

**FLAME EMISSION, ATOMIC ABSORPTION, & ATOMIC FLUORESCENCE SPECTROMETRY
CHEMISTRY TEST METHODS**

Note: Make enough copies of **Pages 1-12** to assess **each test method** in use at the laboratory, one method at a time

CHEMISTRY TEST METHOD EVALUATED: _____

- _____ **5.5.4.1.2(a)** Does the laboratory have an **in-house methods manual** for each accredited **analyte** or **method**
Note: This manual may consist of copies of published or referenced test methods
- _____ **5.5.4.1.2(b)** Does the laboratory **clearly indicate** in its methods manual **any modifications** made to the referenced test method and **describe any changes or clarifications** where the referenced test method is ambiguous or provides insufficient detail

Does each test method in the in-house methods manual include or reference, where applicable:

- _____ **5.5.4.1.2(b)(1)** **Identification** of the test method
- _____ **5.5.4.1.2(b)(2)** Applicable **matrix or matrices**
- _____ **5.5.4.1.2(b)(3)** **Method Detection Limit**
- _____ **5.5.4.1.2(b)(4)** **Scope & application**, including components to be analyzed
- _____ **5.5.4.1.2(b)(5)** **Summary** of the test method
- _____ **5.5.4.1.2(b)(6)** **Definitions**
- _____ **5.5.4.1.2(b)(7)** **Interferences**
- _____ **5.5.4.1.2(b)(8)** **Safety**
- _____ **5.5.4.1.2(b)(9)** **Equipment & supplies**
- _____ **5.5.4.1.2(b)(10)** **Reagents & standards**
- _____ **5.5.4.1.2(b)(11)** **Sample collection, preservation, shipment, & storage**
- _____ **5.5.4.1.2(b)(12)** **Quality control**
- _____ **5.5.4.1.2(b)(13)** **Calibration & standardization**
- _____ **5.5.4.1.2(b)(14)** **Procedure**
- _____ **5.5.4.1.2(b)(15)** **Calculations**
- _____ **5.5.4.1.2(b)(16)** **Method performance**
- _____ **5.5.4.1.2(b)(17)** **Pollution prevention**
- _____ **5.5.4.1.2(b)(18)** **Data assessment & acceptance criteria** for quality control measures
- _____ **5.5.4.1.2(b)(19)** **Corrective actions** for out-of-control data
- _____ **5.5.4.1.2(b)(20)** Contingencies for **handling out-of-control or unacceptable data**
- _____ **5.5.4.1.2(b)(21)** **Waste management**
- _____ **5.5.4.1.2(b)(22)** **References**
- _____ **5.5.4.1.2(b)(23)** **Tables, diagrams, flowcharts, validation data**
- _____ **D** Does the laboratory ensure that the **essential standards** outlined in Appendix D are incorporated into the method manuals and/or Quality Manual

COMMENTS:

CHEMISTRY TEST METHOD EVALUATED: _____

- ___ 5.5.5.2.2 Do the laboratory's initial & continuing instrument calibration verifications meet the requirements in **mandated test methods & regulations** (see page 14 for acceptance criteria and the number of standards required)
Note: If it is not apparent which standard is more stringent, then the requirements of the regulation or the mandated test method are to be followed
- ___ 5.5.5.2.2.1(a) Does the laboratory's **test method SOP** include or reference details of the **initial instrument calibration procedures**
Note: This includes calculations, integrations, & associated statistics
Note: If the test method is referenced for initial instrument calibration procedures, the laboratory must **have this method & make it available** for review
- ___ 5.5.5.2.2.1(b) Does the laboratory retain **sufficient raw data records to permit reconstruction** of the initial instrument calibration
Note: Examples of such data records include calibration date, test method, instrument, analysis date, each analyte name, analyst initials or signature, concentration & response, calibration curve or response factor, and unique equation or coefficient used to reduce instrument responses to concentration
- ___ 5.5.5.2.2.1(c) Does the laboratory **quantitate sample results** only from the **initial instrument calibration** and not from any continuing instrument calibration verifications, unless required by regulation, method, or program
- ___ 5.5.5.2.2.1(d) Does the laboratory **verify all initial instrument calibrations** with a standard obtained from a **second manufacturer or lot** if the lot can be demonstrated from the manufacturer as prepared independently from other lots
Note: When commercially available, traceability shall be to a national standard
- ___ 5.5.5.2.2.1(e) Has the laboratory established **criteria for the acceptance** of an initial instrument calibration
Note: Examples include linear regression correlation coefficient & response factor %RSD
Note: The acceptance criteria must be **appropriate** to the calibration technique employed
- ___ 5.5.5.2.2.1(f) For purposes of establishing the **working calibration range**, is the lowest calibration standard concentration the **lower limit of quantitation**
- ___ 5.5.5.2.2.1(f) Is all data reported **below the lower limit of quantitation** reported using **defined qualifiers** or flags or **explained in the case narrative**
- ___ 5.5.5.2.2.1(g) Is the highest calibration standard the **highest concentration** for which **quantitative data are to be reported**
- ___ 5.5.5.2.2.1(g) Is all data reported **above the highest calibration standard** reported using **defined qualifiers** or flags or **explained in the case narrative**
- ___ 5.5.5.2.2.1(h) Does the laboratory report measured concentrations **outside the working calibration range** as having **less certainty** & using **defined qualifiers or flags or explained in the case narrative**
- ___ 5.5.5.2.2.1(h) Is the **lowest calibration standard above the limit of detection** for each analyte

CHEMISTRY TEST METHOD EVALUATED: _____

Note: For instrument technologies (e.g., ICP, ICP/MS) with validated techniques from manufacturers or methods employing standardization with a zero point & a single-point calibration std., the following must occur:

- _____ **5.5.5.2.2.1(h)(1)** Prior to the analysis of samples, are the **zero point & single point calibration analyzed**, and the **linear range of the instrument established** by analyzing a series of standards, one of which must be at the lowest quantitation level
Note: Sample results within the established linear range will not require data qualifier flags
- _____ **5.5.5.2.2.1(h)(2)** Are the zero point & single point calibration standard analyzed **with each analytical batch**
- _____ **5.5.5.2.2.1(h)(3)** Is a standard corresponding to the **limit of quantitation** analyzed with each analytical batch & meet established acceptance criteria
- _____ **5.5.5.2.2.1(h)(4)** Is the **linearity verified** at a frequency established by the test method and/or the manufacturer
- _____ **5.5.5.2.2.1(i)** Does the laboratory **perform corrective actions** & reanalyze all associated samples if the initial instrument calibration results are **outside established acceptance criteria**
- _____ **5.5.5.2.2.1(i)** When reanalysis is not possible, does the laboratory **report sample data** associated with unacceptable initial instrument calibrations **with appropriate data qualifiers**
Note: NELAC Standards 5.5.5.2.2.1(h) & (i) may need to be assessed **in conjunction with the Quality Systems data audit**
- _____ **5.5.5.2.2.1(j)** Does the laboratory have a standard operating procedure for **determining the number of points** for establishing the initial instrument calibration
- _____ **5.5.5.2.2.1(j)** Does the laboratory use a **minimum of two calibration standards** (not including blanks or a zero standard) for performing an initial instrument calibration
Note: This Standard applies if a reference or mandated method does not specify the number of calibration standards
Note: One of the standards must be at the limit of quantitation
Note: This Standard does not apply to instrument technologies for which it has been established by methodologies & procedures that a zero & a single point standard are appropriate for calibrations (see Section 5.5.5.2.2.1(h))

COMMENTS:

- _____ **5.5.5.10** Does the laboratory **verify** the validity of the initial calibration by a **continuing instrument calibration verification with each analytical batch, prior to sample analyses**, whenever an initial instrument calibration is not performed on the day of analysis
- _____ **5.5.5.10(a)** Are the **details** of the continuing instrument calibration verification **procedure, calculations, & associated statistics** included or referenced in the **test method SOP**
- _____ **5.5.5.10(b)** Is calibration verified **for each compound, element, or other discrete chemical species**
Note: For multi-component analytes such as Aroclors, Total Petroleum Hydrocarbons, or Toxaphene, a representative chemical related substance or mixture can be used

CHEMISTRY TEST METHOD EVALUATED: _____

- ___ 5.5.5.10(c)(1) Is the instrument calibration verification performed at the **beginning & end of each analytical batch**
Note: Only **one** verification needs to be performed at the beginning of the analytical batch if an **internal standard** is used
- ___ 5.5.5.10(c)(2) Is the instrument calibration verification performed whenever **it is expected** that the analytical system **may be out of calibration** or might not meet the verification acceptance criteria
- ___ 5.5.5.10(c)(3) Is the instrument calibration verification performed if the **time period** for calibration or the most previous calibration verification **has expired**
- ___ 5.5.5.10(c)(4) Is the instrument calibration verification performed for analytical systems that **contain a calibration verification requirement**
- ___ 5.5.5.10(d) Does the laboratory retain **sufficient raw data records** to permit **reconstruction** of the continuing instrument calibration verification
Note: Such records include test method, instrument, analysis date, name of each analyte, concentration & response, calibration curve or response factor, or unique equations or coefficients used to convert instrument responses into concentrations
- ___ 5.5.5.10(d) Does the laboratory's continuing calibration verification records **explicitly connect** the continuing verification data to the initial instrument calibration
- ___ 5.5.5.10(e) Has the laboratory established **criteria for the acceptance** of a continuing instrument calibration verification (e.g. relative percent difference)
- ___ 5.5.5.10(e) Does the laboratory **perform corrective actions** if the continuing instrument calibration verification results are **outside established acceptance criteria**
- ___ 5.5.5.10(e) Does the laboratory perform a **new initial instrument calibration** if the routine corrective action procedures **fail to produce a second consecutive** (immediate) calibration **verification within acceptance criteria**
Note: Alternatively, the laboratory can demonstrate acceptable performance after correction with **2 consecutive calibration verifications**
- ___ 5.5.5.10(e) If the laboratory has not verified calibration, do sample analyses **not occur** until the analytical system **is calibrated or calibration verified**
Note: For sample data associated with an **unacceptable calibration verification**, the results **must be flagged** but the data may be useable under the following special conditions:
- **Non-detects** for analytes in associated samples where the acceptance criteria for the continuing calibration verifications are **exceeded high**
- Any test result for an analyte that indicates **exceedence of a maximum regulatory limit** or decision level, when the acceptance criteria for the continuing calibration verification for that analyte is **exceeded low**
Any samples with test results that do not meet either of the above criteria **must be re-analyzed after** a new initial instrument calibration has been established, evaluated, & accepted

COMMENTS:

- _____ **5.5.4.2.2(a)** Has the laboratory performed a **satisfactory demonstration of method capability** prior to the acceptance & institution of this test method
C.1
- Note:** Demonstrations of capability are done in an applicable & available **clean quality system matrix sample** in a quality system matrix where **no target analytes or interferences present** at concentrations that impact the results of a specific test method
- Note:** These following steps are **may not be applicable** for tests with which **spiking is not an option** and for which Quality Control samples are **not readily available**
- Note:** Actual sample spike results, such as **4 consecutive matrix spikes** (or quality control samples of analytes that do not lend themselves to spiking), within the **last 12 months** may be used to meet this Standard
- Note:** A demonstration of capability is **not required** in cases where samples are analyzed with this test method in use by the laboratory **before July 1999** & where there have **been no significant changes** in instrument type, personnel, or test method, in which case the analyst's documentation of continued proficiency is acceptable (the laboratory must have records on file to show that a demonstration of capability is not required)
- Note:** **Continuing demonstration of method performance**, per the QC requirements in App. D (e.g., laboratory control samples), is required thereafter
- _____ **C.1** Does the laboratory **document** in its Quality Manual **other adequate approaches to Demonstration of Capability** if the procedure below is **not required** by the mandated test method or regulation and if the laboratory **elects not to perform** this procedure
- _____ **C.1(a)** Is the **quality control sample** used for this Demonstration of Capability obtained from an **outside source**
Note: If an outside source is not available, the laboratory may prepare this sample with stock standards that are **prepared independently** from those used in instrument calibration
- _____ **C.1(b)** Are the analytes diluted in a volume of **clean quality system matrix** sufficient to prepare **4 aliquots** at the **specified concentration** or to a concentration approximately **1-4 times the limit of quantitation**
- _____ **C.1(c)** Are **at least 4 such aliquots prepared & analyzed** according to the test method
Note: These analyses may occur either concurrently or over a period of days
- _____ **C.1(d)** Does the laboratory **calculate the mean recovery** in the appropriate reporting units & the **standard deviation** of the population sample (n-1) in the same units for **each parameter of interest** using **all of the analysis results obtained**
Note: When it is not possible to assess mean & standard deviation, such as **for presence-absence & logarithmic values**, the laboratory must assess performance against established & documented criteria
- _____ **C.1(e)** Are the mean and standard deviation for each parameter **compared** to the corresponding **acceptance criteria for precision & accuracy** in the test method (if applicable) or in laboratory-generated acceptance criteria (if the method or analyte is non-standard)
- _____ **C.1(e)** Does the laboratory consider the performance unacceptable & **not analyze actual samples** for parameters that **fail the acceptance criteria**
- _____ **C.1(f)** When one or more parameters **fail** at least one of the **acceptance criteria**, does the analyst:
 - **Locate & correct** the source of the problem, then **repeat the test** for all parameters of interest, OR
 - **Repeat the test** for all parameters that failed to meet criteria
Note: Repeated failure from employing the second option above indicates a general problem with the entire measurement system, and the analyst must then perform the first option above

CHEMISTRY TEST METHOD ASSESSED: _____

- ___ **C.1** Is an **initial evaluation** performed for **all analytes to be added** to an existing accredited test method (for analytes not currently found on the laboratory's list of accredited analytes)
- ___ **5.5.2.6(c)(3)** Does each Analyst have **documentation of continued proficiency** by at least **one of the following once per year**:
- Acceptable performance of a **blind sample** (single blind to the analyst)
 - An initial measurement system evaluation or another demonstration of capability
 - Successful performance of a blind performance sample on a **similar test method** using the **same technology** (acceptable limits must be determined prior to analysis)
 - At least **4 consecutive** laboratory **control samples** with **acceptable levels** of precision & accuracy (the acceptable limits must be determined prior to analysis)
 - Analysis of **authentic samples** that have been analyzed by **another trained analyst** with **statistically indistinguishable results**
- ___ **5.5.4.2.2(d) C.2** Does the laboratory use the **NELAC-specified certification statement** to document the **completion of each Demonstration of Capability** (initial & continuing)
- ___ **C.2** Are copies of these certification statements retained in the **personnel records** of each **employee performing the test method**
- ___ **5.5.4.2.2(d) C.1** Does the laboratory **retain & make available all associated supporting data** necessary to **reproduce the analytical results** summarized in the appropriate certification statement
- ___ **5.5.4.2.2(e) C.1** Does the laboratory **complete a demonstration of capability each time** there is a **change in instrument type, personnel, or test method**
- ___ **5.5.4.2.2(f)** Does the laboratory **fully document** the achievement of **demonstration of capability requirements** for each **specialized work cell**
Note: A work cell is defined as a group of analysts with specifically defined tasks that together perform the test method
- ___ **5.5.4.2.2(g)** Does the laboratory demonstrate & document acceptable performance through **acceptable continuing performance checks** (e.g, laboratory control samples) **each time** that **membership** in a work cell **changes**
- ___ **5.5.4.2.2(g)** Do the **new members** of the work cell **work with experienced analysts** in the specialty area
- ___ **5.5.4.2.2(g)** Does the laboratory **repeat a Demonstration of Capability** with the new work cell if the **first 4 continuing performance checks** following the change in personnel **produce a failure** in any sample batch acceptance criteria
- ___ **5.5.4.2.2(g)** Does the laboratory **repeat a Demonstration of Capability** if the entire **work cell is changed or replaced**
- ___ **5.5.4.2.2(h)** Is the **performance of the work cell** as a group **linked to the training records** of the **individual members** of the work cell
- ___ **5.1.1** Does the laboratory's **procedure for demonstrating its capability** to perform the method, the **analyst's capability** to perform the method, or the **acceptance criteria** for precision & accuracy **comply with the requirements specified in the mandated test method**
Note: See page 15 for such Demonstration of Capability procedural requirements & acceptance criteria

CHEMISTRY TEST METHOD ASSESSED: _____

- ___ **D** Does the laboratory have **procedures** for developing **acceptance/rejection criteria** for each Chemistry test method (where no regulatory or method criteria exist)
- ___ **D** Does the laboratory **assess & evaluate** all **quality control measures** on an **on-going basis**
- ___ **D** Does the laboratory **use** quality control **acceptance criteria** to determine the **validity of the data**
- ___ **5.5.9.2(d) App. D** Does the laboratory's **Chemistry data** indicate that the **quality control protocols** in the test methods manual **are being followed** (by all analysts)
- ___ **5.1.1** Does the laboratory's **acceptance criteria** for blanks, laboratory control samples, duplicates, & matrix spikes **fulfill the requirements** in **mandated test methods**
Note: See page 15 for acceptance criteria
- ___ **5.1.1** Does the laboratory fulfill **additional requirements** specified in the **mandated test method** or **regulation**
Note: See page 17 for the additional requirements stated in test methods
- ___ **D.1.1.1(a)** Does the laboratory process the method blank along with & under the **same conditions** as the associated samples to **include all steps** in the analytical procedure
- ___ **D.1.1.1(a)** Does the laboratory have procedures in place to determine if a **method blank is contaminated**
- ___ **D.1.1.1(b)** Does the laboratory analyze **method blanks** at a frequency of at least **one per preparation batch or one per 20 environmental samples** analyzed together with the same method & personnel using the same lots of reagents
- ___ **D.1.1.1(c)** Does the method blank consist of a quality system matrix **similar to associated samples** & known to be **free of the analytes of interest**
- ___ **D.1.1.1(d)** Does the laboratory **critically evaluate** each method blank as to the nature of any **interferences & the effect** on the analyses of each **sample within the batch**
- ___ **D.1.1.1(d)** Is the source of the contamination **investigated** & measures taken to **minimize or eliminate the problem**
- ___ **D.1.1.1(d)** Are **all samples** associated with a **contaminated blank reprocessed** for analysis or **reported** with appropriate **data qualifying codes**
Note: Such sample results can be reported with data qualifiers:
- If the analyte concentration in the blank is **at or above the reporting limit AND is greater than 1/10 of the amount measured** in any sample OR
- If the method blank contamination **affects the sample results** as per test method requirements or individual project data quality objectives
- ___ **D.1.1.1(d)** Does the laboratory **document all corrective actions** taken with respect to a contaminated blank

- _____ **D.1.1.2(b)** Does the laboratory analyze at least **one laboratory control sample** (LCS or QC Check Sample) **per preparation batch or one per 20 environmental samples** analyzed together with the same method & personnel using the same lots of reagents
Note: This Standard does not apply to analytes for which spiking solutions are not available (e.g. Total Suspended Solids, Total Dissolved Solids, Total Volatile Solids, Total Solids, pH, Color, Odor, Temperature, Dissolved Oxygen, or Turbidity)
Note: The matrix spike may be used in place of this control sample as long as the acceptance criteria are as stringent as for the laboratory control sample
Note: The LCS may consist of media containing known & verified concentrations of analytes or as a Certified Reference Material
- _____ **D.1.1.2(c)** Does the laboratory **include all target analytes** in the LCS spike mixture over a **2-year period**
- _____ **D.1.1.2(c)** Are all analyte concentrations in the LCS **within the calibration range** of the test method
- _____ **D.1.1.2(c)** Are the components spiked into the LCS **as specified by the mandated test method** or other regulatory requirement or as requested by the client
Note: In the absence of such requirements, the minimum number of analytes to spike are:
 - For methods with 1-10 target analytes, spike all analytes
 - For methods with 11-20 analytes, spike at least 10 analytes or 80%, whichever is greater
 - For methods with more than 20 target analytes, spike at least 16 analytes
Note: The analytes selected for spiking must be representative of all analytes reported & must represent the chemistries and elution patterns of the components to be reported, when some components interfere with accurate assessment (e.g., simultaneously spiking technical Chlordane, Toxaphene, & PCB's)
- _____ **D.1.1.2(d)** Does the laboratory **document the calculations for percent recovery** of the individual batch LCS
- _____ **D.1.1.2(d)** Are the individual analyte percent recoveries **compared to the acceptance criteria** published in the mandated test method or, where such criteria are not established, to client-specified acceptance criteria or to internal criteria determined at the laboratory
Note: The laboratory must **document the method used** to establish internal LCS recovery limits
- _____ **D.1.1.2(d)** Are **all samples** associated with an **out-of-control LCS reprocessed** for analysis or **reported** with appropriate **data qualifying codes**
- _____ **D.1.1.2(e)** For **large number of analytes** in the LCS, does the laboratory take corrective actions if **acceptance criteria** (3 standard deviations) **are not achieved**:
 - for 2 analytes when the LCS contains 11-30 analytes
 - for 3 analytes when the LCS contains 31-50 analytes
 - for 4 analytes when the LCS contains 51-70 analytes
 - for 5 analytes when the LCS contains 71-90 analytes
 - for 6 analytes when the LCS contains over 90 analytes
- _____ **D.1.1.2(e)** Does the laboratory locate the source of error & take corrective action **if the same analyte** exceeds LCS control limits **repeatedly**
- _____ **D.1.1.2(e)** Does the laboratory have a written procedure to **monitor the application of marginal exceedance allowances** to LCS control limits to **ensure random behavior**

- ___ **D.1.1.3** Does the laboratory document **procedures for determining the effect of the sample matrix** on test method performance
Note: These procedures relate to the analysis of quality system matrix specific QC samples & could be data quality indicators for a specific sample using a designated test method; these controls alone are not used to judge laboratory performance
- ___ **D.1.1.3** Does the laboratory have procedures in place for **tracking, managing, & handling matrix-specific QC criteria**
Note: These procedures must include spiking appropriate components at appropriate concentrations, calculating recoveries & relative percent difference, and evaluating & reporting results based on performance of the QC samples
- ___ **D.1.1.3.1(b)** Does the laboratory perform **matrix spikes (MS)** at a frequency **specified by the test method**
Note: This matrix spike analysis frequency is specified in pages xx-xx
Note: If the test method is not mandated, the laboratory must determine the frequency of matrix spike analysis as part of a **systematic planning process** (e.g., data quality objectives)
- ___ **D.1.1.3.1(c)** Are the components spiked into the MS **as specified by the mandated test method** or other regulatory requirement or as requested by the client
Note: In the absence of such requirements, the minimum number of analytes to spike are:
 - For methods with 1-10 target analytes, spike all analytes
 - For methods with 11-20 analytes, spike at least 10 analytes or 80%, whichever is greater
 - For methods with more than 20 target analytes, spike at least 16 analytes
Note: The analytes selected for spiking should represent the chemistries & elution patterns of components to be reported (e.g., simultaneously spiking Chlordane, Toxaphene, & PCB's)
- ___ **D.1.1.3.1(c)** Does the laboratory **include all target analytes** in the MS spike mixture over a **2-year period**
- ___ **D.1.1.3.1(d)** Does the laboratory **document the calculations for percent recovery & relative percent difference** in matrix spikes & matrix spike duplicates
- ___ **D.1.1.3.1(d)** Are the individual analyte percent recoveries **compared to the acceptance criteria** published in the mandated test method
- ___ **D.1.1.3.1(d)** If there is no established criteria, has the laboratory **determined internal criteria & documented the method** used to establish the limits
- ___ **D.1.1.3.1(d)** Are **all samples** associated with matrix spike results **outside established criteria** documented with corrective actions or **reported** with appropriate **data qualifying codes**

COMMENTS:

CHEMISTRY TEST METHOD EVALUATED: _____

- ___ **D.1.1.3.2(b)** Does the laboratory perform **matrix duplicates** at a frequency specified by the **required mandated test method**
Note: This matrix duplicate analysis frequency is specified in pages xx-xx
- ___ **D.1.1.3.2(c)** Are matrix duplicates performed on **replicate aliquots of actual samples**
- ___ **D.1.1.3.2(d)** Does the laboratory **document the calculations for relative percent difference** or other statistical treatments
- ___ **D.1.1.3.2(d)** Are the individual analyte duplicate precisions **compared to the acceptance criteria** published in the mandated test method
- ___ **D.1.1.3.2(d)** If there is no established criteria, has the laboratory **determined internal criteria & documented the method** used to establish the limits
- ___ **D.1.1.3.2(d)** Are **all samples** associated with duplicate precisions **outside established criteria** documented with corrective actions or **reported** with appropriate **data qualifying codes**
- ___ **D.1.1.3.3(b)** Does the laboratory add **surrogate compounds** to all **samples, standards, & blanks** for all **appropriate test methods**
Note: This Standard does not apply if the sample matrix precludes the use of surrogates or when a surrogate is not commercially available
- ___ **D.1.1.3.3(c)** Do the surrogates **represent the various chemistries** of the method's target analytes & deliberately chosen for **being unlikely to occur** as an environmental contaminant
- ___ **D.1.1.3.3(d)** Are the surrogate recoveries **compared to the acceptance criteria** in the mandated test method
- ___ **D.1.1.3.3(d)** Does the laboratory evaluate surrogate recoveries outside acceptance limits for **the effect indicated** for the individual sample results
- ___ **D.1.5(a)** Has the laboratory **evaluated selectivity** by following the checks established within the method
Note: These evaluations may include mass spectral tuning, second-column confirmation, chromatography retention time windows, ICP inter-element interference checks, sample blanks, spectrochemical absorption or fluorescence profiles, co-precipitation evaluations, & electrode response factors.
- ___ **D.1.5(b)** Does the laboratory perform confirmations to **verify compound identification** when positive results are detected on a **sample from a location** that has **not been previously tested** by the laboratory
Note: These confirmations are performed on pesticides, herbicides, acid extractables, or other organic tests, or when recommended by the analytical test method
Note: Confirmation is not required when the analysis involves the use of a mass spectrometer
Note: Confirmation is required unless stipulated in writing by the client
- ___ **D.1.5(b)** Does the laboratory **document all confirmations** of compound identity
- ___ **D.1.5(c)** If a mass spectrometer is used, has the laboratory documented **acceptance criteria for mass spectral tuning**

CHEMISTRY TEST METHOD EVALUATED: _____

- ___ **D.1.2** Does the laboratory **document all procedures & retain all supporting data** in determining & verifying limits of detection & limits of quantitation
- ___ **D.1.2.1** Does this test method **provide limits of detection (LOD's)** that are **appropriate & relevant** for the intended use of the data
- ___ **D.1.2.1** Has the laboratory **determined the limit(s) of detection** by the **protocol** in the mandated **test method** or applicable **regulation**
Note: If the protocol for determining LOD's is not specified, the laboratory must **still determine the LOD's** but according to a procedure that **reflects instrument limitations & intended application** of the test method
Note: In the absence of regulatory or client requirements, an LOD **is not required** when test results are **not reported outside of the calibration range**
- ___ **D.1.2.1(a)** Has the laboratory **initially determined the detection limits** for the **compounds of interest** in this test method **in a quality system matrix** in which there are **no target analytes or interferences** at a concentration that would impact the results
Note: If this is not possible, the laboratory must determine these detection limits **in the quality system matrix of interest**
- ___ **D.1.2.1(b)** Does the laboratory determine LOD's **each time** there is a **change** in the test method that **affects how the test is performed** or when a **change in instrumentation** occurs that **affects the sensitivity of the analysis**
- ___ **D.1.2.1(c)** Does the laboratory have **established procedures** to relate **LOD's with Limits of Quantitation (LOQ's)**
- ___ **D.1.2.1(d)** Has the laboratory **verified the LOD annually** for each quality system matrix, test method, & analyte
Note: All sample processing steps of the analytical method must be included in the determination of the LOD
Note: Validity of the LOD is confirmed by **qualitative identification** of the analyte(s) in a quality control sample in each quality system matrix containing the analyte at **no more than 2-3x** the LOD for single-analyte tests and **1-4x** the LOD for multiple analyte tests
Note: LOD verification must be performed **on every instrument that is to be used** for analysis of samples & reporting of data
Note: A LOD study is not required for any component for which spiking solutions or quality control samples are not available (e.g., Temperature), or when test results are **not to be reported to the LOD** (versus the Limit of Quantitation or working range of instrument calibration according to Appendices D.1.2, D.4.5, D.5.4, and D.6.6 to NELAC Chapter 5).

CHEMISTRY TEST METHOD EVALUATED: _____

- _____ **D.1.2.2(a)** Are **all established LOQ's** above the LOD's for each analyte
- _____ **D.1.2.2(b)** Has the laboratory **verified the LOQ annually** for each quality system matrix, test method, & analyte
Note: The LOQ study is not required for any component or property for which spiking solutions or quality control samples are not commercially available or otherwise inappropriate (e.g., pH).
Note: The **validity of the LOQ** is confirmed by **successful analysis** of a quality control sample, containing the analytes of concern in each quality system matrix at **1-2 times** the claimed LOQ
Note: A successful analysis is one where the recovery of each analyte is within the established test method acceptance criteria or client data quality objectives for accuracy.
Note: This single analysis is not required if the **bias & precision** of the measurement system are **evaluated at the LOQ**
Note: The LOQ verification is not required is not required if the LOD is re-evaluated or verified
- _____ **5.1.1** Do the laboratory's limits of detection **fulfill the requirements of mandated test methods or regulations**
Note: US EPA's Safe Drinking Water Act (SDWA) & Clean Water Act (CWA) regulations require determination of Method Detection Limits according to the procedures & criteria in 40 CFR Part 136, Appendix B
Note: See page 16 for SDWA Maximum Contaminant Levels & RCRA Toxicity Characteristics, which the LOD, LOQ, or the lowest-concentration calibration standard must be reliably & consistently below
Note: Other regulations (including state regulations) & permits may contain additional requirements for **Reporting Limits, Minimum Levels, Lower Limits of Detection,** & other criteria

COMMENTS: List analytes for which the above requirements for measurement sensitivity have not been fulfilled

FLAME EMISSION, ATOMIC ABSORPTION, & ATOMIC FLUORESCENCE SPECTROMETRY

Flame Photometric Methods – SM3500K D (<=19th ed.), SM3500K B (20th ed.);
SM3500Na D (<=19th ed.), SM3500Na B (20th ed.)
Flame AA Methods – EPA 2xx.1 & 7xx0 (generally); SM3111B,C,D; USGS I-3xxx-85 (generally);
ASTM Dxxxx-yyA or B (generally); AOAC 973.53, 973.54, 974.27; ANSI Photo. Effluents
Furnace AA Methods – EPA 2xx.2 & 7xx1 (generally), 200.9; SM3113B; ASTM Dxxxx-yyC or D (generally)
Hydride AA Methods – EPA 206.3, 270.3, 7061, 7062, 7741, 7742; SM3114B; ASTM D2972-97B, D3859-98A;
USGS I-3062-85, I-3667-85
Cold Vapor AA Methods – EPA 245.1, 245.2, 245.5, 245.6, 7470, 7471; SM3112B; ASTM D3223-91;
USGS I-3462-85; AOAC 977.22
Au Amalgamation Cold Vapor AA Methods – EPA 1631C, 7473
Atomic Fluorescence Methods – EPA 245.7, 1631E, 7474

REQUIRED REAGENTS & STANDARDS

EPA 200-series, 7000-series; SM3000-series

Stock Standards for each Metal
Hollow cathode or electrodeless discharge lamps for each Metal (Atomic Absorption Spectrometry)
Matrix modifiers for Graphite Furnace AA:
Pd/Ni(NO₃)₂ – As, Cd, Pb, Se
Pd/Mg(NO₃)₂ – Cd, Pb, Tl
NH₄H₂PO₄ or H₃PO₄ -
H₂ in Ar purge gas – Sb & Tl
Matrix modifiers for Flame AA:
LaCl₃ – Ca (releasing agent to prevent pyrophosphate formation in flame)
KCl – Ba & Na (K ionization more readily vs. Ba & Na)
Digestion reagents (unless sample is aqueous with turbidity < 1 NTU (SDWA); sample is filtered (to
analyze for Dissolved Metals) and no COD or TOC (CWA); and not analyzed by
cold-vapor AA, hydride AA, colorimetric, or chelation-extraction techniques)
Nitric Acid (plus hydrochloric acid depending on the aqueous sample & metal analyzed)
(plus HCl, H₂O₂, or HF depending on the metal analyzed & the
solid/sludge/sediment sample)
Permanganate & Sulfuric Acid to digest oils
Xylene, MIBK, or Kerosene to dissolve oils, greases, or waxes
Note: Microwave digestion not approved for SDWA; in CWA only approved for FL-AA & ICP
analyses of Al, As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Se, V, Zn
Permanganate, Persulfate, HNO₃, & H₂SO₄ required for aqueous Mercury digestions
(waterbath for 2 hr at 95 C) (then hydroxylamine to decolorize & SnCl₂ to generate Hg vapor)
Bromate/Bromide & HCl required to digest for ultratrace concentrations of Mercury
Sodium Carbonate & Sodium Hydroxide to digest for Chromium(VI)
Chelation-Extraction reagents: Ammonium Pyrrolidine Dithiocarbamate & MIBK
Coprecipitating reagents for Cr(VI): Ammonium Sulfate & Lead Nitrate
Reducing agents for Hydride Generation & Cold-vapor AA methods:
Tin(II) Chloride to generate Hg vapor, or to reduce As(V) & Se(VI) to As(III) & Se(IV)
Potassium Iodide or Urea (alternates to reduce As(V) & Se(VI) to As(III) & Se(IV))
Zinc Metal/Hydrochloric Acid or Sodium Borohydride, to generate volatile metal hydrides

HOLDING TIME, SAMPLE CONTAINER, & SAMPLE PRESERVATION REQUIREMENTS

24-Hour Holding Time, plastic or glass containers, 4 C

Chromium(VI)

28-Day Holding Time, plastic or glass containers, 4 C, Nitric Acid to pH<2

Mercury

6-Month Holding Time, plastic or glass containers, Nitric Acid to pH<2

Metals (except Cr(VI) & Hg; add HNO₃ if sample unpreserved & let stand at least 16 hours prior to analysis)

6-Month Holding Time, plastic or glass containers, Nitric or Sulfuric Acid to pH<2

Hardness

INITIAL INSTRUMENT CALIBRATION ACCEPTANCE CRITERIA FOR MANDATED TEST METHODS

3 standards + blank

SM1020B, 5, applies to all mandated SM methods

EPA Metals, 10.2.1 refers to all EPA 200-series FL-AA & FUR-AA methods used for SDWA

EPA 200.9, 11.4.4

EPA 245.7, 9.1

EPA 7000, 8.2, applies to all EPA 7000-series FL-AA & FUR-AA methods, **daily**

SM3113B, 4c, **daily**

D3919, 11.2 refers to all ASTM FUR-AA methods

D4691, 11.2 refers to all ASTM FL-AA methods

4 standards + blank

EPA Metals, 8.2 refers to all EPA 200-series FL-AA & FUR-AA methods

5 standards + blank

EPA 245.1, 11.2.2 (**standards must contain same digestion reagents or be digested** along with samples)

EPA 245.5, 9.1 (**standards digested** along with samples)

EPA 1631E, 10.2 & 10.3, plus **3 system blanks**, CF<15%RSD, lowest std. 75-125% recovery, blanks <0.5 ng/L

6 standards + blank

I-3xxx-85, 6, **daily**, applies to all USGS FL-AA Metals mtds.

CALIBRATION VERIFICATION ACCEPTANCE CRITERIA FOR MANDATED TEST METHODS

Recovery 80-120%

EPA 1631E, 9.5.3 (every 12 hr & end of run), all procedural steps included, Table 2 says 77-123% recovery at 5 ng/L

EPA 7000, 8.3, for continuing calibration verifications done **after every 10 samples**

Recovery 90-110%

EPA Metals, 10.2.2 for MCL std. at beginning & **every 20 samples**

EPA 200.7 200.8, 200.9, 245.1, 9.3.4 after **every 10 samples & end of run**, calibration blank analysis also required each time

SM3020B (AA Metals)

EPA 7000, 8.2, for second-source initial calibration verification

Recovery 95-105%

EPA 200.9 & 245.1, 9.3.4 for midpoint std. after initial calib.

Inclusion of both Standard & Calibration Blank Analysis

EPA 245.7, 10.5 (including end of the run)

**PRECISION & ACCURACY ACCEPTANCE CRITERIA FOR MANDATED TEST METHODS
(INITIAL DEMONSTRATION OF CAPABILITY)**

Method Detection Limits & Linear Dynamic Range (or Linear Calibration Range) evaluations required for each analyte & wavelength used – upper limit within 10% of extrapolated value

EPA 200.9, 9.2.2, 6 stds. needed

EPA 245.1, 9.2.2, 3 stds. needed

EPA 245.5, 245.6, 10.2.1

Table Criteria of 79-121%, 21% RSD

EPA 1631E, 9.2.2, also requires MDL <0.2 ng/L

QUALITY CONTROL ACCEPTANCE CRITERIA FOR MANDATED TEST METHODS

QC Check Sample Recoveries within 85-115%

EPA 200.9, 245.1, 9.3.2-9.3.3 (Metals LFB)

2 concentrations required for QC Check Sample Analyses

ASTM D4691, 11.4.1 refers to all ASTM FL-AA methods

External QC Check Sample Recoveries within 80-120%

EPA 7000, 8.3, every 10 samples

External QC Check Sample Recoveries within 90-110%

EPA 7000, 8.2, daily after each initial calibration

EPA QC Check Sample Recoveries within 90-110%

EPA 200.9, 245.1, 9.2.3 analyzed quarterly (Metals)

Matrix Spike (SMS or LFM) Recoveries within 70-130%

EPA 200.9, 245.1, 9.4.2-9.4.3, analyzed every 10 samples (Metals)

Matrix Spike & Matrix Spike Duplicate Recoveries within Table Criteria of 71-125%, <24% RPD

EPA 1631E, 9.3, MS/MSD required every 10 samples

Matrix Spike Recoveries within 85-115%

EPA 7000, 8.6.2, criterion to avoid quantitation of metals by the method of standard additions

SM3020 (Metals) (SDWA: In-furnace addition recovery needed to avoid quantitation of Metals by the method of standard additions)

Matrix Spike Recoveries within 90-110%

EPA Metals, 5.2.1 for post-digestion spikes, refers to all EPA 200-series FL-AA & FUR-AA methods

Serial Dilution Results within 10%

EPA 7000, 8.6 analyzed each sample batch

Background Absorbance < 1.0

EPA 200.9, 9.4.6

EPA REGULATORY LEVELS REQUIRING SPECIFIC DETECTION LIMITS

SDWA MAXIMUM CONTAMINANT LEVELS

Antimony	6.0 ug/L
Arsenic	10.0 ug/L
Barium	2000 ug/L
Beryllium	4.0 ug/L
Cadmium	5.0 ug/L
Chromium	100 ug/L
Copper	1300 ug/L (1.0 ug/L if analyzing composite samples) (20 ug/L if analyzing composite samples by FL-AA)
Lead	15.0 ug/L (1.0 ug/L if analyzing composite samples)
Mercury	2.0 ug/L
Nickel	100 ug/L
Selenium	50.0 ug/L
Sodium	20000 ug/L (reporting level)
Thallium	2.0 ug/L

RCRA TOXICITY CHARACTERISTICS

Arsenic	5.0 mg/L	Lead	5.0 mg/L
Barium	100.0 mg/L	Mercury	0.2 mg/L
Cadmium	1.0 mg/L	Selenium	1.0 mg/L
Chromium	5.0 mg/L	Silver	5.0 mg/L

ADDITIONAL REQUIREMENTS

Matrix Spikes, Control Standards, & Duplicates at least 15% of workload for any parameter

USGS Bk. 5, Ch. A1, p.7, applies to all USGS Metals & General Chemistry mtds.

Method of Standard Additions required to quantitate Metal analytes

EPA 7000, 8.7, for all EP-TOX extracts, analyses for RCRA delisting petitions, & analysis of new matrices

Matrix Spikes analyzed every 10 samples

EPA 245.5, 245.6, 245.7, 10.4, or batch

Matrix Spike every 10 samples, or Matrix Spike & Duplicate every 20 samples

SM1020B, 2 (applies to all SM methods unless more stringent requirements appear elsewhere)

Duplicate every 10 samples or analytical batch

EPA 245.7, 10.3

D4691, 14.3, applies to ASTM FL-AA Metals mtds.

Matrix Spike & Matrix Spike Duplicate each batch of 20 samples or fewer

EPA 7000, 8.4 (applies to all 7000-series FL-AA & FUR-AA Metals mtds.)

EPA 7473, 9.3, may use sample dup. in place of MSD

Spike Duplicate analyzed every 10 samples

EPA 7195, 7197, 8.6

All Samples analyzed in Duplicate

SM3113B, 4d, repeat replicate analyses until variation < 10%

Calibration Verification every 10 samples

D3919, 12.3, applies to ASTM FUR-AA Metals mtds.

D4691, 11.3, applies to ASTM FL-AA Metals mtds.

Calibration Verification every 15 samples

EPA 7195, 7197, 8.5, second-source std.