Stock container: Three years

Use container: One year

* + - * 1. Lot number: Eight digit format year/month/day/HgCl2/Initials of preparer. Example: 20101231HgCl2XXX
        2. PQCC

Reference material: Heroin

Acceptable result: Fans / dendrites

* + - 1. 0.05 N Hydrochloric Acid (B)
         1. Mix 1 milliliter of concentrated hydrochloric acid with 250 milliliters of deionized water.
         2. Storage: closed container
         3. Expiration: Stock container: Three years

Use container: One year

* + - * 1. Lot number: Eight digit format year/month/day/HCl0.05N/Initials of preparer. Example: 20101231HCl0.05NXXX
        2. PQCC

Reference material: Heroin

Acceptable result: Fans / dendrites

* 1. **Gold Chloride in 20 % Acetic Acid**
     1. This reagent is used for cocaine.
     2. Selected characteristic results:
        1. Cocaine - cross-shaped crystals.
     3. Preparation
        1. 2% Gold Chloride (w/v) in 20 % Acetic Acid (v/v)
           1. Add 10 milliliters glacial acetic acid to 40 milliliters of water, mix.
           2. Dissolve 1.0 gram of gold chloride in the 50 milliliters of 20 % acetic acid, with stirring.
           3. Storage: Closed container
           4. Expiration: Stock container: Three years

Use container: One year

* + - * 1. Lot number: Eight digit format year/month/day/AuCl/Initials of preparer. Example: 2010123AuClXXX
        2. PQCC

Reference material: Cocaine

Acceptable result: Cross-shaped crystals

1. **Limitations** 
   1. Diluents and adulterants may interfere with crystal formation. Refer to the Drug Chemistry Unit Technical Procedure for Extractions to remove unwanted components prior to microcrystalline testing.
   2. Concentration of samples may need to be increased or decreased to aid in crystal formation.
2. **Safety –** Refer to the CCBI Crime Laboratory Safety Manual
3. **References** 
   1. *Nikon Polarizing Microscope Eclipse E400Pol Instructions*, Nikon Inc, Melville, NY, M216E 98.8.VF.1.
   2. Clarke, E.G.C., and R.G. Todd, eds. *Isolation and Identification of Drugs*. 1st Edition. London: Pharmaceutical Press, 1969: 135-141, 801.
   3. Allen, A. C., Copper, D. A., Kiser, W. O., Cottrell, R. C., “The Cocaine Diastereoisomers,” *Journal of Forensic Sciences*, Vol. 26, No.1, Jan. 1981, pp. 12–26.
   4. Smith, F.P., ed. *Handbook of Forensic Drug Analysis.* Boston, Massachusetts: Elsevier Academic Press, 2005: 238.
4. **Records**
   1. Reagent log
   2. Case record

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/15/13 | 1 | ISO Compliance |
| 11/1/17 | 2 | Reorganized section 7.5. Removed 8.2.3.2 and 8.2.3.2.1. |
| 4/8/20 | 3 | 5. Standards and Controls - removed 5.3.3. and revised 5.4.1.2.  7. Procedure - Revised 7.5., 7.5.1.1., and 7.5.2.1. |
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# 12: Gas Chromatography/Mass Spectrometry (GC-MS)

1. **Purpose / Scope** - This procedure provides direction for the initial setup, performance checks and usage of gas chromatograph – mass spectrometer instruments in the Drug Chemistry Unit of the Raleigh/Wake City-County Bureau of Identification.
2. **Definitions**
   1. **Performance verification -** The initial confirmation of the reliability of a previously or externally validated method or instrument.
   2. **Quality control check -** Periodic confirmation of the reliability of equipment, instrumentation, and/or reagents.
   3. **Reference Material** - Material sufficiently homogeneous and stable with reference to specified properties, which has been established to be fit for its intended use in measurement or in examination of nominal properties
3. **Abbreviations**
   1. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis
4. **Equipment, Materials and Reagents**
   1. **Equipment**
      1. Agilent 6890 or 7890 Gas Chromatograph with Agilent 5975 Series Mass Selective Detector with Agilent Automatic Liquid Sampler and tray
      2. Computer with Agilent Analytical MSD Productivity ChemStation Software and Printer
   2. **Reference Materials**
      1. Multi-component drug solution containing alprazolam, clonazepam, diazepam, flunitrazepam, lorazepam, nitrazepam, oxazepam and temazepam
   3. **Materials**
      1. Sample vials, caps and inserts
      2. ALS Syringe, 10*μ*l straight, fixed needle, 23/42/HP
      3. DB5-MS Column, 30 m X 0.250 mm X 0.25 µm
      4. Agilent inlet liner, split, single taper with glass wool, deactivated
      5. Agilent liner O-ring, non-stick flip-top
      6. Merlin microseal
      7. Non-stick septa, 11mm
      8. Septum wrench
      9. Tweezers
      10. Clean, lint free, non-nylon gloves
      11. Wrenches, ¼ inch and ½ inch
      12. Gold plated inlet seal with cross and 0.375 outer diameter washer
      13. Star or Torx screwdriver
      14. Flat head screwdriver, large
      15. Hex key, 5 mm
      16. Inland 45 pump oil
      17. Funnel
      18. Hex ball driver, 1.5 mm
      19. Hex ball driver, 2.0 mm
      20. Wrench, open-end, 10 mm
      21. Alumina abrasive powder
      22. Cotton swabs
      23. Ultrasonic bath
   4. **Commercial Reagents**
      1. Methanol, Optima or GC Resolv grade
      2. Hexanes, Optima grade
      3. Chloroform, Optima grade
      4. Acetonitrile, Optima grade
      5. Ethyl acetate, Optima grade
      6. Methylene chloride, Optima or Pesticide grade
      7. Helium gas, Grade 5.0
      8. Perfluorotributylamine [PFTBA], neat
5. **Standards and Controls**
   1. An electronic GC-MS logbook shall be maintained. The logbook shall contain the GC-MS Activity Log, GC-MS Daily QCC Log, the GC-MS Monthly QCC Log, the GC-MS Maintenance Log and any manufacturer’s certificates, performance verification documentation, monthly and daily QCC’s, sequence logs and maintenance documentation.
      1. The logbook shall contain the Drug Chemistry GC-MS activity log.
         1. Record the date, data file name, initials of operator, GC-MS method used, NQCC results, and any results/comments for each sample analyzed on the Drug Chemistry GC-MS Activity Log.
            1. If samples are rerun for any reason, record a new entry on the Drug Chemistry GC-MS Activity Log.
         2. Record any error messages on the Drug Chemistry GC-MS Activity Log.
      2. The logbook shall contain the Drug Chemistry GC-MS daily QCC log.
         1. Record all Daily QCC’s on the Daily QCC log with the date, time, initials, NQCC results and any comments.
         2. Save Daily QCC’s in the instrument logbook folder.
      3. The logbook shall contain the monthly QCC data, refer to 5.7. Other reference material retention time data may be maintained in the logbook.
      4. The logbook shall contain the GC-MS maintenance log, refer to Section 6.
   2. When the GC-MS has been placed out of service for maintenance, malfunction or leaving direct control of the Laboratory, the Drug Chemistry Technical Leader shall evaluate the instrument and determine if any additional quality control checks are needed to ensure instrument performance. At a minimum, a Daily QCC must be successfully performed prior to placing the instrument back in service, refer to 5.6.
      1. If maintenance is performed that may affect retention times, a monthly QCC, refer to 5.7., shall be performed before the instrument is placed back in service.
   3. The Drug Chemist shall record any malfunctions or error messages in the GC-MS Activity Log, notify the Drug Chemistry Technical Leader of any malfunctions or error messages and place the instrument out of service by marking the GC-MS Activity Log “Out of Service.”
   4. The Drug Chemistry Technical Leader shall correct any problems with the instrument or request service. The Drug Chemistry Technical Leader shall examine the effect(s), if any, of a malfunction or error message on analysis results and implement the CCBI Laboratory Procedure for Corrective and Preventive Action as required.
   5. **Negative Quality Control Check**
      1. Negative QCC’s are performed prior to each sample injection, refer to 7.3.
   6. **Daily Quality Control Check – Autotune**
      1. Perform an Autotune (atune) with Perfluorotributylamine (PFTBA) as the tuning standard prior to beginning the first sample sequence each day the instrument is in use.
         1. Sample sequences that continue overnight may be allowed to complete without performing a new tune provided that they do not extend more than thirty six hours beyond the time of the tune.
      2. Compare the atune report to previous ones. Record any major variations on the Daily QCC log and notify the Drug Chemistry Technical Leader.
      3. The mass assignments of the tuning masses, 69.00, 219.00, and 502.00, in the upper part of the tune report must be within **+/-** 0.2 amu.
      4. The peak widths on the tune report for masses 69.00, 219.00, and 502.00, must be within **+/-** 0.10 amu of 0.55 (i.e., 0.45-0.65) amu at 50% peak height (PW50) and the peaks should be generally be smooth and symmetrical.
      5. The base peak on the tune report must be identified as mass 69 or 219. The relative abundance ratio of mass 219 to mass 69 must be > 40% and the relative abundance ratio of mass 502 to mass 69 must be > 2.4%.
      6. The 70/69 isotopic ratio must be from 0.5 – 1.6, the 220/219 ratio must be from 3.2 – 5.4, and the 503/502 the ratio must be from 7.9 – 12.3.
      7. The abundance of any peaks less than 69 amu should not be greater than 10 % of the abundance of the base peak.
         1. Peaks at 18, 28 or 32 amu are indicative of water, nitrogen and oxygen, respectively, and may indicate an air leak. Other peaks may indicate gas impurities.
         2. If an air leak is detected, isolate the leak and tighten fittings to correct the leak and perform another atune.
         3. If the problem persists, place the instrument out of service by marking the activity log “out of service” and notify the Drug Chemistry Technical Leader.
         4. The Drug Chemistry Technical Leader shall correct any problems with the instrument or request service.
      8. If any parameter listed in 5.6.2. - 5.6.7. does not meet the requirements listed, document the deviation on the atune report and on the GC-MS daily QCC log.
         1. Perform another atune.
         2. If the problem persists, place the instrument out of service by marking the activity log “out of service” and notify the Drug Chemistry Technical Leader.
         3. The Drug Chemistry Technical Leader shall correct any problems with the instrument or request service.
         4. The daily QCC must be successfully completed prior to placing the instrument back in service.
      9. Save the atune report in the instrument logbook folder and record the results in the GC-MS daily QCC log.
   7. **Monthly Quality Control Check**
      1. The multi-component drug solution from 4.2.1. shall be injected on each method, refer to 7.1., each month the instrument is in use to verify instrument performance.
      2. The solution shall, when feasible, be run during the first seven calendar days of each month.
         1. If the standard solution is not run during the first seven calendar days of the month, the instrument shall be out of service until the standard solution is successfully run.
      3. Name the multi-component reference material solution data files with “MC” followed by the numerical year and month designation and the method name. Name the corresponding solvent blank with the same designation followed by “-b”, indicating that it is a blank.

Example: The name of a standard solution run in January, 2099 on the LOW method would be “MC209901LOW” and the blank would be “MC209901LOW-b.”

* + 1. Visually examine the TIC of the monthly QCC solution for chromatographic quality and resolution. All components must exhibit visually symmetrical peaks that are visually baseline resolved or for peaks separated by 0.2 minutes or less, visually resolved at half height.
    2. Perform a GC retention time comparison, refer to 7.10., for the Oxazepam, Temazepam and Alprazolam components of the monthly QCC solution to those of the previous monthly QCC solution run.
    3. Perform a mass spectral comparison, refer to 7.9., for the Oxazepam, Temazepam and Alprazolam components of the monthly QCC solution to reference material.
    4. Each component must have a positive comparison for 5.7.5. and 5.7.6.
       1. Record any component that does have a positive comparison on the instrument monthly QCC log, place the instrument out of service by marking the GC-MS activity log “out of service” and notify the Drug Chemistry Technical Leader.
       2. The Drug Chemistry Technical Leader shall correct any problems with the instrument or request service. The Drug Chemistry Technical Leader shall examine the effect(s), if any, on analysis results and implement the CCBI Laboratory Procedure for Corrective and Preventive Action as required.
       3. The monthly QCC must be successfully completed prior to placing the instrument back in service.
    5. Save the monthly QCC TIC with the retention times displayed, the mass spectrum of Oxazepam, Temazepam and Alprazolam and the corresponding blank TIC.
       1. Record the lot number of the standard solution on the TIC.
       2. Save the generated data in the instrument logbook folder.
       3. Record the monthly check in the monthly QCC log.
    6. Additional reference material solutions may be run on a monthly basis to establish retention times.
  1. **Performance Verification for New Instrumentation**
     1. New GC-MS instruments shall be installed by a manufacturer representative or approved vendor according to the manufacturer’s guidelines.
     2. Prior to use, perform daily QCC’s, refer to 5.6., on three separate days. The daily QCC’s must meet all specified requirements.
     3. Prior to use, analyze the multi-component drug solution from 4.2.1 on each method (refer to 7.1.) on three separate days.
        1. The mass spectra of each component must have a positive mass spectral comparison to reference material, refer to 7.9.
        2. The retention times of each component must have a positive GC retention time comparison to reference material, refer to 7.10.
     4. Label the instrument data with the lot number of the reference material and date. Record the performance verification in the GC-MS logbook and place the data in the GC-MS logbook folder.
     5. The performance verification must be reviewed and approved by the Drug Chemistry Technical Leader prior to the instrument being used for casework. The Drug Chemistry Technical Leader shall record the review and approval in the GC-MS logbook.

1. **Maintenance**
   1. Place the instrument out of service prior to performing any column or mass spectrometer maintenance by marking the GC-MS activity log “Out of Service.” When the instrument is ready to be returned to service, mark the GC-MS activity log “Back in Service.”
   2. Record all maintenance on the GC-MS maintenance log at the time it is performed with the name of the person performing the maintenance or repairs, the initials of the Drug Chemist recording the maintenance or repairs, the date, the time, a description of the maintenance or repairs and a list of any parts replaced, the type of post maintenance QCC performed, and any additional comments.
   3. Record the length of column trimmed in the activity log and maintenance log. If the column is trimmed, the instrument shall be out of service until a monthly QCC is successfully completed, refer to 5.7.
      1. Reference materials ran prior to the column maintenance shall not be used for retention time comparison after the column maintenance.
      2. The Drug Chemistry Technical Leader shall update the instrument log when the instrument is ready to be used for casework and save any generated data in the instrument logbook folder.
   4. **Suggested Routine maintenance** – The routine maintenance schedule is a suggested guideline. The maintenance schedule will be determined by the Drug Chemistry Technical Leader based upon instrument usage and performance.
      1. Wash Vials
         1. Rinse and fill daily when in use. Use methanol in the first wash vial and ethyl acetate in the second wash vial.
         2. Required post-maintenance check: None.
      2. Septum or Merlin microseal
         1. For septum, replace weekly, at a minimum, when in use.
         2. For Merlin microseal, replace yearly at a minimum when in use.
            1. Press [Oven] and set the oven to 35°C. When the temperature reaches setpoint, turn the oven off. Press [Front Inlet] and turn off the inlet temperature and pressure.
            2. Be careful - The inlet fittings may be hot enough to cause burns. Remove the septum retainer nut, using the wrench if the nut is hot or sticks.
            3. Remove the old septum or Merlin microseal, using tweezers if necessary. Be sure that it is completely removed and take care to avoid gouging or scratching the interior of the septum head.
            4. Press a new septum or Merlin microseal into place firmly.
            5. Replace the septum or Merlin microseal retainer nut, tightening it finger-tight until the c-ring is about 1 mm above the nut. Avoid overtightening.
            6. Using ChemStation load a method to return the GC to appropriate settings. If prompted, do not save any method changes.
            7. Allow the GC to return to the setpoints.
         3. Record on the GCMS Maintenance Log.
         4. Required post-maintenance check: Successful daily QCC, refer to 5.6.
      3. Syringe
         1. Inspect monthly for cleanliness and ease of movement. Replace yearly, at a minimum, when in use.
            1. Mount the injector on a parking post.
            2. Open the injector door.
            3. Slide the syringe carriage to the top position.
            4. Completely loosen the plunger thumb screw until it reaches the stop, and lift the plunger carrier off of the syringe plunger.
            5. Open the syringe latch by swinging it in a counterclockwise direction.
            6. Carefully pull the top of the syringe out of the flange guide, then lift the needle out of the needle support foot.
            7. Carefully pass the new syringe needle through the guide hole in the needle support foot.
            8. Align the syringe flange with the flange guide and press the syringe into place, keeping the needle end in the guide hole of the needle support foot. Make sure that the flat edge of the syringe flange faces out.
            9. Close the syringe latch by swinging it clockwise until it snaps in place.
            10. Slide the plunger carrier down until it is completely over the syringe plunger, and tighten the plunger thumb screw until finger- tight.
            11. Manually move the plunger carrier up and down. If the syringe plunger does not move along with the carrier, repeat the previous steps until installed correctly. Be sure the plunger thumb screw is secure and tight. Verify that the needle is inside the guide hole of the needle support foot. The needle should be straight and pass freely through the needle guide hole. If the needle is bent or is outside the guide hole, remove the syringe and reinstall.
            12. Close the injector door.
            13. Mount the injector on the inlet.
         2. Record on the GCMS Maintenance Log.
         3. Required post-maintenance check: None.
      4. Liner
         1. Replace monthly, at a minimum, when in use.
            1. Press [Oven] and set the oven to 35°C. When the temperature reaches setpoint, turn the oven off. Press [Front Inlet] and turn off the inlet temperature and pressure.
            2. Be careful - The inlet fittings may be hot enough to cause burns. Flip the inlet open.
            3. Remove liner with tweezers, being careful not to break the liner.
            4. Hold the new liner with tweezers or lint free tissue and place the o-ring on the liner about 2 to 3 mm from its top end.
            5. Insert the liner straight down into the inlet and press gently to ensure it is seated.
            6. Replace the inlet cover and flip the top into place.
            7. Using ChemStation load a method to return the GC to appropriate settings. If prompted, do not save any method changes.
            8. Allow the GC to return to the setpoints.
         2. Record on the GCMS Maintenance Log.
         3. Required post-maintenance check: Successful daily QCC, refer to 5.6.
      5. Pump Oil
         1. Change every six months.
            1. Vent the MSD by selecting the vent option in Instrument Control of Chemstation. Allow the vent cycle to run, when the cycle is complete and the temperatures are below 100 degrees Celsius turn off the MSD.
            2. Press [Oven] and set the oven to 35°C. Press [Front Inlet] and turn off the inlet temperature and pressure. When the temperature reaches the setpoint turn the GC off.
            3. Place a book or other object approximately two inches thick under the pump motor to tilt it up slightly.
            4. Remove the fill cap.
            5. Place a container under the drain plug.
            6. Remove the drain plug. Allow the pump oil to drain out. The foreline pump and oil may be hot.
            7. Replace the drain plug.
            8. Remove the book or object used to prop up the pump.
            9. Refill the foreline pump with Inland 45 pump oil, using a funnel, until the oil level is between the two fill marks in the site window, approximately 0.28 L of oil.
            10. Wait a few minutes for the oil to settle. If the oil level drops, add oil to bring the oil level near the upper line.
            11. Reinstall the fill cap.
            12. Power on the GC.
            13. Ensure that the vent valve is closed. Holding the MSD chamber door closed, power on the MSD and ensure that the turbo pump speed climbs to 100%.
            14. Start the Chemstation software and apply setpoints.
            15. Allow the instrument to equilibrate for two hours prior to tuning.
         2. Record on the GCMS Maintenance Log.
         3. Required post-maintenance check: Successful daily QCC, refer to 5.6.
      6. Clean Source
         1. Clean annually, at a minimum.
            1. Vent the MSD by selecting the vent option in Instrument Control of Chemstation. Allow the vent cycle to run, when the cycle is complete and the temperatures are below 100 degrees Celsius turn off the MSD.
            2. Press [Oven] and set the oven to 35°C. Press [Front Inlet] and turn off the inlet temperature and pressure. When the temperature reaches the setpoint turn the GC off.
            3. Open the vent valve
            4. Detach the ribbon cables from the circuit board on the MSD chamber door.
            5. Pull open the MSD chamber door by hand.
            6. Detach the leads from the ion source, loosen the screws and remove the ion source.
            7. Remove the filaments using a hex ball driver.
            8. Separate the repeller assembly from the source body. The repeller assembly includes the source heater assembly, repeller, and related parts.
            9. Remove the repeller.
            10. Unscrew the interface socket. A 10-mm open-end wrench fits the flats on the interface socket.
            11. Remove the setscrew for the lenses.
            12. Push the lenses out of the source body.
            13. If insulators are dirty, clean them with a cotton swab dampened with reagent-grade methanol. If that does not clean the insulators, replace them. Do not abrasively or ultrasonically clean the insulators.
            14. The filaments and source heater assembly cannot be cleaned ultrasonically. Replace these components if major contamination occurs.
            15. Collect the following parts that contact the sample or ion beam to be cleaned.

Repeller

Interface socket

Source body

Drawout plate

Drawout cylinder

Ion focus lens

Entrance lens

* + - * 1. Abrasively clean the surfaces that contact the sample or ion beam.
        2. Use an abrasive slurry of alumina powder and methanol on a cotton swab. Use enough force to remove all discolorations. Polishing the parts is not necessary; small scratches will not harm performance. Also abrasively clean the discolorations where electrons from the filaments enter the source body.
        3. Rinse away all abrasive residue with reagent-grade methanol.
        4. Make sure all abrasive residue is rinsed way before ultrasonic cleaning. If the methanol becomes cloudy or contains visible particles, rinse again.
        5. Separate the parts that were abrasively cleaned from the parts that were not abrasively cleaned.
        6. Ultrasonically clean the parts (each group separately) in polar and non-polar solvents; as recommended by the instrument manufacturer.
        7. Place the parts in a clean beaker.
        8. If needed, dry the cleaned parts in an oven at 100 °C for 5–6 minutes.
        9. If needed, let the parts cool before you handle them.
        10. Take care to avoid recontaminating cleaned and dried parts. Put on new, clean gloves before handling the parts. Do not set the cleaned parts on a dirty surface. Set them only on clean, lint-free cloths.
        11. Slide the drawout plate and the drawout cylinder into the source body.
        12. Assemble the ion focus lens, entrance lens, and lens insulators.
        13. Slide the assembled parts into the source body.
        14. Install the setscrew that holds the lenses in place.
        15. Reinstall the repeller, repeller insulators, washer, and repeller nut into the source heater assembly. The resulting assembly is called the repeller assembly.
        16. Reconnect the repeller assembly to the source body. The repeller assembly includes the source heater assembly, repeller, and related parts.
        17. Reinstall the filaments, replace if excessively worn.
        18. Reinstall the interface socket.
        19. Do not overtighten the repeller nut or the ceramic repeller insulators will break when the source heats up. The nut should only be finger-tight.
        20. Do not overtighten the interface socket. Overtightening could strip the threads.
        21. Reinstall the ion source into the MSD and reattach the leads.
        22. Close the vent valve.
        23. Push the MSD chamber door close and reattach the ribbon cables to the circuit board.
        24. Power on the GC.
        25. Holding the MSD chamber door closed, power on the MSD and ensure that the turbo pump speed climbs to 100%.
        26. Start the Chemstation software and apply setpoints.
        27. Allow the instrument to equilibrate for two hours prior to tuning.
      1. Record on the GCMS Maintenance Log.
      2. Required post-maintenance check: Successful daily QCC, refer to 5.6., and monthly QCC, refer to 5.7.
    1. Gold Seal
       1. Replace annually, at a minimum.
          1. Vent the MSD by selecting the vent option in Instrument Control of Chemstation. Allow the vent cycle to run, when the cycle is complete and the temperatures are below 100 degrees Celsius turn off the MSD.
          2. Press [Oven] and set the oven to 35°C. Press [Front Inlet] and turn off the inlet temperature and pressure. When the temperature reaches the setpoint turn the GC off.
          3. Be careful - The inlet fittings may be hot enough to cause burns. Loosen the inlet column nut with the ¼ inch wrench and remove the column from the inlet. Cap the open end of the column to prevent contamination.
          4. Remove the insulation cup from around the base of the inlet using the star screwdriver.
          5. Use the 1/2-inch wrench to loosen the reducing nut, and then remove it.
          6. The washer and seal are inside the reducing nut. Remove them, noting their orientation.
          7. Handle the new gold seal and washer with clean, lint-free, non-nylon gloves. Place the washer in the reducing nut. Place the new inlet base seal on top of it with the raised portion facing down.
          8. Replace the reducing nut. Use the 1/2-inch wrench to tighten the nut.
          9. Replace the column and the insulation cup.
          10. Using ChemStation load a method to return the GC to appropriate settings. If prompted, do not save any method changes.
          11. Allow the GC to return to the setpoints.
          12. Ensure that the vent valve is closed. Holding the MSD chamber door closed, power on the MSD and ensure that the turbo pump speed climbs to 100%.
          13. Start the ChemStation software and apply setpoints.
          14. Allow the instrument to equilibrate for two hours prior to tuning.
       2. Record on the GCMS Maintenance Log.
       3. Required post-maintenance check: Successful daily QCC, refer to 5.6., and monthly QCC, refer to 5.7.

1. **Procedure**
   1. Instrument Settings
      1. Select a GC-MS method based on the sample and any analysis results.
         1. The SCREEN (SCRN) method shall be used when a controlled substance is not previously indicated and a GC-MS analysis is performed, i.e. negative preliminary testing and/or infrared analysis indicated a non-controlled substance and a GC-MS analysis is performed.
         2. The SCREEN (SCRN) method shall be used for at least one sample preparation when GC-MS is the sole technique used in analysis.
         3. Each method may be used with split ratios of 5:1, 20:1, or 100:1. Numbers in front of the method name indicates the split ratio.
         4. Splitless injections are generally not utilized, but may be used for sample preparations that did not provide successful GC or MS comparison of a compound using a 5:1 or higher split ratio. “NoSplit” in front of the method name indicates a splitless injection.
         5. Each method shall wash the syringe at least 10 times between injections to ensure sample integrity
         6. When the standard methods are not appropriate to analyze a compound, a modified method may be used in accordance with the CCBI Administrative Procedure for Exceptions.
      2. HIGH – typically used for compounds that elute after 13 minutes in the screen method, e.g. buprenorphine, LSD, some steroids and some synthetic cannabinoids.
         1. 1.0 minute initial time
         2. 280 °C initial temperature
         3. 10 °C/minute ramp
         4. 300 °C final temperature
         5. 22.0 minutes final time
         6. 25.0 minutes total time
         7. Scan range = 40-500 amu
         8. 230 °C source temperature
         9. 150 °C quadrupole temperature
      3. LOW2 – typically used for compounds that elute prior to 15 minutes in the screen method, e.g. cocaine, amphetamines, some steroids, some synthetic cannabinoids, most opiates and most benzodiazepines.
         1. 1.5 minutes initial time
         2. 100 °C initial temperature
         3. 30 °C/minute ramp
         4. 300 °C final temperature
         5. 6.83 minutes final time
         6. 15.0 minutes total time
         7. Scan range = 40-500 amu
         8. 230 °C source temperature
         9. 150 °C quadrupole temperature
      4. SCREEN (SCRN) – Use this method when GC-MS is used to screen samples to determine if a controlled substance may be present.
         1. 1.5 minutes initial time
         2. 100 °C initial temperature
         3. 30 °C/minute
         4. 300 °C final temperature
         5. 26.83 minutes final time
         6. 35.0 minutes total time
         7. Scan range = 40-500 amu
         8. 230 °C source temperature
         9. 150 °C quadrupole temperature
      5. ISOTHERMAL2 (ISO) – This method can be used to differentiate structurally similar compounds including phenethylamines and fentanyl derivatives such as ortho, meta, and para-Fluoroisobutyryl Fentanyl, ortho, meta, and para-Fluorobutyryl Fentanyl, Cyclopropyl Fentanyl, and Crotonyl Fentanyl.
         1. 25.00 minutes initial time
         2. 250 °C initial temperature
         3. 250 °C final temperature
         4. 25.0 minutes total time
         5. Scan range = 40-500 amu
         6. 230 °C source temperature
         7. 150 °C quadrupole temperature
   2. Shutdown / Startup
      1. The GC-MS shall be left on at all times.
      2. The computer may be shut down or restarted if needed.
      3. A successful daily QCC check, refer to 5.6., must be performed following any GC or MS shutdown.
      4. Record any shutdown on the GC-MS activity Log.
   3. Prior to the injection of a sample, perform a negative QCC injection using the negative quality control extraction prepared using the same techniques, reagents materials, reagents and solvents as the sample preparation, refer to DCTP10. Use the same method and split ratio as the sample.
      1. Prepare the negative QCC extraction at the time of sample preparation from the same solvent source used in sample preparation.
      2. Evaluate the negative QCC to ensure that the instrument and solvent are free of any controlled substance, any substance being identified in the sample and any substance that may interfere with the identification of sample component(s).
         1. Note the presence of large amounts of common gas chromatography peaks (e.g., siloxanes) in the GC-MS activity log and notify the Drug Chemistry Technical Leader.
         2. Record all negative QCC’s results (pass/fail) and any comments on the GC-MS activity log.
   4. Evaluate and prepare samples prior to injection to avoid overloading, extreme pH, oils, sugars and compounds known to be retained in the instrument.
      1. At a minimum, filter solid samples with solvent to prevent particulate matter and undesired compounds from being introduced into the instrument (e.g., sugars). Particulate matter should not be visible in an autosampler vial.
      2. Refer to the Drug Chemistry Unit Technical Procedure for Extractions for additional sample preparation.
      3. Extract/convert sulfates prior to introduction into the instrument.
      4. If a derivatizing agent is used the controlled substance reference material must be derivatized contemporaneously.
         1. The mass spectrum of the derivatized reference material must be compared to published spectral data from an informed treatise generally accepted in the field and found to be substantially comparable, i.e., equivalent.
   5. Use the current date in the names of sequences. Sequences need not be archived. Upon completion of each sequence, save the sequence log in the GC-MS logbook folder.
   6. Include the CCBI case file number in the data file name and any additional information needed to uniquely identify the sample.
      1. Data files associated with casework and performance checks shall not be deleted or overwritten.
      2. The Drug Chemistry Technical Leader shall electronically archive data files annually. Store archived files electronically on the shared drive.
      3. Notify the Drug Chemistry Technical Leader if the data storage location becomes full.
   7. The GC-MS provides retention time data and mass spectral data. Refer to the Drug Chemistry Unit Technical Procedure for Drug Chemistry Analysis. Evaluate the chromatogram and spectra for each peak.
   8. Record in the case record the:
      1. Total Ion Chromatogram (TIC) for the corresponding blank.
      2. Sample TIC.
      3. Mass spectra of significant peaks.
      4. Expanded mass spectra of any phenethylamines.
   9. Mass Spectral Comparison
      1. For a positive mass spectral comparison, the sample mass spectrum must be substantially comparable, i.e., equivalent, to that of primary or secondary reference material.
         1. Record in the case record the mass spectrum of the reference material with the supplier and lot number or other Drug Chemistry Unit designation. Library search results may be included.
      2. If a derivatizing agent is used the mass spectrum of the sample mass spectrum must be compared to contemporaneously prepared derivatized reference material and found to be substantially comparable, i.e., equivalent.
         1. Record in the case record the mass spectrum of the reference material with the supplier and lot number or other Drug Chemistry Unit designation and the supplier and lot number of the derivatizing agent.
   10. GC Retention Time (RT) Comparison
       1. For a positive GC RT comparison of compounds with a retention time of 10 minutes or less, the difference between the sample retention time and a primary or secondary reference material retention time must be 0.10 minute or less. For a positive GC RT comparison of compounds with a retention time greater than 10 minutes, the percent difference between the sample retention time and a primary or secondary reference material retention time must be 1.0% or less.
          1. The chromatographic peaks must be visually smooth and symmetrical.
          2. The reference material must be run within thirty days before or after the case sample.
             1. If the reference material is a component of the monthly QCC solution, the retention time may be used for the month in which it was run plus the first seven calendar days of the following month.
             2. There must not be any column maintenance performed between the analysis of the sample and reference material.
          3. Record in the case record:
             1. Reference material TIC with the retention time(s) displayed.
             2. Reference material mass spectrum and any other significant peaks with the retention time(s) displayed.
             3. Reference material standard supplier and lot number or other Drug Chemistry Unit designation.
             4. The percent difference of the reference material and sample retention times, rounded to one decimal place, refer to 11.7.
2. **Calculations**
   1. Percent Difference Calculation, round to one decimal place, refer to 11.7.:

|(reference material RT – sample RT)| / (reference material RT) \* 100

1. **Limitations**
   1. The GC-MS methods described in this procedure shall not be used to distinguish between optical isomers.
   2. Introduction of improperly prepared samples may lead to poor sensitivity and carryover.
   3. The ISOTHERMAL2 temperature program alone cannot be used to distinguish retention times in a mixture containing Methoxyacetyl Fentanyl and Cyclopropyl Fentanyl.
   4. GC-MS analysis may not be able to distinguish between all isomers. Discretion shall be used when using GC-MS analysis for isomer determination.
2. **Safety**
   1. Refer to the CCBI Health and Safety Manual.
   2. Handle syringes with care to avoid punctures.
   3. Use extreme caution handling/installing/removing/transporting compressed gas cylinders. Cylinders shall not be moved without the cylinder cap securely in place.
   4. Gas Chromatograph and Mass Spectrometer may be extremely hot. Avoid touching hot areas and wear protective gloves while performing maintenance.
3. **References**
   1. Agilent 6890 GC Instrument Manuals.
   2. Agilent 5975 MSD Instrument Manuals.
   3. Moffat, A. C., et al., eds. *Clarke’s Isolation and Identification of Drugs.* 2nd Edition. London: Pharmaceutical Press, 1986.
   4. Moffat, A.C., et al., eds. *Clarke’s Analysis of Drugs and Poisons.* 4rd Edition. London: Pharmaceutical Press, 2011.
   5. Skoog, Douglas A., F. James Holler and Timothy A. Nieman. *Principles of Instrumental Analysis*. 5th Edition. Garcourt Brace & Company, 1998.
   6. *Agilent GC-MSD ChemStation and Instrument Operation Student Manual Course Number H4043A Volume 1*, Revision E.02.xx. Agilent Technologies: printed February 2008.
   7. *Guide for the Use of the International System of Units (SI).* NIST Special Publication 811, 2008 Ed., (March 2008; 2nd printing November 2008). p.43.
4. **Records**
   1. GC-MS Maintenance Log
   2. GC-MS Daily QCC Log
   3. GC-MS Monthly QCC Log
   4. GC-MS Activity Log
   5. Case record

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| **Revision History** | | |
| Effective Date | Version  Number | Reason |
| 1/1/13 | 1 | ISO Compliance |
| 1/8/13 | 2 | Correction to 7.10.1-requirements for GC retention time comparison. |
| 8/7/13 | 3 | Incorporation of Uncertainty of Measurement and Measurement Assurance |
| 2/16/15 | 4 | Updated lines 5.1, 5.7.8.2, 6.4.2, 6.4.4.1, 6.4.6, 6.4.7.1, 7.3, 7.3.1 and 7.5. |
| 5/12/17 | 5 | Added 5.6.3, 5.6.4, & 5.6.5, Removed portions of 5.6.7.3., 5.6.7.4, Removed section 5.6.7.5 |
| 12/14/17 | 6 | Updated 5.1, 5.1.2.2, 5.6.2, 5.6.9, 5.7.8, 5.8.4, 6.3.2, 7.5, 7.6.2, to allow for electronic storage.  Updated 5.1.1.1, 5.1.2.1, 6.2, to reflect the current information recorded on the respective form.  Updated 5.1.4, 6.4.2.2, 6.4.3.2, 6.4.4.2, 6.4.5.2, 6.4.6.2, 6.4.7.2, 7.2.4, 12.1 to reflect the current form title.  Removed 5.1.5 due to electronic format of instrument logbook.  Updated 5.2 to include all maintenance.  Changed 5.6.1.1. to modify tune requirements.  Reorganized 5.6.7 and 5.6.8 to reflect order of performance.  Updated 6.1 to require the activity log to indicate the instrument is out of service when performing column or mass spectrometer maintenance.  Updated 6.3  Removed 6.4.1.2.  Updated 6.4.6.1.21, 6.4.6.1.22, 6.4.6.1.23, 6.4.6.1.24.  Removed duplicate text in 7.9.2.  Removed 12.1, 12.2, and 12.3.  Updated 12.4. |
| 3/6/18 | 7 | Added ISOTHERMAL method to 7.1.5. Updated 9.3 to include limitation to ISOTHERMAL method. Added 9.4 to inform chemist to use discretion when using GC-MS for isomer determination |
| 4/19/18 | 8 | Changed 7.1.3. low temperature program to Low2 with a run time of 15 minutes. Changed 7.1.3.5. to 6.83 minutes final time and 7.1.3.6. to 15.0 minutes total time. Changed “CCBI Crime Laboratory Safety Manual” to “CCBI Health and Safety Manual”. |
| 9/5/19 | 9 | Added 7890 Gas Chromatograph to Equipment in 4.1.1. |
| 3/13/20 | 10 | 3. Abbreviations - removed abbreviations  4.3 Materials - Added Merlin microseal  6.4 Suggested Routine Maintenance - added Merlin microseal  Changed ISOTHERMAL method to ISOTHERMAL2 throughout the procedure |