CANNABIS TESTING LABORATORY COMPLIANCE DOCUMENT

Prepared for:

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Revision Date

September 30, 2019

Revision History

This section summarizes revisions made since the last revision of this document.

September 24, 2019 public comment updates:

- Page 3 – Expanded "Purpose and Scope" section, providing background on motivation for creating this document.
- Page 4 – Blank and Duplicate Sample definitions updated. For Duplicate Sample, the 'per batch' requirement is removed, leaving a per sample frequency requirement. (Text under the preparation batch QC section discusses rotating matrices used for the duplicate sample.)
- Page 5 – The Matrix Spike (MS), Method Validation, and Method Verification definitions are updated. Definitions are added for Negative Control and Positive Control. For the MS, the 'per batch' requirement is removed, leaving a per sample frequency requirement. (Text under the preparation batch QC section discusses rotating matrices used for the MS.)
- Page 6 – Secondary Source Material definition is updated.
- Page 11 – Second paragraph added to "Method Blank (MB)" section.
- Page 12 – Third paragraph added to "Surrogate" section. Second paragraph added to "LCS" section. The "MS" (matrix spike) section updated to remove the per batch requirement, leaving a per sample frequency requirement. Also added to the "MS" section is discussion on rotating the matrix used as the parent sample, as possible.
- Page 13 – "Duplicate", "Instrument Blank", and "Second Source Standard" sections are updated. The "Duplicate" section is updated to remove the per batch requirement, leaving a per sample frequency requirement. Also added to the "Duplicate" section is discussion on rotating the matrix used as the parent sample, as possible. For the "Second Source Standard", additional options added.
- Page 14 – Second paragraph added to "Continuing Calibration Verification" section.
- Page 15 - "Duplicate Sample" section updated to remove the per batch requirement. Frequency is 1 per 20 samples, rotating the parent sample choice to capture all matrices received.

August 1, 2019 public comment updates:

- Page 4 – Definitions expanded for Duplicate Sample, Internal Standard, Laboratory Control Sample, and Matrix Spikes.
- Page 5 – Definition expanded for Surrogate.
- Page 10 – Minor grammatical changes.
- Page 11 – The sections Selectivity, Peer Review, and Safety Plan and Training moved here from page 13.
- Page 11 – 13 – Quality control samples segregated into two sections, "Preparation Batch QC" and "Analytical Batch QC".
- Page 14 – Use of negative and positive controls for microbiology QC clarified.
- Page 19 – Clarifications in paragraph 2 where and entire sample cannot be homogenized.

Introduction

History and Purpose

In December 2017, responding to accusations of alleged gaps and inconsistencies in the results from two licensed testing facilities, as well as concerns of "results shopping" and unfair trade practices, the Alcohol and Marijuana Control Office (AMCO), collected several plant samples and food products from retail marijuana establishments and submitted the samples to two licensed testing facilities in an attempt to independently verify the labeled results. The two laboratories' results did not compare well, resulting in AMCO requesting a data audit. The data audit revealed quality control (QC) inconsistencies and gaps in the data supporting the laboratories' results. The findings revealed the need for guidance on quality assurance (QA) and quality control (QC) requirements for licensed marijuana testing laboratories. Current regulations do not provide usable guidance evaluating compliance or applying consistent standards. The language is limited, in part, to the requirement that a testing facility simply have standard operating procedures (SOPs) and follow "good laboratory practices" (3AAC306.620(c) and 3AAC3060635(c)). However, regulation does not provide definition for the term "good laboratory practices".

The two testing facilities requested clarification on regulatory language. At the direction of the Marijuana Control Board, a collaborative process that included contributions from board members, licensed cultivators and product manufacturers, AMCO enforcement, and public health and environmental health experts, informed this document, which ultimately achieves a clearer definition for the term "good laboratory practices."

The QA/QC concepts, requirements, and terminology used in this document have supported nationwide laboratory data for decades (e.g. EPA's CERCLA (aka Superfund) and RCRA programs). Together, all the QC samples provide a sound statistical and legally defensible foundation for reported sample results. These requirements must be reflected in a laboratory's SOPs and consistently adhered to as part of legal defensibility.

The purpose of this document is to establish requirements and guidance for laboratories performing cannabis industry-related testing. Matrices may include, but are not limited to cannabis plant material, concentrates, and sugar-based or oil-based consumables. This document shall be applied as reference to regulation set forth in 3 AAC 306 of the Alaska Administrative Code.

Definitions

Accuracy – a combination of random and systematic error that assesses the difference between a result and a "true" value.

Analyte – a chemical compound or organism of interest.

Analyte group – a collection of chemical compounds or organisms consisting of similar characteristics.

Analytical balance – a type of balance capable of measuring sub-milligram quantities, typically 0.1 mg or better.

Analytical staff – employees with demonstrated competency to routinely prepare samples for testing and/or perform the testing.

Aqueous – a solution in which the base solvent is water.

Audit – a systematic and independent examination.

Batch – a group of samples governed by the same quality control measures and subjected to the same protocols at the same time.

Bias – a tendency towards or away from an expected outcome.

Blank – a material or container absent of a material, analyte, or organism of interest.

Calibration (CB) – the base solvent or reagent used to subject a sample to analysis that is free of the analyte of interest.

Method (MB) – a material free of the analyte of interest (e.g. oregano, oil) to demonstrate the cleanliness of the testing and analytical process without contribution or interference from the actual targeted matrix.

Temperature (TB) – a media utilized to determine a representative temperature for the entire space of a temperature controlled unit (e.g. sample shipment cooler, refrigerator, oven).

Calibration –

Initial calibration (ICAL) – reference material prepared at incremental concentrations to assess the range within which an instrument can predictively quantitate an analyte of interest.

Continuing calibration verification (CCV) – reference material prepared at a known concentration to determine if instrument performance is at the same level as assessed at the time of the ICAL.

Calibration Range – the concentration range within which an instrument can predictively quantitate an analyte of interest, defined by the lowest and highest possible concentrations. Ideally, it is the range of linear instrument response vs. target analyte concentration.

Chain of custody (COC) – trail of information that documents the sequence of custody, person or storage control, transfer, and final disposition of sample, hardcopy, or electronic evidence.

Comparability – demonstration of a procedure or set of procedures to generate a similar result upon changing a matrix, quality control materials, or quality control operating parameters.

Completeness – a measure of the extent that sample and quality controls meet data quality objectives (e.g. sensitivity requirements, quality control results within acceptance limits)

Control Material - {compare to reference material}

Correlation coefficient (CC) – a measure of the linear relationship between two or more data points differentiated by each point's concentration.

Corrective action – a change in policy or procedure intended to prevent a nonconformance, anomaly, or unwanted trend from recurring.

Deficiency – lacking something or to describe a situation or material containing less than the desired amount of a particular defining characteristic.

Document – contains or relays information that does not change until there is a change in policy, procedure, or related external reference material or used to record data.

Duplicate Sample – a second portion of a sample, subsampled in the same manner as the original sample and subjected to the same procedures as the original sample and in the same batch as the original sample. For chemistry and microbiology testing, one duplicate is required for every 20 client samples, rotating matrices to include all matrices the laboratory typically encounters. For chemistry testing, if insufficient sample volume is available for a duplicate analysis, this requirement may be substituted by generation of an LCSD (LCS duplicate; see definition of LCS below).

Form – A document created by the lab to record visual observations or data. Each form must minimally

contain the laboratory name, unique form ID, revision date of the form template, a title indicating the activity being documented, and initials and date of staff recording information.
Internal Standard (IS) – a compound chemically similar to an analyte or analyte of interest, used to independently assess the effectiveness of an analytical procedure on an individual sample, control, or reference material and also serve to quantitate an analyte of interest. The IS is added to the sample after all preparation, cleanup, and dilution steps and immediately prior to introducing the sample, control, or reference material into the instrument. Use of an IS is recommended, but not required.
Laboratory Control Sample (LCS) – For chemistry testing, a known amount of analyte of interest or chemically similar analyte in addition to the surrogate, added to a blank matrix (i.e. a matrix that does not contain the analyte of interest but is similar in phase (i.e. aqueous, solid, organic (e.g. oil for concentrates or oregano for plants)) to test the effectiveness of a method to test for the analyte in that phase. One LCS is required for each preparation batch of 20 samples or less, regardless of matrix type of samples being tested.
Matrix – the main material; the non-analyte components of a material
Matrix Spike (MS) – a known amount of analyte of interest or chemically similar analyte in addition to the surrogate, added to an aliquot of a sample to test the effectiveness of a method to test for the analyte in that sample's matrix. For chemistry testing, one MS is required for every 20 client samples, rotating matrices to include all matrices the laboratory typically encounters. The matrix spike assesses a method's extraction efficiency for a given target analyte on a per batch basis as implemented by the lab. The analyte is added after sample reduction, homogenization, and subsampling and just before the start of the sample preparation/extraction phase.
Measurement uncertainty (MU) – an indication of incomplete information of a quantitative value, indicating to what degree the value may be biased on both the low and high end.
Method detection limit (MDL) – the lowest quantity or concentration at which a substance or analyte can be identified with 99% confidence under a given set of conditions.
Method reporting limit (MRL) – the lowest quantity or concentration at which a substance or analyte can be quantitated with 99% confidence under a given set of conditions.
Method validation – demonstrating the effectiveness of implementing a new method, a method new to a lab, or a significant change to an existing method. The SOP for the test must be strictly adhered to for the method validation.
Method verification – demonstrating the effectiveness of an existing method's ability to manage a new variable, e.g. new matrix, new location of testing, change in reagents, change in prep or testing conditions. The SOP for the test must be strictly adhered to for the method verification.
Negative Control – material lacking the target substance or organism, but containing a non-targeted substance or organism, demonstrating the ability of the laboratory to control processes sufficiently enough such that a process does not result in a false positive.
NIST – National Institute of Standards and Technology
Nonconformance – a defect or occurrence that deviates from procedure or falls outside of acceptable limits
PARRCCS – precision, accuracy, representativeness, reproducibility, comparability, completeness, sensitivity
Positive Control – material containing the target substance or organism, demonstrating the ability of a laboratory to identify the substance or organism.
Precision – {Mean % Difference, CV/RPD,} - assess repeatability of a procedure given the same conditions, materials, and steps for each attempt. Common statistical measurements include mean percent difference, relative percent difference (RPD) and coefficient of variation (CV).
Primary source – a vendor that supplies reference material for instrument calibration or as the primary reference for initially identifying and/or quantifying an analyte of interest.
Quality assurance (QA) – the outline of quality policies and expectations that govern overall how and why a business operates.
Quality control (QC) – daily quality procedures or activities that are implementing a QA program.
Quality manual (QM) – the document that outline quality policies and expectations that govern a business.
Raw data – original numbers collected by an instrument or original observations recorded by a technician.
Record – input or output containing data, observations, or actual operating parameters.
Representativeness – demonstration of thoroughness that a particular procedure or set of procedures is

characterizing a sample matrix through identification and quantitation of analytes of interest. Typically an intra-laboratory measure.
Reproducibility – demonstration of a procedure or set of procedures to generate the same result when employed at different labs or if implementation of a procedure change is able to achieve the same result.
Secondary source material – a vendor that supplies reference material from a different lot than the associated primary source that is used to confirm the identity and/or quantitation of an analyte of interest determined by comparison to the primary source. Alternatively, a second source material can be reference material from a vendor other than the vendor considered the primary source provider.
Sensitivity – the lowest quantity of an analyte of interest that can be observed in a sample, evaluated as part of a method validation for the ability to meet the desired data quality standards.
Subcontract – requesting service from an entity operated as a separate business unit.
Surrogate – a compound chemically similar to an analyte or analyte of interest, used to independently assess the effectiveness of the extraction and analytical procedures on an individual sample, control, or reference material basis. The surrogate is added after sample reduction, homogenization, and subsampling and just before the start of the sample preparation/extraction phase. Surrogate addition is required for plant and edible matrices. The surrogate assesses a method's extraction efficiency on a per sample basis as implemented by the lab for each batch.

Program Administration

Sample Receiving/Login/Storage. A Sample Receiving SOP is required, detailing instructions and requirements for documenting the receipt of samples, such as:

- number of samples received
- the matrix or matrices received
- relinquishing and receiving signatures demonstrating custody transfer
- dates and times of sample collection
- courier delivering the samples (e.g. hand carried, commercial courier)
- verification of sample condition
- sufficient volume received for requested tests
- sample properly preserved and packaged for the tests requested
- documentation of client requested tests
- instructions for receiving samples in METRC
- instructions for reconciling weight discrepancies between METRC and throughout the pre-testing, testing, and post-testing phases of the sample.
- instructions that follow METRC requirements for transferring samples from one lab to another lab.

The SOP must explain how the laboratory tracks and manages samples from receipt, to analysis, to reporting, to storage, to disposal. The detail shall include how samples are uniquely numbered, the internal sample labeling procedures, protocols for reviewing for clerical errors, and sample login data entry errors.

Acceptance/rejection criteria are required in the SOP, including (as applicable):

- identification of who can reject samples
- administrative errors that can result in rejection
- rejection based on weight deficiencies or discrepancies
- rejection based on observations at receiving (e.g. leaking container, obvious contamination)
- procedure for handling rejected samples.

An SOP outlining sample storage procedures is also required, discussing requirements for storing samples upon receipt, during the testing process, and long term storage. Details to include are:

- temperature of storage
- dates of storage, removal of storage, return to storage
- comments (e.g. reason for removing sample)
- the security of the samples and related hardcopy and digital records documenting custody
- initials of the recorder

Subcontracting. Receiving lab must have an Alaska cannabis license and be located within the State of Alaska. If incorporating a subcontract lab result into a report of other results, the subcontract lab must be identified on the report for the result(s) it provided. The report must also include sample custody transfer documentation.

By definition, a subcontract lab is another business unit, whether its own discrete company or a separate business unit (different physical location) of the same company. A customer service center location is not a subcontractor.

Training. The laboratory must document responsibilities, training, and competency for all staff via curriculum vitae (CV), resumes, training records, competency assessment (internal and/or external), and professional certifications. The documentation must identify the analyses and procedures each individual is authorized to independently perform and which require supervision. The criteria for which a person must demonstrate competency for the task or method must be documented.

Record keeping. Visual observations of sample testing that either support the final result or affect the final result must be recorded.

Raw data, including manual integrations (chromatograms representing before and after the manual integration must be available, initialed and dated by the person making the change(s)), including original observations and calculations recorded at the time they were made, having been correctly interpreted and performed.

A data reviewer/auditor must be able to recreate the testing environment with which the results were analyzed/determined. Observations that do not directly factor into the final result, but support test results, confirm integrity of sample, standard, and reagent storage conditions, must also be recorded. Examples include but are not restricted to:

- incubation times and temperatures,
- analysis dates and times
- identification of analysts performing the testing and which steps were completed by each person
- instrument IDs, instrument settings and calibrations (see Laboratory Facilities and Equipment section)
- manufacturer and lot numbers of reagents and materials used
- results of control samples (see Quality Control sections below)
- results of quality control checks performed on media and reagents

Laboratory facilities and equipment – environmental controls, separation of office activities from laboratory

The laboratory must outline protocols in an SOP or throughout SOPs (as applicable) regarding general housekeeping, including glassware cleaning, to avoid the impact of poor housekeeping on the quality of results.

Instrument maintenance logs are required for documenting scheduled (e.g. daily, weekly) and unscheduled maintenance and repair events. The logs are an important tool for troubleshooting and ensuring that all maintenance and repair are in agreement with manufacturer specifications. After adjustments, the instrument must be verified fit for use by analyzing controls, calibration material, or blanks, as appropriate.

Temperature charts and logs are required for documenting adherence to requirements for temperature dependent equipment (e.g. refrigerators, freezers, incubators, water baths) and tests. The frequency of measurements is dependent on the intended use of the unit or the characteristic of the subject method. Units intended for sample preparation and analysis must minimally have start and stop temperatures recorded. Incubation periods that are more than a day require starting temperature readings, a temperature reading each day of the incubation period, and an incubation period ending temperature, including the date and time of each reading, and documenting date and time of the start and stop of the full incubation period. The required temperature range must be stated on each log to assist in identifying outliers. Outliers must be acknowledged on the form, to include corrective action (e.g. temperature adjustment and follow-up reading) or reference to a corrective action document.

Quality Systems

General

This section covers QA, QC, method selection, sample handling, and documentation requirements for the laboratory. The laboratory must discuss these elements in their QM and SOPs (as applicable) and implement them in operations.

Quality manual (QM).

- Defines the laboratory's quality system. Policies and procedures guiding the laboratory are documented or referenced in the QM. Annual review and updates required.
- Identify key staff positions and the corresponding responsibilities.
- Describe how and the frequency in which the possibility of conflicts of interest are assessed and prevention measures in place to identify or avoid conflicts.
- State commitment from management regarding ethics, code of conduct, and commitment to quality.
- Describe calibration requirements for support equipment, covering balances, thermometers (reference and working) (liquid, digital, data loggers), weights (reference and working), pipettes, and fume hoods. Certificate documentation must be maintained, whether performed in-house or by an outside vendor. In-house service/calibrations required and the associated SOP, documented annual training of technicians, and demonstration of competency for the calibration and service.
- Procedures for calibration, verification, and maintenance of support equipment.
- Detail procedures for control, maintenance, and retention of records and documents.
- Discuss document procedures: error correction, completing forms digitally or on hardcopy, traceability, and record and evidence retention time requirements for hardcopy (sample, testing, and custody evidence related) (5 years required), and digital data acquisition (5 years required).
- Describe calculation and data reduction procedures for results. It is recommended to adopt EPA rules for rounding.
- Describe review and reporting procedures, indicating individual qualifications required to perform data review and reporting.
- Provide procedures for achieving and maintaining traceability of chemical, biological, and metrological standards, reagents, and reference materials used to support or derive any results or measurements.
- Describe sample receiving, control, storage, and disposal handling procedures.
- Describe corrective action procedures – Required:
    - When deviation or nonconformance from policies and procedures are identified.
    - When QC or PT sample results are outside of acceptance limits
    - Identify:

        - The reason for initiating the corrective action.
        - The individual ultimately responsible for action resolution occurring.
        - The date the problem was identified.
        - Source of the problem identified through root cause analysis.
        - Indicate if customer data is impacted.
        - Apply correction.
        - Have a mechanism to verify implementation of the correction and take additional action if initial corrective action implementation fails.

- Document the corrective action process.

- Discuss situations which may occur where data, which do not meet all quality criteria, are accepted and reported to the client and METRC. Authority for making this decision, i.e. professional judgment, must be discussed in the QM, defining what laboratory positions have authorization for making the decision. Situations of professional judgment must be documented in the report's project narrative to include:
  - the nature of the outlier,
  - the QC limit or other criterion not met,
  - the parameter/analyte(s) impacted,
  - the impact on the data,
  - any conversation with the client and resulting outcome(s), and
  - the reason the data are reported, despite the exceedance.
- Demonstration of Capability (staff competence)
- Method selection, validation, and verification procedures
- Measurement traceability
- Measurement uncertainty procedure and frequency of review.

SOPs. Standard operating procedures (SOPs) provide detailed instructions to perform routine operations and practices implemented at the laboratory. These documents represent the procedural flow and give guidance on how to address reasonably anticipated expected and unexpected scenarios.

SOPs must be approved, signed and dated by the Laboratory Director prior to initial use and upon revision. Annual reviews and corresponding updates (if any) are required. SOP documents can be maintained as hardcopy or electronically. If the former, a controlled and documented distribution of documents must be maintained. Only the current versions can be accessible by staff.

Variances to SOPs must be pre-approved by the Laboratory Director or Quality Manager and documented. Each SOP shall have a revision summary that documents the revisions made to generate the current version.

Written procedures are required for calibration, verification, and maintenance of major analytical instruments. Written procedures are required for incorporating and evaluating quality control samples, including, but not limited to instrument tuning and calibration standards, blanks, LCS samples, matrix fortified samples (matrix spikes) and duplicates. Specify QC sample frequency, acceptance criteria, and corrective action guidance for outliers. Either in one document or in several individual documents, discuss protocols for homogenizing samples prior to obtaining a representative subaliquot for testing, and identify instituted controls for not contaminating the source material in the process.

Quality Control Requirements for Chemistry

General. A QC program that includes QC samples, which assess background contamination (background or blank subtraction is not permitted), sensitivity, level of control, level of bias (results may not be adjusted as a result of QC recovery), reproducibility and selectivity. At least annually, the laboratory shall evaluate its QC program, including implementation of QC samples, applicability of acceptance criteria, trends, and document any updates.

- All new and revised methods must be validated prior to use, characterizing the PARRCCS parameters.
- Establish MDL and MRL for testing that results in the reporting of a numerical result.
- Documentation requirements for reagents, controls, and standards –
  - Reagent/Control/Standard containers must be labeled with identity of material.

- Receipt date or preparation date, as applicable.
- Expiration date.
- Receiver's or preparer's initials.
- If received, open date.
- Storage conditions
- Lot number and manufacturer or lab-assigned standard ID number
- Lot numbers or standard ID numbers must be documented for each preparation and analytical batch.

Batching. A preparation or analysis batch consists of at most 20 samples of a similar matrix. Examples:

- Plant samples – Flower, trim, and kief samples can be in the same batch.
- Concentrates – Concentrates can be in one batch, though the laboratory should consider placing samples with an aqueous based solvent (e.g. water) in one batch and samples with an organic based solvent (e.g. oil, butane, propane) in a separate batch.
- Edibles – Segregating edibles into batches is determined by the base constituent of each matrix. For example, separate samples with a flour base from sugar based samples.

For multi-parameter analyses, data acquisition conditions for each parameter must be the same as for all associated quality control samples or measures. The latter includes internal and surrogate standards.

Selectivity. For non-mass spec methods, have a procedure in place to confirm target analyte identity (e.g. dual column, dual detector, dual wavelength, RT windows)

Peer Review. Data review procedures must be sufficient to assess the accuracy, precision, and other performance measures are attained and the tests performed as required to ensure accurate and reliable results are reported. Timing and number of reviewers should be assessed periodically for effectiveness.

Safety Plan and Training.

- Fume hoods are recommended for any work involving toxic chemicals.
- SDS's should be readily available, either hardcopy or electronically.
- Spill kits must be available.
- Signage is recommended for areas where hazardous chemicals are stored and used.
- Fire extinguishers or other fire suppression system is recommended.
- Hand washing stations are required.
- Eye wash stations and emergency showers are recommended.
- Designated space apart from laboratory operations for desk work, eating and drinking is required.

Preparation Batch QC.

- Method blanks (MB) – One MB is required per sample preparation batch of 20 client samples or less. If sample preparation is not a required step, then one MB is required per analytical batch. An MB consists of a matrix similar to the samples and is known to not contain the parameter of interest. For a batch of plant material, a matrix like oregano is an option. An MB is subjected to all of the same steps as a sample. The MB result must be less than the MRL. Samples associated with a failing MB must be re-prepared and reanalyzed with a new set of preparation QC.

  An MB supports the data by proving there was nothing in the preparation or analysis process or materials contributing to contamination of the client samples.

- Other Blanks – other blanks may be used by the laboratory depending on the type of method and concerns of the laboratory and/or client. For instance, trip blanks are used to check for interferences encountered during sample collection and handling for the analysis of solvents.

- Surrogates – A compound chemically similar to the test parameter, used to determine method efficiency. The surrogate signal ideally must not interfere with that of the target analytes, or as little as possible. Surrogate addition is required for all organic testing (e.g. potency, terpenes). The surrogate is added to all samples, preparation batch QC samples (including, but not limited to MB, LCS, MS, and Duplicates), and analytical batch QC samples (including, but not limited to calibration standards, calibration check standards, QC or second source standards, MSA analyses, and IB). The surrogate is added to the samples at the beginning step of sample preparation and directly into the matrix. This addition occurs after sample reduction, homogenization, and subsampling processes and is required for plant and edible matrices.

  The surrogate is measured in the same way as the target analyte (i.e. same channel or wavelength). The laboratory shall establish performance based QC limits (PBQLs) based on historical data generated at the lab. If sufficient historical data are not available, the laboratory will use 80 – 120% as interim limits until which time sufficient data points are available to generate PBQLs. PBQLs shall represent a 99% confidence interval. Samples and QC samples with surrogate results not meeting the QC limits must be re-prepared and reanalyzed. Preparation batch QC samples with failing surrogate results necessitate the re-preparation of all samples and QC samples.

  Surrogate analysis supports the data by proving that each sample preparation vessel and analysis injection were free of any process conditions which would significantly affect the result of a compound similar to the target analyte.

- LCS – One LCS is required per sample preparation batch of 20 client samples or less. An LCS is subjected to all of the same steps as a sample. The LCS is measured in the same way as the samples (i.e. same channel, wavelength, parent ion, etc.). The laboratory shall establish performance based QC limits (PBQLs) based on historical data generated at the lab. If sufficient historical data are not available, the laboratory will use 80 – 120% as interim limits until which time sufficient data points are available to generate PBQLs. PBQLs shall represent a 99% confidence interval. Samples with target parameter or surrogate results not meeting the QC limits must be re-prepared and reanalyzed. If a recovery failure occurs for a target analyte or surrogate, the entire preparation batch must be re-prepared and reanalyzed. A recommended LCS duplicate (LCSD) can provide on-going method precision information, and decrease the number of batches needed to accumulate performance-based data.

  LCS analysis supports the data by proving that the preparation and analysis processes for the batch efficiently extracts and accurately identifies the target parameter for a matrix similar to the matrix of the client samples (e.g. oregano may be chosen for the plant material matrix, and olive oil chosen for the concentrates matrix).

- MS - One MS is required per 20 client samples. An MS is subjected to all of the same steps as a sample, and it is best practice to use the same parent sample as the Duplicate Sample (see below). The matrix of the duplicate sample is rotated to include all matrices the laboratory typically encounters. The MS is measured in the same way as the samples (i.e. same channel, wavelength, parent ion, etc.). The laboratory shall establish performance based QC limits (PBQLs) based on historical data generated at the lab. If sufficient historical data are not available, the laboratory will use 80 – 120% as interim limits until which time sufficient data points are available to generate PBQLs. PBQLs shall represent a 99% confidence interval. Samples with surrogate results not meeting the QC limits must be re-prepared and reanalyzed. If a recovery failure occurs for a target

analyte or surrogate and the recovery is greater than or equal to 50%, data can be accepted if all target analyte and surrogate results in the associated batch LCS are acceptable. If the MS recovery is less than 50%, the parent sample, MS, and associated duplicate must be re-prepared and reanalyzed.

- Duplicate (sample duplicate or matrix spike duplicate) – One duplicate is required per 20 client sample. The matrix of the duplicate sample is rotated to include all matrices the laboratory typically encounters. Given sufficient sample volume, it is best practice to use the same parent sample for the Duplicate sample as used for the MS sample. A duplicate sample is subjected to all of the same steps as a sample. The Duplicate is measured in the same way as the samples (i.e. same channel, wavelength, parent ion, etc.). The laboratory shall establish performance based QC limits (PBQLs) based on historical data generated at the lab. If sufficient historical data are not available, the laboratory will use an RPD of 20 as an interim limit until which time sufficient data points are available to generate PBQLs. PBQLs shall represent a 99% confidence interval. Samples with surrogate results not meeting the QC limits must be re-prepared and reanalyzed. If an RPD failure occurs for a target analyte and the recovery is less than or equal to 100, data can be accepted if all target analyte and surrogate recovery results in the associated batch LCS are acceptable. If the duplicate sample RPD recovery is greater than 100, the parent sample, duplicate, and associated MS sample must be re-prepared and reanalyzed.

  A Duplicate supports reproducibility of the data for the sample preparation and analysis processes as implemented by the laboratory.

Analytical Batch QC.

- Instrument blanks (IB) – One IB is required at the start of each analytical batch. The IB consists of the same solvent make-up used to introduce samples onto the instrument. The IB result must be less than the MRL. Samples and preparation batch QC associated with a failing IB must be reanalyzed.

  An IB supports the data by proving there was nothing in analysis process or materials contributing to contamination of the client samples.

- QC or second source standard – A second source standard must be analyzed immediately after each multi-point initial calibration and before samples and QC samples can be analyzed. Results of this standard must be between 80 – 120% for target analytes and surrogates before sample and QC sample analysis can proceed. If the second source standard is accompanied by a vendor supplied certificate indicating PBQLs specific for the standard, those limits may be used instead.
  Option 1: Purchase a standard from a manufacturer other than the standard used to calibrate the instrument, or the same manufacturer can be used if the secondary standard is a different lot. Analyze secondary standard immediately after the calibration curve is run.
  Option 2: Purchase the same type of standard as in option 1, but use it to spike the LCS in each batch.
  Option 3: Purchase the second source with enough time to analyze it before the primary lot expires. Analyze the new standard immediately after running the calibration curve with the old standard, and before using the new standard for any other purpose. Once the new standard passes, it may be used as the primary standard.

- Instrument calibration (ICAL) – The ICAL must consist of a minimum of three standards analyzed at varying concentrations with the lowest concentration standard at or greater than the MRL, but greater than zero (0). All standards analyzed to establish the ICAL must be analyzed within a 12-hour period. An acceptable ICAL will have a %RSD greater than or equal to 15%, a linear regression correlation coefficient greater than or equal to 0.995, or a coefficient of determination value greater than or equal to 0.99 for target analytes and surrogates before the second source standard, sample,

and QC sample analyses may proceed. Ideally, the calibration is not forced through zero. An IB may be used as an additional calibration point, but it cannot replace one of the three known concentrations.

- Continuing calibration verification (CCV) – A CCV standard, which is prepared from the same stock standard as the ICAL standards, must be analyzed at the start of the run, after every 10 injections, and at the end of the run. If an ICAL starts the analytical run, the CCV must be analyzed after the second source standard and before samples and QC samples are analyzed. The target analytes and surrogates in the CCV must have recoveries between 85 – 115%. Analyses of the sample and QC samples must be bracketed (before and after analysis) by compliant CCVs. Any samples or QC samples associated with a noncompliant CCV must be reanalyzed. Bracketing CCVs must be no longer than 12 hours apart.

  CCV analysis supports the data by proving that the analysis process for the batch did not significantly affect the target compound results. The CCV also proves the correct operation of the instrument throughout the analysis day, being run at the beginning, every 10 samples, and at the end. Trends of the CCV analyses throughout the day can protect against errors caused by instrument drift.

- Internal standards (IS) – ISs can be added to samples and preparation and analysis QC samples for quantitative and retention time (RT) shift monitoring purposes. If ISs are used, they must be added to all samples, blanks, and preparation and analysis QC samples. IS addition occurs after all preparation, cleanup, and dilution steps are completed and immediately prior to introduction into the instrument. Use of an IS is recommended, but not required.

  The IS area and RT data are compared to the area(s) and RT(s) of the mid-level standard in the ICAL. The quality control limits for the area are from 50% to 200% percent of the IS area in the mid-level ICAL standard. The quality control limits for the RT are ± 0.50 minutes of the IS RT in the mid-level ICAL standard. If the IS area or RT does not fall within the QC limits, the sample or QC sample must be reanalyzed.

Quality Control Requirements for Microbiology.

Documentation requirements for reagents, controls, and standards –

- Reagent/Control/Standard containers must be labeled with identity of material.
- Receipt date or preparation date, as applicable.
- Expiration date.
- Receiver's and/or preparer's initials.
- Open date.
- Storage conditions
- Lot number or lab-assigned standard ID number
- Lot numbers or standard ID numbers must be documented for each preparation and analytical batch.

- Negative control –Negative controls will differ depending on the technology used. For media methods, the negative control contains another organism to demonstrate method selectivity. The organism may be similar in nature to the target organism and does not produce the same reaction as the target organism. For media based methods, one negative control must be analyzed on each lot of media before use. If a negative control fails and samples were analyzed concurrently, samples with a negative result may be reported with comment. All other samples must be invalidated. For qPCR, a negative control is a blank sample made with a reagent that does not contain an organism (e.g. sterile water). For qPCR, a negative control is required for every batch, or more often if required by the

manufacturer's validated method (reference method). If a negative control fails, associated samples with a negative result may be reported with comment. All other samples must be invalidated.

- Positive control – Positive controls will differ depending on the technology used. For media methods, the positive control contains the target analyte/strain of interest. For media based methods, one positive control must be analyzed on each lot of media before use. If a positive control fails and samples were analyzed concurrently, presence/absence samples with a positive result may be reported with comment. All other samples must be invalidated. For qPCR, a positive control contains either the target analyte/strain of interest or a commercial positive control, based on manufacturer's instructions. For qPCR, a positive control is required for each analyte/strain of interest for every batch, or more often if required by the reference method. If a positive control fails, associated presence/absence samples with a positive result may be reported with comment. All other samples must be invalidated.

- Duplicate sample - One duplicate is required per twenty (20) client samples or less. A duplicate sample is subjected to all of the same steps as the original sample. For qualitative analyses, if the duplicate sample does not equal the sample result, the sample and its duplicate must be reanalyzed. Consideration should also be given to possibility of re-preparing and reanalyzing all associated samples. For quantitative analyses, if the RPD of the sample and duplicate is greater than 100, the parent sample and duplicate sample must be reanalyzed. Consideration should also be given to possibility of re-preparing and reanalyzing all associated samples. When data are accepted, the result for the sample portion designated as the "original sample" is reported.

- Temperature monitoring (see "Laboratory facilities and equipment")

- Sample preparation documentation is required for pre-enrichment and sample preparation steps and shall include the unique ID of the negative and positive controls, the client samples associated with the controls, the weight of the subsample used, the unique ID of all media and reagents used in pre-enrichment and to prepare the samples, dates/times and temperature samples are placed into and remove from the incubator, the preparer's initials, and the date and time of preparation.

- Sample analysis documentation is required. Time and date samples are placed in the incubator, removed from incubator, and analyzed or examined must be recorded, along with observations or instrument raw data.

- Any verification steps required by the method must also meet the same documentation requirements as preparation and analysis.

- Documentation of macroscopic and microscopic examinations shall include pictures and written observations.

Reporting

The laboratory report is required to contain the following elements.

- Testing laboratory's name and physical address. If a subcontract laboratory is used for part or all of the testing, the report must identify the name of the subcontract laboratory and identify the specific testing it performed.
- The report date.
- A unique sample number or alpha-numeric number assigned by the laboratory's receiving and accessioning processes.
- The name of the person submitting the sample for testing and the identifier assigned by the submitter for each sample.
- The date and time the laboratory received the sample.
- Sample matrix.
- The chain of custody record documenting the transfer of the sample from the submitter to the laboratory. If the laboratory submits a sample to a subcontract laboratory, documentation of that custody transfer must also be included in the report.
- A name for each test method and identity of each individual parameter determined by the method.
- The published method or laboratory SOP unique ID for each test method.
- The numerical or text result for each method or individual parameters of a method. If the parameter is not detected, the laboratory can provide the result as "Not Detected", "ND", "Not found", etc.
- The units for each result, as applicable. If the parameter is not detected, the units are still required for the report.
- The MRL for each numerical result, as applicable. If the parameter is not detected, the MRL is still required for the report.
- A report project narrative discussing anomalies or quality control outliers and related corrective action steps encountered during sample receiving, sample preparation, or analytical testing.
- Report results to the MRL, as applicable, unless otherwise specified on a 'per client' or per project basis.
- Amended reports must indicate in the report project narrative what changed from the original report, the reason for the change, and the date of the revised report.
- Chemistry results for plant material must be reported on a dry weight basis (DWB). The percent (%) moisture of the plant sample 'as received' must be reported separately. The % moisture value is used to calculate the dry weight chemistry result. Chemistry results for all other sample matrices are reported on an 'as received' basis.

$$\text{Result (DWB)} = \text{ wet wt. sample result} \times \frac{100}{100 - \%\ \text{moisture}}$$

- Each required test, whether failing or passing, must be reported in METRC within 24 hours (i.e. one (1) calendar day) of the test completing as per 3AAC306.670. "Test completing" is defined by this document as the sample and related preparation batch and analytical batch QC have been successfully analyzed.

Proficiency Testing

To obtain and maintain a license to perform testing, the laboratory must participate in Proficiency Testing (PT) for each test. This testing ensures accurate results are being produced by licensed laboratories, regardless of methodology. For multi-parameter tests (e.g. potency and terpenes testing), the laboratory must successfully identify and quantitate 80% of the target analytes. Any false positive or false negative results are considered unsatisfactory.

Required analyses – applies to regulated constituents (*Aspergillus niger, flavus, fumigatus, E.coli, Salmonella,* THC, THCA, CBD, CBDA, CBN for each matrix being tested. Sample matrices are cannabis plant material, any edible matrix, or a concentrate. PTs are required for a new analyst, a method validation, and ongoing on an annual basis per lab (vs. per analyst).

Treatment of PT samples – PT samples are treated the same as commercial samples, undergoing the same size reduction, subsampling, pre-treatment, extraction, number of analyses, and analysis procedures. If any special handling is necessary (e.g. sample prep, unit conversion), this treatment is documented with the statement. PT samples may not be reanalyzed to confirm results, may not be analyzed in duplicate, or analyzed with additional QC beyond what is performed for client samples.

Laboratories may report multiple results for a given sample that represent multiple prep and/or analytical protocols/combinations, multiple matrices, or multiple analytical staff. Laboratories may not send a PT sample to another lab and report that lab's result(s). Conversely, a laboratory may not knowingly analyze a PT sample received from another laboratory. Laboratories may not compare results with another laboratory.

The Laboratory Director must sign an attestation statement when submitting results that indicates the PT samples were integrated into the routine sample workflow and did not receive special treatment.

Reporting - PT reports are submitted to the entity producing and issuing the samples for scoring. Score reports are sent to the laboratory and AMCO simultaneously. The scored results may be used in part or in whole for decisions regarding licensing/certification status. Reports of PT results may be amended when errors attributed to the PT sample provider are identified or when a clerical error unique to the reporting of PT samples is discovered. The reason for an amended report must be discussed in the PT report project narrative and is subject to rejection or request for additional information issued by the PT provider or AMCO.

Acceptance limits and grading – established by the PT provider and determined by provider's in-house testing, factoring in participating lab performance. Acceptance limits are associated with all quality control testing processes and analytes.

Corrective action – see corrective action in QM section.

Audits

Internal. One internal audit for each sample preparation and test method the laboratory performs must be conducted within six months from the date of implementation. A report must be generated for each internal audit, containing:

- Audit date(s)
- Auditor name
- Date of the report
- Title of the report indicating the method(s) audited
- Name(s) of staff interviewed for the audit
- Questions/topics explored during the audit
- Findings
- Due date for corrective action response

Internal audit reports and the associated corrective action response must be minimally available for inspection within five years of the end of the audit.

Internal audits may be horizontal or vertical in nature. A horizontal audit reviews one particular aspect that is implemented across a laboratory, e.g. document control. A vertical audit reviews one aspect of an operation that is not performed throughout an organization, e.g. extraction for potency testing. These audits are intended, in part, to assess adherence to SOPs and good laboratory practice and to perform a gap analysis of a procedure or quality system(s).

Auditor qualifications for internal audits

The concept of someone being trained or qualified as an auditor is defined by a person's skill set and experience. The following aspects are traits and skills to evaluate when identifying a person to be an internal auditor. All of the items below are not required to have a 'yes' answer.

- Overall technical knowledge and experience relative to the audit subject.
- Objective thinking ability.
- Capability to investigate independent of a checklist and has the initiative to pursue unplanned routes of inquiry.
- Professionalism demonstrated with sound judgment and strength in interpersonal skills.
- Fair and respectful of confidentiality when needed.
- Understanding of the lab's quality policies and procedures.
- Ability to stay focused on an audit scope.
- Ability to write a detailed and coherent narrative.

External. External audits may be requested and/or conducted by AMCO or other entity that is an unrelated business concern to the laboratory. The laboratory must allow access to the laboratory and all documentation for purposes of the onsite audit, in order to maintain laboratory certification with AMCO. The resulting audit reports and the corrective action response(s) must be submitted to the auditor and AMCO within one week of completion of the corrective action plan, even if not all of the corrective actions have been implemented or verified to be effective. All corrective actions must be approved by the auditing entity before the audit is considered to be closed.

Corrective action – see corrective action in QM section.

Homogenization and Subsampling Considerations

Homogenization can be thought of as two parts: breaking the sample down into smaller pieces, and mixing those pieces uniformly. While breaking down a sample into smaller pieces may need only occur initially, mixing should take place each time a subsample is taken. All samples are expected to exhibit some degree of non-uniform distribution of target analytes. Therefore, the entire sample should, ideally, be homogenized before taking subsamples or aliquots for testing.

If not practical to homogenize the entire sample, multiple portions must be taken from all parts of the sample, combined, and homogenized before a single subsample is taken for testing. Considerations must be taken to prevent contamination or cross contamination between samples. Using clean (sterile if microbiology testing) scissors/scalpel and tweezers to randomly and representatively collect multiple portions. Visually assess the sample for varying features, taking portions from each feature. If the sample is in a container that makes difficult accessing all areas of the sample, considering emptying the sample out onto a clean (sterile if microbiology testing) surface.

The QA Manual or SOP(s) must describe, in detail, homogenization and subsampling procedures, including:

- How are subsamples taken?
- How are sample materials homogenized?
- What are the required sample sizes for different types of samples and tests?
- Sample homogenization and subsampling for each of the following types of samples:
    - Flower and other plant parts may be homogenized in a mill, blender, food processor, laboratory homogenizer or other mechanical method.
    - Concentrates: Liquid concentrates may be homogenized by agitation (vortexing, blending, or shaking) before subsamples are aliquoted. Foam generated during agitation can result in a non-homogeneous distribution of target parameters. Use mechanical means (e.g. sterile wood applicator), freezing, or chemical means (e.g. mixing in salt) to force the foam back into solution. If multiple subsamples are taken, agitation should take place frequently during subsampling (no more than about two minutes should elapse between agitation and aliquoting). Thicker (oil like) concentrates may be mixed using sterile spoons or other utensils (clean utensils free of the analytes of interest may be used if not sampling for microorganisms.)
    - Edibles: Consideration for each of the following types of edibles must also be described in detail:
        - Flour Based: may be homogenized using a mill, blender, food processor, laboratory homogenizer, or other chemical method.
        - Sugar Based: may require different techniques depending on the matrix. Hard candies or chocolates may be pulverized in a mill or food processor (avoid elevated temperatures), while gummies and other soft/chewy candies may be cut into small pieces using sterile utensils. (Note: FDA recommends mixing hard candies/caramels with equal masses of water and heat to boiling, except if testing for microbial or volatile constituents.)
        - Drinks: may be homogenized by agitation (vortexing, blending, or shaking) before subsamples are aliquoted. If multiple subsamples are taken, agitation should take place frequently during subsampling (no more than 2 minutes

should elapse between agitation and aliquoting).

- Crystalline: may be broken down into finer particles and homogenized by blenders, food processors, mills, or a laboratory homogenizer before taking subsamples.