



CASTNET

Quality Assurance Project Plan

Appendix 4: CASTNET Laboratory Standard Operating Procedures

Clean Air Status and Trends Network

Quality Assurance Project Plan

Revision 10.2

Appendix 4:

CASTNET Laboratory Standard Operating Procedures

March 6, 2025

Laboratory Instrumentation	
GLM3180-001	Determination of Inorganic Anions in Water and Air Filters by Ion Chromatography for Acid Deposition Projects (EPA Method 300.0)
GLM3180-004	Ammonia for Dry and Wet Deposition (Modified EPA Method 350.1)
GLM3180-005	Inductively Coupled Plasma-Atomic Emission Spectrometry: Perkin Elmer Optima 3000 DV (Modified EPA Method 6010B)
GLM3180-007	Hydrogen Ion (pH) in Water (ASTM D1293-12)
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Laboratory - Management	
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GLO3180-038	Procedure for Calibration of Pipettors

Notes: GLM = Gainesville Laboratory Method.

GLO = Gainesville Laboratory Operations.

TITLE: DETERMINATION OF INORGANIC ANIONS IN WATER AND AIR FILTERS BY ION CHROMATOGRAPHY FOR ACID DEPOSITION PROJECTS (EPA METHOD 300.0, MODIFIED)

Effective

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Annual Review			
Reviewed by:	Title:	Date:	Signature:

DETERMINATION OF INORGANIC ANIONS IN WATER AND AIR FILTERS BY ION CHROMATOGRAPHY FOR ACID DEPOSITION PROJECTS (EPA METHOD 300.0, MODIFIED)

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the determination of inorganic anions in air filters, water, and annular denuders by ion chromatography (IC). The anions of interest include particulate chloride (Cl^-), particulate nitrite (NO_2^-), particulate nitrate (NO_3^-), nitric acid (HNO_3); and gaseous sulfur dioxide (SO_2) as particulate sulfate (SO_4^{2-}), depending on filter type; and particulate sulfate (SO_4^{2-}).

2.0 SCOPE

This method is used for acid deposition projects and covers the determination of selected inorganic ions by IC in rainwater, cloud water, lake water, snow, and in various filter media as dry deposition.

3.0 SUMMARY OF METHOD

An aliquot of a water sample or an aliquot of an extract (filter or denuder) is passed through a series of ion exchangers. The anions of interest are separated on the basis of their relative affinities for a strongly basic anion exchanger (analytical column) and then converted to their highly conductive acid form by membrane suppression. Detection is accomplished by electrical conductivity. The resulting chromatographic peaks are identified on the basis of retention time compared to known standards. Quantitation is performed by the comparison of the peak area to the calibration curve areas.

3.1 Method Interferences

Interferences can be caused by substances with retention times that are similar to and overlap with those of the anion(s) of interest. Column overloading can lead to peak tailing, poor peak resolution, and/or carryover into an adjacent downfield peak.

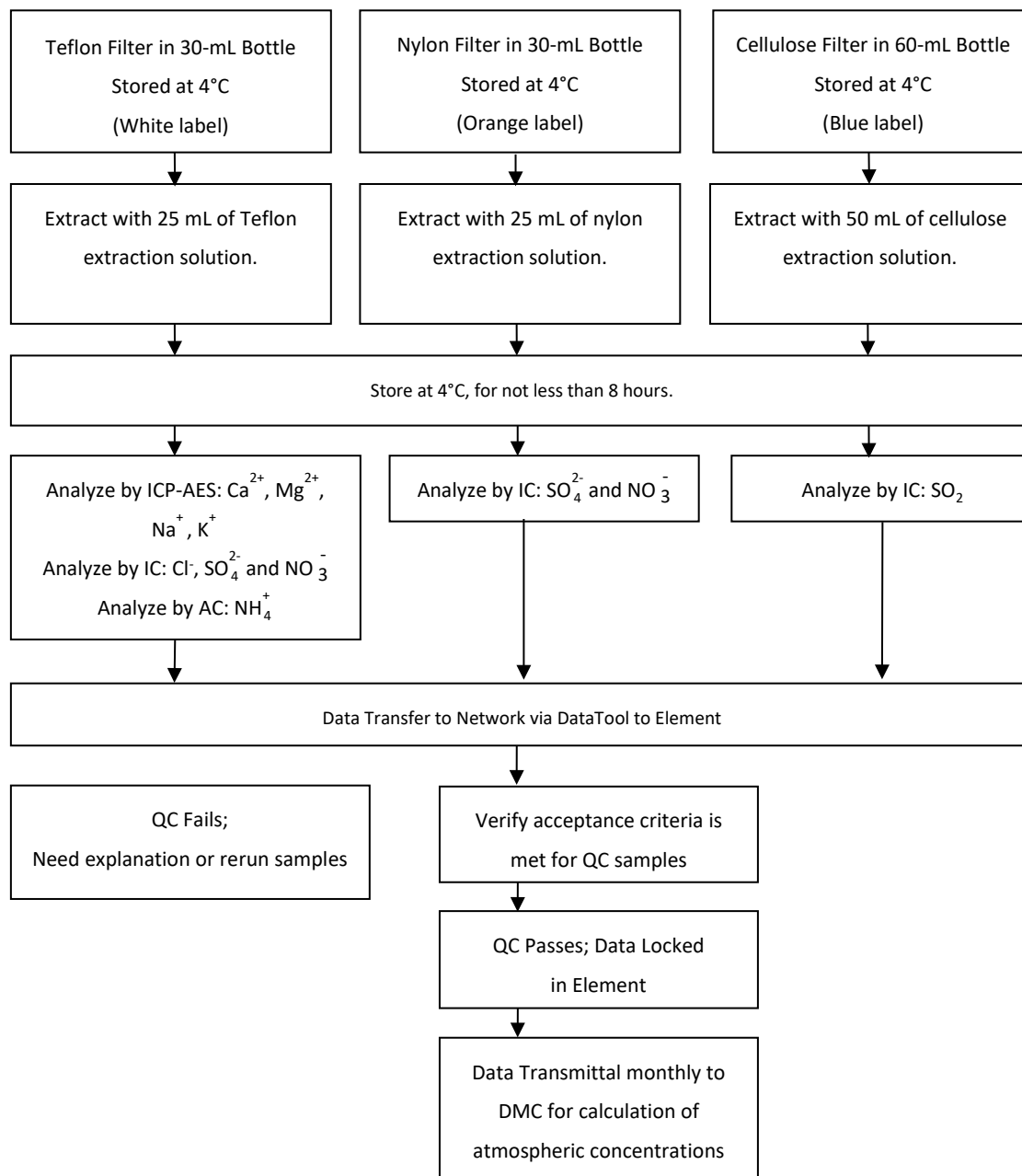
Method interferences may be caused by contaminants in the reagent water, reagents, glassware, or other sample processing accessories that lead to discrete artifacts or an elevated baseline in ion chromatograms.

Samples that contain particles larger than 0.45 micrometers (μm) and reagent solutions that contain particles larger than 0.20 μm require filtration to prevent damage to instrument columns and flow systems.

3.2 Deviations from the Method

A general overview of the steps described in this SOP is depicted in Figure 1. Deviations from the analytical method described in this SOP are not permitted.

Figure 1. Overview – Laboratory Operations Procedures for Filter Packs



3.3 Environmental Conditions

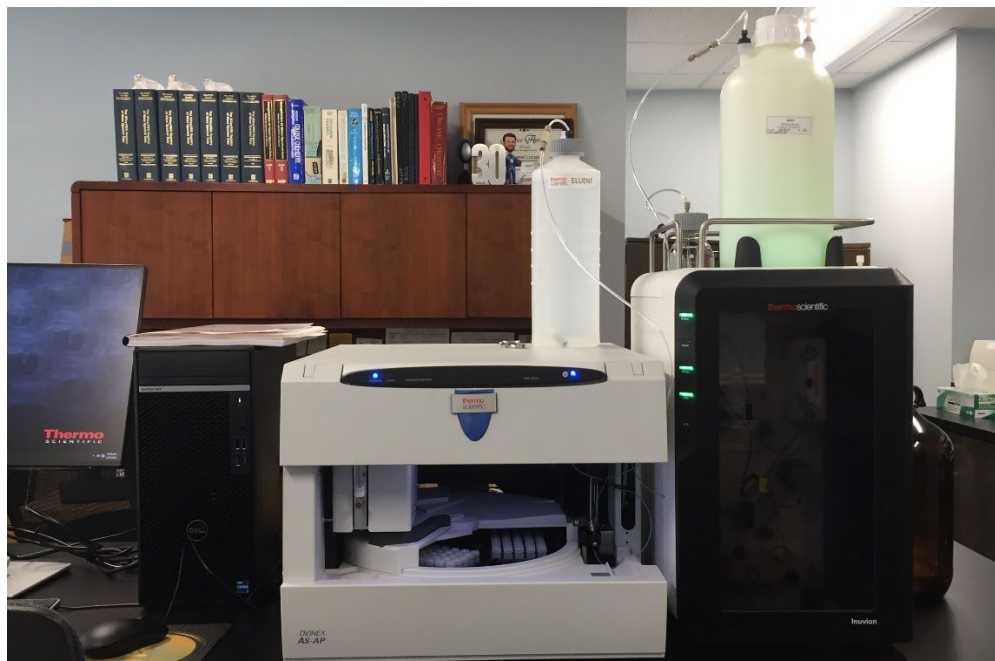
The ion chromatographs have a large working range: 4-40 degrees Celsius (°C) and 5-95 % relative humidity with no condensation. However, the laboratory should be maintained at a temperature and humidity within this range that is comfortable for the analyst. If the laboratory is not within comfortable working conditions, the laboratory manager should be notified and a service call will be placed. It is the responsibility of the analysts(s) working in each lab to keep their areas organized and clean.

4.0 MATERIALS

4.1 Apparatus

- Analytical balance capable of accurately weighing to the nearest 0.01 gram (g)
- Ion chromatograph: Dionex ICS-1600, Aquion, Inuvion or equivalent (see Figure 2)
- Anion guard column: Dionex AG14, AG22, AG22-Fast or equivalent
- Anion analytical column: Dionex, AS14, AS22, AS22-Fast or equivalent
- Anion self-regenerating suppressor: ASRS-300, or equivalent
- Conductivity cell detector: Approximately 1.25 microliter (μL)-internal volume or equivalent
- Appropriate autosampler vials and caps
- Eppendorf variable or fixed volume pipettors or equivalent with appropriate disposable tips
- Disposable plastic beakers
- Shaker tables
- Ultrasonic baths

Figure 2. Dionex Inuvion Ion Chromatograph



4.2 Reagents

4.2.1 Water and Single Compounds

- Reagent water: deionized (DI) water of resistivity of 15 mega ohms ($M\Omega$) or greater derived from mixed bed ion exchangers, activated carbon filters, and polishing exchangers. Water should contain particles no larger than 0.20 μm .
- Sodium hydroxide (NaOH) 2 normal (N) solution, American Chemical Society (ACS) reagent grade or better. Chemical Abstracts Service Registry Number (CAS#) 1310-73-2
- Sodium bicarbonate (NaHCO_3), ACS reagent grade or better. CAS# 144-55-8
- Sodium carbonate (Na_2CO_3), ACS reagent grade or better. CAS# 497-19-8
- Concentrated hydrochloric acid (HCl), ACS reagent grade or better. CAS# 7647-01-0
- Hydrogen peroxide (H_2O_2), 30 percent volume-to-volume (v/v), ACS reagent grade or better. CAS# 7722-84-1

4.2.2 Mixtures

- Eluent (mobile phase) solutions: A solution of a suitable $\text{Na}_2\text{CO}_3/\text{NaHCO}_3$ buffer prepared as determined by the choice of analytical column. The solutions used for the AS22, AS22-Fast and AS14 columns follow.
 - AS22 and AS22-Fast concentrated eluent solution: 600 millimolar (mM) NaHCO_3 /400 mM Na_2CO_3 : Dissolve 100.59 g NaHCO_3 and 84.28 g Na_2CO_3 in reagent water and dilute to 2 liters (L).
 - AS 14 concentrated eluent solution: 100 mM NaHCO_3 /350 mM Na_2CO_3 : Dissolve 16.78g NaHCO_3 and 73.96g Na_2CO_3 in reagent water and dilute to 2 L
- Working eluent solutions: Dilute 40 milliliters (mL) of the appropriate concentrated eluent solution to 4 L with reagent water. The final concentrations of the listed working eluent solutions are as follows:
 - AS22 and AS22-Fast– 4.0/ 6.0 mM $\text{CO}_3^{2-}/\text{HCO}_3^-$
 - AS14 #2- 3.5/1.0 mM $\text{CO}_3^{2-}/\text{HCO}_3^-$
- Calibration stock solutions are purchased as National institute of Standards and Technology (NIST)-traceable solutions. A Certificate of Traceability (Figure 3) and an expiration date will be provided with each stock. These solutions are purchased as a set of nine from AccuStandard. NO_2^- and NO_3^- are expressed in terms of nitrogen. A minimum of five points shall be used for each calibration curve. The concentrations of the daily curve are listed in Table 1 in units of micrograms (μg) per mL:


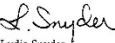
Table 1. Concentration Curves (µg/mL)

IC Curve	[Cl ⁻]	[NO ₂ ⁻ as N]	[Br ⁻]	[NO ₃ ⁻ as N]	[SO ₄ ²⁻]
STD 1	0	0	1.0	0	0
STD 2	0.008	0.004	1.0	0.008*	0.040*
STD 3	0.020*	0.010*	1.0	0.020	0.10
STD 4	0.040	0.020	1.0	0.040	0.20
STD 5	0.10	0.050	1.0	0.10	0.50
STD 6	0.30	0.150	1.0	0.30	1.50
STD 7	0.60	0.30	1.0	0.60	3.0
STD 8	1.0	0.50	1.0	1.0	5.0
STD 9	2.0	1.0	1.0	2.0	10.0
STD 10	3.0	NA	1.0	3.0	15.0

Notes: *Indicates concentration of reporting limit
STD = calibration standard

- Control standards used as continuing calibration verification (CCV) spikes are purchased as ready-to-use NIST-traceable standard solutions containing analytes of interest (e.g., from Inorganic Ventures, High Purity Standards (HPS), or equivalent). A Certificate of Traceability and an expiration date is provided with each lot. To ensure calibration accuracy during each analytical run, a CCV is used to verify accuracy.
- Standard Reference Material (SRM) reference solution (RF) is purchased as a ready-to-use NIST-traceable standard solution containing analytes of interest (e.g., Simulated Rainwater #2 from HPS or equivalent) with a certificate of analysis and an expiration date. Note that the SRM is used to verify the calibration and must be from a source other than that of the calibration standards.
- Blank Spike (BS) standards are purchased as ready-to-use NIST-traceable standard solutions containing analytes of interest.
- Bromide stock solution, 1,000 milligrams (mg) per L, is made by adding 2.06 g of Rubidium Bromide (RbBr) to a liter of DI water. CAS# 7789-39-1

Figure 3. Certificate of Traceability

125 Market Street New Haven, CT 06513 USA		 AccuStandard, Inc. CERTIFICATE OF ANALYSIS AccuIon™ Reference Standard Item Number: IS-7966B-R2		Tel (203) 786-5290 Fax (203) 786-5287 Website AccuStandard.com	
Mix Name: Custom IC Standard Matrix: Water, tr. CHCl ₃		Lot Number: 210015038 Expiration Date: Jul / 2011			
Concentration in µg/mL					
Br <u>1000</u> 3184 Cl <u>8</u> 3182 NO ₃ -N <u>8</u> 3185 SO ₄ <u>40</u> 3181					
<p>The total maximum uncertainty on the certified value(s) is ±2%. See reverse side of certificate for details.</p> <p>RESULTS: This solution standard was certified for accuracy of the listed components via methodology traceable to primary or well characterized secondary standards.</p> <p>This standard was prepared gravimetrically to contain the concentrations shown above. Balances, used in the preparation, are calibrated regularly using NIST-traceable weights. All glassware used in preparation is Class A.</p> <p>We use the highest purity raw materials available, ASTM type I 18 megohm deionized water, and typically 99.999%+ starting materials to minimize impurity levels in the final solution. All solutions are filtered through a 0.2 µm filter prior to being bottled.</p> <p>Use good laboratory procedure when diluting this product. Shake bottle prior to use and do not pipette directly out of the bottle. Use only cleaned Class A volumetric glassware.</p> <p>We certify the accuracy of this standard to be ± 0.5% of the stated value until the expiration date listed above, provided it is kept tightly capped and stored under normal laboratory conditions.</p>					
Rec. 01/20/10 KSB		 Lydia Snyder Inorganic QC Supervisor			
AccuStandard is accredited to ISO/IEC 17025:2005 and certified to ISO 9001:2000					

- Preparation of extraction solutions:
 - Extraction solution for cellulose filters: To a 4-L glass bottle add approximately 2 L of DI water; 4 mL of the 1,000 mg/L bromide stock; 6.7 mL 30 percent H₂O₂; and 10 mL concentrated HCl. Bring to 4 L with DI water.
 - Extraction solution for nylon filters: To a 4-L glass bottle add approximately 2 L of DI water; 4 mL of the 1,000 mg/L bromide stock; 6.7 mL 30 percent H₂O₂; and 6 mL of 2 N NaOH. Bring to 4 L with DI water.
 - Extraction solution for Teflon filters and denuders: To a 4-L glass bottle add approximately 2 L of DI water and 4 mL of the 1,000 mg/L bromide stock. Bring to 4 L with DI water.
- Acceptance criteria for extraction solutions:
 - Prepare extraction solution acceptance test samples as method blanks (MB) (see section 6.1.2 of this SOP), but do not take them through the extraction procedure.

Prior to use in extraction, each solution and the lowest concentration calibration standard (STD2) are analyzed by IC. In order to pass acceptance criteria, the responses for the target analytes of each solution must be less than the responses of STD2. Each of the target analytes must pass. If not, the solution is remade and reanalyzed.

- See GLO3180-10 for cellulose filter impregnation solution

5.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Safety Data Sheets (SDS) must be consulted. The SDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

6.0 PROCEDURE

6.1 Sample Extraction

Note: The Teflon filter and denuder extracts from this procedure can also be analyzed for cations by GLM-3180-004 (Ammonia) and GLM-3180-005 (ICP).

- 6.1.1 Pull the appropriate number of samples from the cold room. **Note:** There is no extraction for water samples.
- 6.1.2 Prepare a method blank (BLK). For Teflon and nylon filters, the BLK is an empty, labeled bottle. For cellulose filters, add 1 mL of the cellulose filter impregnation fluid to an empty, labeled bottle. BLK is extracted as regular samples.
- 6.1.3 A blank spike (BS) or laboratory control sample (LCS) is prepared by adding the appropriate extraction fluid to the bottle, removing 1 mL, and adding 1 mL of anion BS solution with concentrations of 5 parts per million (ppm) for Cl^- , 2.5 ppm for NO_3^- as N, and 12.5 ppm for SO_4^{2-} . The extracted instrument targets are 0.2 $\mu\text{g/mL}$ for Cl^- , 0.1 $\mu\text{g/mL}$ for NO_3^- , and 0.5 $\mu\text{g/mL}$ for SO_4^{2-} . For Teflon extractions, a cation BS is also included. For cellulose, 2 mL is used since the extraction volume is 50 mL. A 1 mL aliquot of the cellulose filter impregnation fluid is added to the cellulose BS prior to removing the 3 mL. Both the anion and cation BS solutions are custom made by HPS.
- 6.1.4 Select the proper extraction fluid for the extraction.
- 6.1.5 Calibrate a repipettor to 25 mL for Teflon and nylon, 50 mL for cellulose, and 20 mL for denuders. Tare the first bottle and a bottle every 10 samples. Pipette the extraction solution and reweigh the bottle to check the reproducibility of the repipettor. The

acceptable limits are 25.00 ± 0.10 g for Teflon and nylon, 50.00 ± 0.20 g for cellulose, and 20.00 ± 0.10 g for denuders. Record the checked weights in the “Notes” section of the run log.

- 6.1.6 Extract the samples according to filter type (see Figure 1). Visually confirm that the proper filter type is in the bottle with each sample.
- Teflon and cellulose: 15 minutes shake, 30 minutes sonication, and 15 minutes shake. Teflon filters use the “high” shaker setting. Cellulose filters use the “low” setting.
 - Nylon: 30 minutes high-speed shake.
 - Denuders: 20 inversions and rotations (done by hand). After extraction, the denuder extract is transferred to a 30-mL Nalgene bottle.
- 6.1.7 A peer review will be done to verify that the sample IDs on the extract bottles match the extraction worksheet.

Note: *Sample extracts must be stored at 4 ± 2 degrees Celsius ($^{\circ}\text{C}$) for at least 8 hours prior to analysis. This step ensures the reaction between the extraction fluid and the sample filter is complete.*

6.2 Sample Analysis

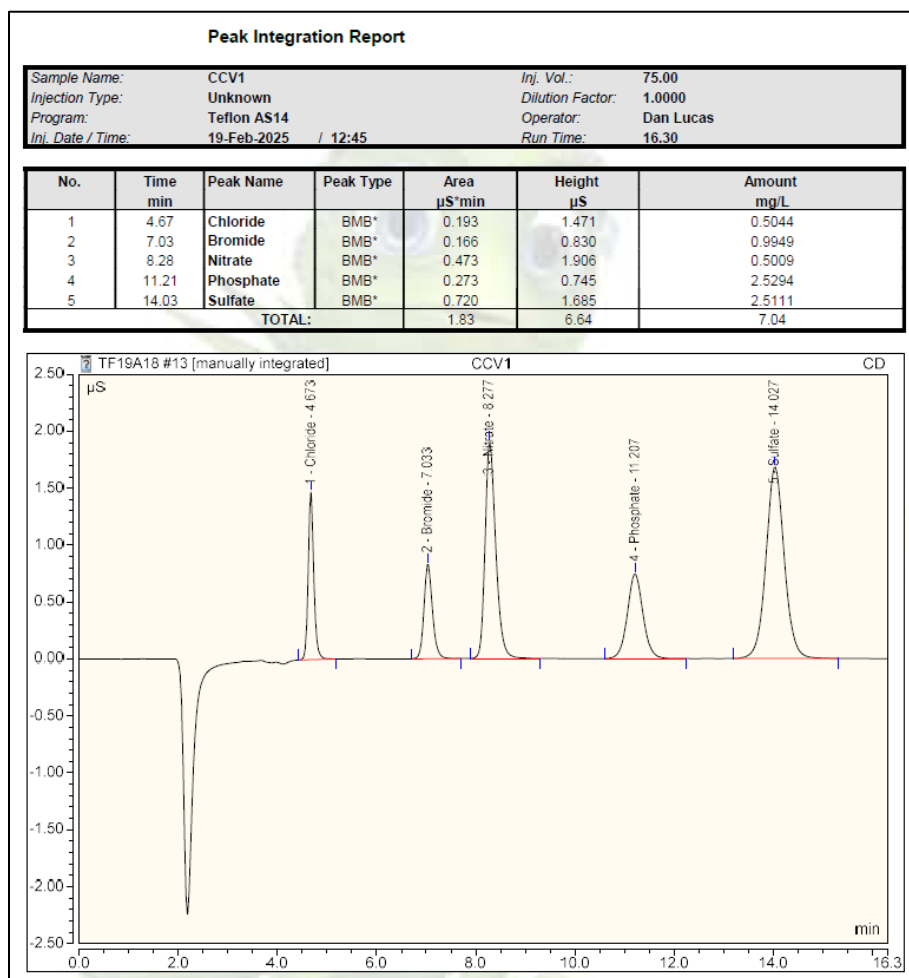
- 6.2.1 Establish a stable baseline by pumping the mobile phase (Section 4.2.2 of this SOP) through the instrument for at least 30 minutes. The operator’s manuals provided by the manufacturer contain detailed information regarding optimization of instrument performance and optimum operating criteria.
- 6.2.2 Load the auto-sampler vials beginning with the calibration curve followed by the extracted method blank (BLK1), the initial control standard (CCV1), the initial reference sample (SRM1), and extracted samples. Additional control standards (CCV2 through CCV9, CCVA¹, and CCVB, etc.) should be run every 10 samples and at the end of the analytical run. A second RF (SRM2) should also be run preceding the end-of-run CCVx.
- Note:** *Verify that the run-log printout auto-sampler positions are correct and the extract bottle IDs match the runlog; initial when complete.*
- 6.2.3 Each auto-sampler vial cap is scored with a razor knife. The razor knife is rinsed with Deionized water and wiped with a Kim wipe prior to scoring the cap. A number of auto-sampler vial caps will be scored in advance and stored in a clean container for future use. This additional step prevents the auto-sampler needle from getting bent causing a bad injection/replacement. When possible after analysis, visually inspect the vials to confirm they have all been injected by the auto-sampler. Samples that have responses exceeding the highest standard must be diluted and reanalyzed in the next available run.

¹ There is a 4 character limit in the software for this field, thus requiring the use of A, B, etc. after CCV9.

6.3 Data Analysis

- 6.3.1 Data files are processed using algorithms contained in the data collection software. Thermo-Fisher Dionex Chromeleon 7.2 software is currently in use (7.3 for the Inuvion IC). Parameters are adjusted as dictated by instrument performance.
- 6.3.2 Examine all chromatograms visually (Figure 4). Note any anomalies in the data batch narrative.

Figure 4. IC Chromatogram



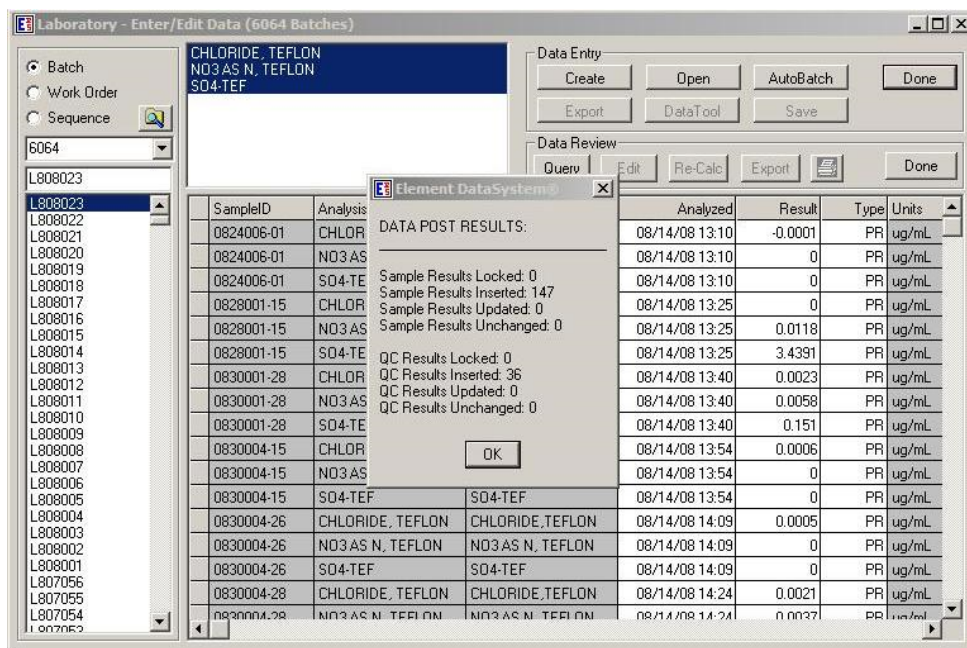
- 6.3.3 Prepare the Element upload file (Figure 5) using the batch processing feature of the Chromeleon software, and generate an upload file in final concentration as described in SOP GLO-3180-35, Element Batch Preparation.
- 6.3.4 Generate data batch in Element and DataTool using the uploaded file (Figure 6). The analyst can note any analytical anomalies in a separate batch narrative. Print a hard copy of the data batch to be included in the data batch folder.

Figure 5. Element Auto Batch

The screenshot shows the 'Data Review - L808023 (183 Analytes - 0 Hidden)' window. The left sidebar lists samples from L808022 to L807040. The top menu bar has 'Batch' (selected), 'Work Order', and 'Sequence'. The main table displays the following data:

SampleID	Analysis	Analyte	Rpt	Lock	Status	Qualifier	IResult	FResult	Type
0824006-01	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		-0.0001	ID [-0.00250]	PR
0824006-01	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0	ND [0.000]	PR
0824006-01	SO4-TEF	SO4-TEF	X		Batched		0	ND [0.000]	PR
0828001-15	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0	ND [0.000]	PR
0828001-15	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0.0118	0.2950	PR
0828001-15	SO4-TEF	SO4-TEF	X		Batched		3.4391	65.98	PR
0830001-28	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0.0023	ND [0.05750]	PR
0830001-28	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0.0058	ND [0.1450]	PR
0830001-28	SO4-TEF	SO4-TEF	X		Batched		0.151	3.775	PR
0830004-15	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0.0006	ND [0.01500]	PR
0830004-15	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0	ND [0.000]	PR
0830004-15	SO4-TEF	SO4-TEF	X		Batched		0	ND [0.000]	PR
0830004-26	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0.0005	ND [0.01250]	PR
0830004-26	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0	ND [0.000]	PR
0830004-26	SO4-TEF	SO4-TEF	X		Batched		0	ND [0.000]	PR
0830004-28	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0.0021	ND [0.05250]	PR
0830004-28	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0.0037	ND [0.09250]	PR
0830004-28	SO4-TEF	SO4-TEF	X		Batched		0.0167	ND [0.4175]	PR
0830004-35	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0	ND [0.000]	PR
0830004-35	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0	ND [0.000]	PR
0830004-35	SO4-TEF	SO4-TEF	X		Batched		0	ND [0.000]	PR
0831001-01	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0	ND [0.000]	PR
0831001-01	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0.0074	ND [0.1850]	PR
0831001-01	SO4-TEF	SO4-TEF	X		Batched		1.5382	38.46	PR
0831001-02	CHLORIDE, TEFLON	CHLORIDE, TEFLON	X		Batched		0	ND [0.000]	PR
0831001-02	NO3 AS N, TEFLON	NO3 AS N, TEFLON	X		Batched		0.0065	ND [0.1625]	PR

Figure 6. Element Data Transfer Completion



- 6.3.5 Assemble the data batch folder, including the Element data batch, copies of all run logs, certificates of analyses and processing methods, and any other necessary documentation. Save digital copies of the chromatograms on the WSP network located on P drive: \LAB\PROJECTS\ICDATA.
- 6.3.6 Complete the batch folder checklists (Attachments B and C), and submit it for review and finalization.
- 6.3.7 Archive all electronic files generated from data collection and processing in condensed form on the WSP network located on P drive: \LAB\PROJECTS\ICDATA.
- 6.3.8 If data are exported to the Clean Air Status and Trends Network database, the BLK, SRM, and DUP prefixes will be changed to MB, RF, and RP respectively upon ingestion.

6.4 Quality Control

- 6.4.1 One BLK is analyzed with each extraction unless specified differently by a project. The BLK is deionized water for wet deposition samples. The BLK for extracted samples is the applicable volume of extraction solution followed by the appropriate extraction procedure. The BLK results must be less than two times the reporting limit for the analytes of concern.

- 6.4.2 A CCV is analyzed at a frequency of 10 percent for every analytical batch, unless specified differently by a project, as well as at the beginning and end of the run. The measured value of the CCV must be within ± 5 percent of the certified value.
- 6.4.3 A SRM is used for an initial and a final calibration verification. The measured value of the reference sample must be within ± 5 percent of the certified value.
- 6.4.4 Sample replicates (DUP1, DUP2) are analyzed at a frequency of ± 5 percent. For samples greater than five times the reporting limit, the relative percent difference (RPD) of the replicate samples must be within ± 20 percent. For samples with concentrations less than or equal to five times the reporting limit, the absolute difference between sample and replicate must be less than the reporting limit.
- 6.4.5 All curves must contain a minimum of five points for quadratic calculations and have a correlation coefficient greater than or equal to 0.995.

6.5 Calculations

- 6.5.1 All calculations are performed with data reduction algorithms that reside in the instrument software.
- 6.5.2 Separate calibration curves are prepared for each anion of interest by plotting the response (peak area) of standards against concentration values using quadratic regression in the instrument software. Sample concentrations are calculated using the quadratic equation for the curve. The analyst may eliminate points to improve accuracy throughout the range of calibration but at least 5 points plus a blank must remain. The final concentration is uploaded into Element via DataTool.
- 6.5.3 Each Element analyses matrix includes the extraction volume conversion in a static data table. Any dilution factors are written in the electronic instrument analysis schedule, noted on the chromatogram, and used to calculate final concentration for single analyte IC analyses. For multi-analyte analyses, single analyte dilutions are manually entered in the data entry section of Element Autobatch and noted on the chromatogram.

6.6 Corrective actions

Attachment A shows the corrective actions taken when the QC Samples are not within acceptance criteria.

6.7 Data review

The checklist used by the analyst, peer reviewer, and supervisor in reviewing the analytical data are attached as Attachments B and C.

7.0 REFERENCES

Thermo/Dionex Corporation. 2024. Dionex Inuvion Ion Chromatography System Operating Manual, Rev. A, Document No. B51002568. February 2024

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8.0 ATTACHMENTS

Attachment A – Corrective Actions

Attachment B – Batch Folder Checklist

Attachment C – Batch Peer Review Checklist

Attachment D – Revisions Table

ATTACHMENT A

Summary of Corrective Action Procedures for Ion Chromatography

Quality Control	Acceptance Criteria	Corrective Action
Calibration curve correlation coefficient	≥ 0.995	Rerun calibration standards. If still out of control, prepare new calibration standards and recalibrate the instrument, or document why data are acceptable.
Calibration curve responses	Brackets all samples	Dilute and reanalyze samples exceeding the calibration curve range, or document why data are acceptable.
Reference standard (SRM)	$\pm 5\%$ of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples, or document why data are acceptable.
Control standard (CCV)	$\pm 5\%$ of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV, or document why data are acceptable.
MB (BLK)	< 2 times the RL	Determine the cause of blank problem. Reanalyze the sample, if necessary, or document why data are acceptable.
Blank Spike (BS)	$\pm 20\%$ of target	Not established
Sample Replicate (DUP)	$\pm 20\%$ RPD if the sample is greater than 5 times the RL	Determine the cause of the problem. Reanalyze the sample, if necessary, or document why data are acceptable.
Notes: RL = Detection limit RPD = Replicate percent difference Source: WSP		

ATTACHMENT B
Batch Folder Checklist



Folder Checklist

Batch # _____

Initial or NA

ELEMENT batch printout

Method reference

Instrument logbook copies

Reagent/Standard prep log sheets

Original raw data

Analyst

Date

Batch Folder Reviewed by

Date


Notes:

ELEMENT Reviewed by

Date

ATTACHMENT C

Batch Peer review Checklist



Batch Folder and ELEMENT Batch Review Checklist

Batch _____

Section 1.

This section is to be completed by the analyst before submitting the batch and counter-signed during peer review. Peer reviewer also checks each statement for accuracy (indicated by a check preceding the item). Any discrepancies must be corrected before the batch can be accepted. Any "No" response must have a comment.

	<u>Yes</u>	<u>No</u>	<u>Comments</u>
____ 1. All samples uploaded correctly.	____	____	_____
____ 2. All duplicate sources entered correctly.	____	____	_____
____ 3. All QC results within established criteria:			
____ MB	____	____	_____
____ BS	____	____	_____
____ CCV	____	____	_____
____ SRM	____	____	_____
____ DUP	____	____	_____
____ 4. All curve coefficients ≥ 0.995 .	____	____	_____
____ 5. All responses within calibration range.	____	____	_____
____ 6. All dilution factors entered correctly.	____	____	_____
____ 7. Other electronic flags in the ELEMENT batch?	____	____	_____ If Yes, describe in Additional

Comments _____

below.

Analyst: _____ Date: _____

Reviewed By: _____ Date: _____

Section 2.

This section is to be completed by the reviewer. Initial each item. All items must be found to be true and be initialed before the batch can be accepted.

1. Instrument run log matches ELEMENT batch.
(Exceptions allowed with sufficient documentation) _____
2. All appropriate documentation present.
(Includes, but is not limited to, standard prep logs, COA, code sheets, method print-outs, schedule print-outs, and run log copies.) _____
3. Raw data (chromatograms, spectra intensities, etc.) is acceptable.
(Additional documentation may be required.) _____

Reviewed By: _____ Date: _____

Additional Comments:

GLF-3180-002/ Rev. 3



ATTACHMENT D

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
11.0	Attachment D	Addition of this table.
	6.2.2	Inserted – Note: <i>Verify that the run-log printout auto-sampler positions are correct; initial when complete.</i>
12.0	4.2.2	Added – “as N” to NO ₂ and NO ₃ on Table I. Also updated standard numbers to 1 through 10.
	6.1.7	Added new section: “A peer review will be done to verify the sample IDs on the extract bottles match the IDs recorded on the extraction worksheet.”
	6.2.2	Added – “and the extract bottle IDs match the runlog.”
	6.2.3	Inserted – “A number of auto-sampler vial caps will be scored in advance and stored in a clean container for future use.”
	6.3.1	Inserted – “Thermo-Fisher Dionex Chromeleon 7.2 software is currently in use.”
	6.3.7	Inserted – “... on the AMEC network located on P drive: \\LAB\PROJECTS\ICDATA”
13.0	1.0	Updated company name.
	4.0	Replaced picture with old DX-500 instrument
	4.1	Removed Anion micro-membrane suppressor
	4.2.1	Removed concentrated sulfuric acid
	4.2.2	Removed regeneration solution; AS14 60/480 & 0.6/4.8 eluents; Acceptance criteria for extractions solutions updated to STD2.
	5.0	Changed MSDS to SDS
	7.0	Updated company name; removed QAPP reference; added Thermo to Dionex; deleted DX-500 manual; updated EPA Guidance Document.
	Attachments	Replaced Attachments B & C with new Amec Foster Wheeler forms.

Table Revisions - continued

Document Revision No.	Section	Revision
14.0	6.0	Note added clarifying use of extracts for cation analysis.
	6.4.1	Removed "or equal to" from BLK requirement. Should just be "less than two times".
	Attachment A	Acceptance criteria for Dup and Method Blank updated from DL to RL.
15.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
15.1	3.3	Added 3.3 Environmental Conditions
16.0	6.1.3	Cellulose filters: add 1 mL of impregnation solution to the spike then remove 3 mLs prior to spiking.
17.0	Authorizations	Katherine W. Barry replaced by Nathaniel J. Topie as Laboratory Operations Manager
	Figure 1	Analysis box expanded so that "Analyze by AC: NH_4^+ " is visible.
	4.2.2	Inorganic Ventures added to control standards vendors and reference solution defined as RF.
	6.2.2	Footnote added to explain CCVx designations.
	6.2.3	Added post analysis inspection of vials.
	6.3.5	Added network address for saving digital files.
17.1	All	Update company name to WSP and apply WSP font formatting.
17.2	All	Add "USA Environment & Infrastructure, Inc." to company name in footers and for initial use.
	<p>The above revisions to this document do not impact the data generated by the procedure.</p> <p>Verified by: </p>	
18.0	All	Update company name to WSP USA Inc.
	4.1	Add Aquion and Inuvion IC models. Figure 2 depicts the Inuvion.
	4.2.2	Add description of blank spike (BS)
	6.3	Add Chromeleon 7.3 software version. Figure 4 updated.
	7.0	References added for new instruments and software.
	<p>The above revisions to this document do not impact the data generated by the procedure.</p> <p>Verified by: </p>	

**TITLE: AMMONIA AS NITROGEN FOR DRY AND WET DEPOSITION
(MODIFIED EPA METHOD 350.1)**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations
Manager

Topie, Nathaniel
(USNT719661)

Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.03.03 11:37:45 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager

Marcus O. Stewart

Digitally signed by
Stewart, Marcus
(USMS719399)
Date: 2025.03.03
11:32:43 -05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Safety
- 6.0 Procedure
- 7.0 References
- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

AMMONIA AS NITROGEN FOR DRY AND WET DEPOSITION (MODIFIED EPA METHOD 350.1)

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the determination of ammonia plus ammonium ($\text{NH}_3 + \text{NH}_4^+$) as nitrogen (N) in air filter, denuder, and water samples using the SEAL AA500 AutoAnalyzer or the Bran+Luebbe Auto Analyzer 3.

2.0 SCOPE

This method is applicable to the determination of $\text{NH}_3 + \text{NH}_4^+$ in wet and dry deposition samples for CASTNET and CASTNET-like projects. The method used to collect and handle samples will determine the proportion of NH_3 and NH_4^+ . It is assumed that the CASTNET sampling method collects particulate NH_4^+ using an open-faced filter pack.

The analytical concentration range is 0.02 to 2.0 micrograms per milliliter ($\mu\text{g/mL}$) of NH_4^+ as nitrogen ($\text{NH}_4^+\text{-N}$). The upper concentration limit may be extended by sample dilution. The reported detection limit is 0.02 $\mu\text{g/mL}$ $\text{NH}_4^+\text{-N}$.

3.0 SUMMARY OF METHOD

This automated procedure for the determination of $\text{NH}_3 + \text{NH}_4^+$ as N uses the Berthelot Reaction, where the formation of a blue-colored compound believed to be closely related to indophenol forms after a solution of an ammonium salt is added to sodium phenoxide followed by the addition of sodium hypochlorite. A solution of ethylenediamine tetraacetic acid (EDTA) is added to the sample stream to eliminate the precipitation of the hydroxides of calcium and magnesium (see section 4.4). Sodium nitroprusside is added to intensify the blue color which is then measured colorimetrically.

Reduced volume versions of this method using the same reagents and the same molar ratios are acceptable as long as all quality control (QC) and performance requirements outlined in this SOP are met.

3.1 Method Interferences

Ammonia is ubiquitous in the environment and may easily contaminate samples. Floor strippers and waxes commonly contain NH_3 and are, therefore, a potential contamination source. Their use should be prohibited in any laboratory area where $\text{NH}_3 + \text{NH}_4^+$ analyses are performed. To help avoid contamination, wash sample cups with deionized water prior to use and rinse the cups again with a portion of the standard or sample to be analyzed. Avoid allowing sample cups that contain any solutions to sit for prolonged periods prior to analysis.

Low-molecular amines react similarly to ammonia and will consequently lead to erroneously high results.

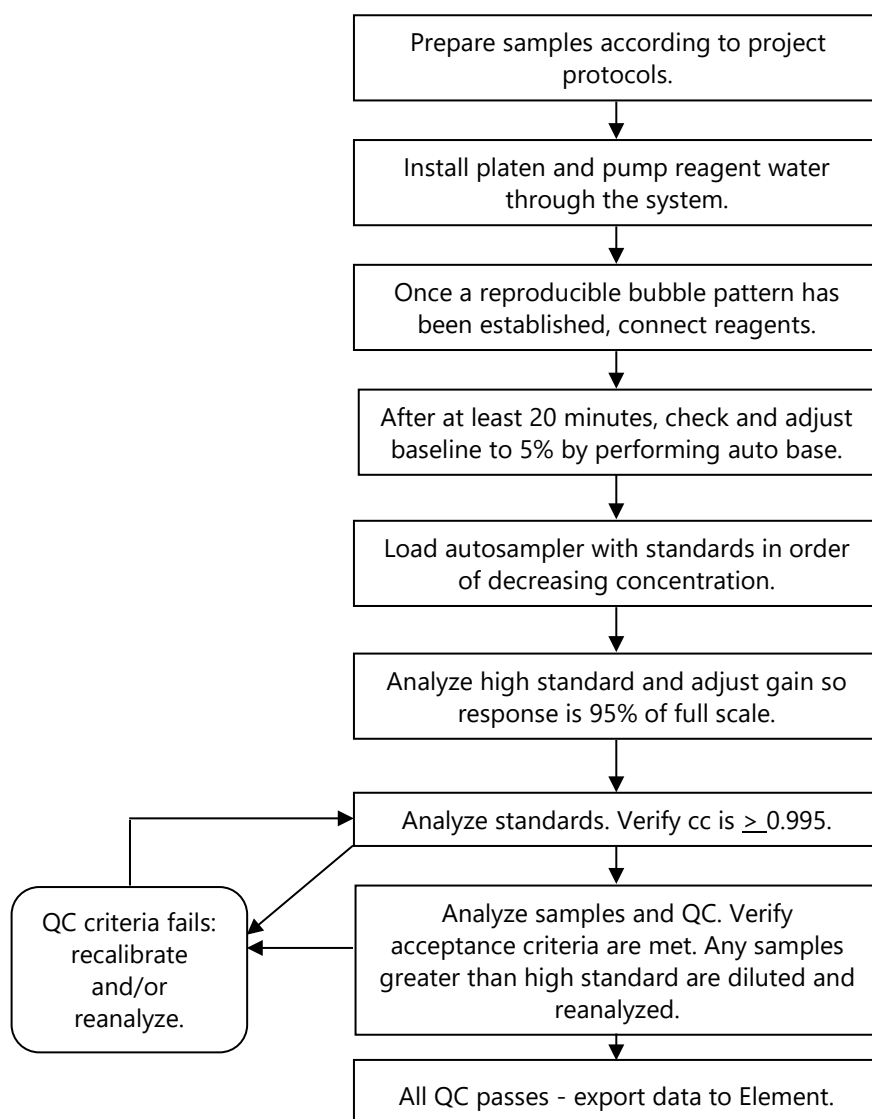
Interferences may occur if the reaction mixture after addition of all reagent solutions does not reach a pH of at least 12.6. This mainly happens with strong acidic and buffered samples.

Metal ions in high concentrations, which precipitate as hydroxides, may cause poor reproducibility.

3.2 Deviations from the Method

A general overview of the steps described in this SOP is depicted Figure 1. Deviations from the analytical method described in this SOP are not permitted.

Figure 1. Overview – Laboratory Operations Procedures for Determination of Ammonia



3.3 Environmental Conditions

The instrument does not have specific temperature and humidity requirements, however, the laboratory should be maintained at a temperature and humidity that is comfortable for the analyst. If the laboratory is not within comfortable working conditions, the laboratory manager should be notified and a service call will be placed.

It is the responsibility of the analysts(s) working in each lab to keep their areas organized and clean.

4.0 MATERIALS

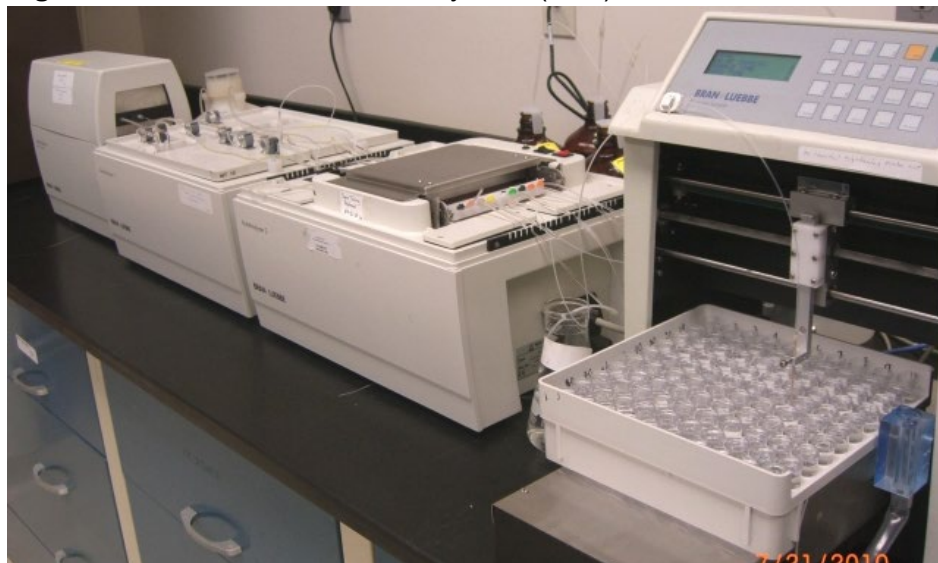
4.1 Apparatus

- Analytical balance, sensitive to 0.1 milligrams (mg).
- Glassware: Class A volumetric flasks and pipettes as required.
- SEAL AA500 AutoAnalyzer (see Figure 2) or Bran+Luebbe Auto Analyzer 3 (see Figure 3): automated continuous flow analysis equipment designed to deliver and react sample and reagents in the required order and ratios. With the following:
 - Compact Auto-sampler with random access, PC or manually controlled.
 - High precision pump with multi-speeds, PC or manually controlled.
 - Chemistry module manifold with leak detector.
 - High sensitivity digital colorimetric detector with 660 nanometer (nm) filter and 10.0 millimeter (mm) by 1.0 mm (inside diameter) flow cells
- Autosampler vials, 4 mL and 5 mL.

Figure 2. SEAL AA500 AutoAnalyzer



Figure 3. Bran+Luebbe Auto Analyzer 3 (AA3)



4.2 Chemicals safety classification

- Ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$ [7783-20-2] --
 - Brij-35, 22-30% solution [9002-92-0] --
 - Di-Sodium ethylenediamine tetra-acetate, EDTA, $\text{C}_{10}\text{H}_{14}\text{N}_2\text{Na}_2\text{O}_8 \cdot 2\text{H}_2\text{O}$
GHS07
 - Phenol, $\text{C}_6\text{H}_5\text{OH}$, [108-95-2] GHS05, GHS06,
GHS08
 - Sodium hydroxide, NaOH [1310-73-2] GHS05
 - Sodium hypochlorite, 5% solution, NaOCl [7681-52-9] GHS05, GHS09
 - Sodium nitroprusside, $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}] \cdot 2\text{H}_2\text{O}$ [13755-38-9] GHS06
- GHS01: Danger - Explosive; GHS02: Danger - Flammable; GHS03: Danger - Oxidizing; GHS04: Warning - Compressed gas; GHS05: Warning/Danger - Corrosive; GHS06: Danger - Toxic; GHS07: Irritant; GHS08: Danger - Health hazard; GHS09: Warning/Danger - Environmentally Damaging

4.3 SEAL AA500 Reagents

- Reagent Water: Deionized (DI) water of resistivity of 15 mega Ohms ($\text{M}\Omega$) or greater, derived from mixed bed ion exchangers, activated carbon filters and polishing exchangers. Water should contain particles no larger than 0.20 micrometers.
- System wash solution: Add 2mL of Brij-solution to 1000mL of DI water and mix thoroughly. Replace if turbid or cloudy.

- Di-Sodium EDTA: Dissolve 32g of di-sodium EDTA and 4g of sodium hydroxide in about 600 mL of DI water. Dissolve 0.18g sodium nitroprusside and dilute to 1000 mL with DI water, mix thoroughly and add 3 mL of Brij-35, 22-30% solution. Replace weekly.
- Alkaline Phenol: Add 91g of liquefied phenol to about 800 mL of DI water. While cooling under tap water or in an ice bath, slowly with swirling add 34g of sodium hydroxide. Cool to room temperature, dilute to 1000 mL with DI water and mix thoroughly. Replace every two weeks.
- Hypochlorite solution: Dilute 31.5 mL of sodium hypochlorite solution 5% to 100 mL with DI water and mix thoroughly. Add about 0.5g sodium hydroxide, or enough to reach a pH of 11.7 - 12.2 at the flowcell.

4.4 Bran+Luebbe AA3 Reagents

- Sodium hydroxide (NaOH), 10 Normal: Purchased commercially as a certified solution. NOTE: Highly caustic; use caution when handling. CAS# 1310-73-2
- Sodium Phenolate: Add 67 milliliters (mL) of 10 Normal NaOH solution (see note for NaOH) and 61.5 mL of liquefied phenol (commercially prepared reagent, approximately 89 percent phenol) to approximately 500 mL of reagent water. Allow the solution to cool, then dilute to 1000 mL (1 L) with reagent water. Store in an amber glass bottle. CAS# for Phenol is 108-95-2. Prepare every two weeks.
- Brij-35: Commercial surfactant solution available from VWR Scientific as CAS number 9002-92-0.
- EDTA: Add 1 mL 10 Normal NaOH to about 650 mL of DI water in a 1-liter (L) volumetric flask. While magnetically stirring, slowly add 33.6 grams (g) of EDTA. Add 2.0 mL of Brij 35. Mix well. Final volume 1-liter. Highest consumption reagent. Make as needed or every month.
Note: EDTA is known and sold under several names. Always crosscheck the Chemical Abstracts Service (CAS) number for this reagent prior to ordering or using it. The CAS number is 6381-92-6.
- Sodium Hypochlorite (NaOCl) solution (2.1%): Dilute a bleach solution (such as Clorox) to a final volume of 1 L with reagent water. Store in an amber bottle, and prepare fresh every week. Since Clorox is a proprietary product, its formulation is subject to change. The analyst should verify the NaOCl concentration listed on the bleach bottle and dilute to a final concentration of 2.1%. For example, for a bleach solution containing 6 percent NaOCl, the analyst would dilute 350 mL to a final volume of 1L. Purchasing a sodium hypochlorite solution from a laboratory reagent supply company is inadvisable due to the difficulty in obtaining recently prepared solutions. CAS#7681-52-9.
- Sodium Nitroprusside: Dissolve 3.5 g of sodium nitroprusside in 500 mL of reagent water and dilute to 1 L. CAS# is 13755-38-9. Prepare monthly.

4.5 Standards

- Reference Standard: WasteWtR Simple Nutrients Quality Control standard, catalog number 505, from Environmental Resource Associates (ERA). Certified $\text{NH}_3\text{-N}$ value in the parts-per-million (ppm) range. The reference standard (SRM) is analyzed to verify calibration.
- Control Standards are continuing calibration verification (CCV) standards. High Purity Standards or equivalent, value of 1 ppm which can be the 1 ppm calibration standard. To ensure calibration accuracy throughout each analytical run, a CCV is used for continuing calibration verification.
- Calibration standards can be purchased as National Institute of Standards and Technology (NIST)-traceable solutions from High Purity Standards as a non-cataloged product - special ESE mix. A certificate of analysis and expiration date is supplied with each solution (see Figure 4). They require no dilution and have the following concentrations in $\mu\text{g/mL}$: 0.00, 0.02, 0.05, 0.10, 0.25, 0.50, 1.00, and 2.00. Alternatively, calibration standards may be prepared manually at the above concentrations using a NIST-traceable solution at $\geq 2.00 \mu\text{g/mL}$.

Figure 4. Certificate of Analysis

hps
high purity standards

7221 Investment Drive • North Charleston, SC 29418
843.767.7900 • info@highpuritystandards.com • www.highpuritystandards.com

Certificate of Analysis

Certified Reference Material

Product Description: NH₃-N Curve Set #1

Product Number: SM-405-015-1-500
Lot Number: 2217234-500
Matrix: Tr Chloroform / H₂O
Purity: 99.999%

ANAB
ANAB International Accredited
AS NEN ISO 17034:2016
ISO 17034:2016 (SRMP)
Accreditation
Certificate Number
APR-1438

Certified Values:

Element	(mg/L)	SRM ID
NH ₃ -N	2.00 ± 0.02	*

* Refer to Traceability Information, Section 4

Packaging and Storage Conditions:
The standard is packaged in a pre-cleaned polyethylene bottle. To maintain the integrity of this product, the solution should be kept tightly capped and stored under normal laboratory conditions.

Expiration Information:
The expiry date is guaranteed to be valid for three months from the shipping date provided and is guaranteed through the month of expiration. For this reason, standards from the same lot may have different expiration dates.

Shipped Date: June 2022
Expiration Date: September 30, 2022
Certificate Issue Date: June 23, 2022

Moses Mututurari
Moses Mututurari, Ph.D., VP Manufacturing

Lot Number: 2217234-500
Revision: 0
Page 1 of 2

Rec.
06/23/22
pdl

5.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Materials Safety Data Sheets (MSDS) must be consulted. The MSDS by chemical and brand can be found in the laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

6.0 PROCEDURE

6.1 Sample Extraction

See SOP GLM-3180-001, Section 6.1 for the extraction procedure.

6.2 Sample Analysis

6.2.1 Connect tubing as shown in Figure 5 (SEAL AA500) or Figure 6 (AA3).

Figure 5. Pump Tubing and Coils for AA500

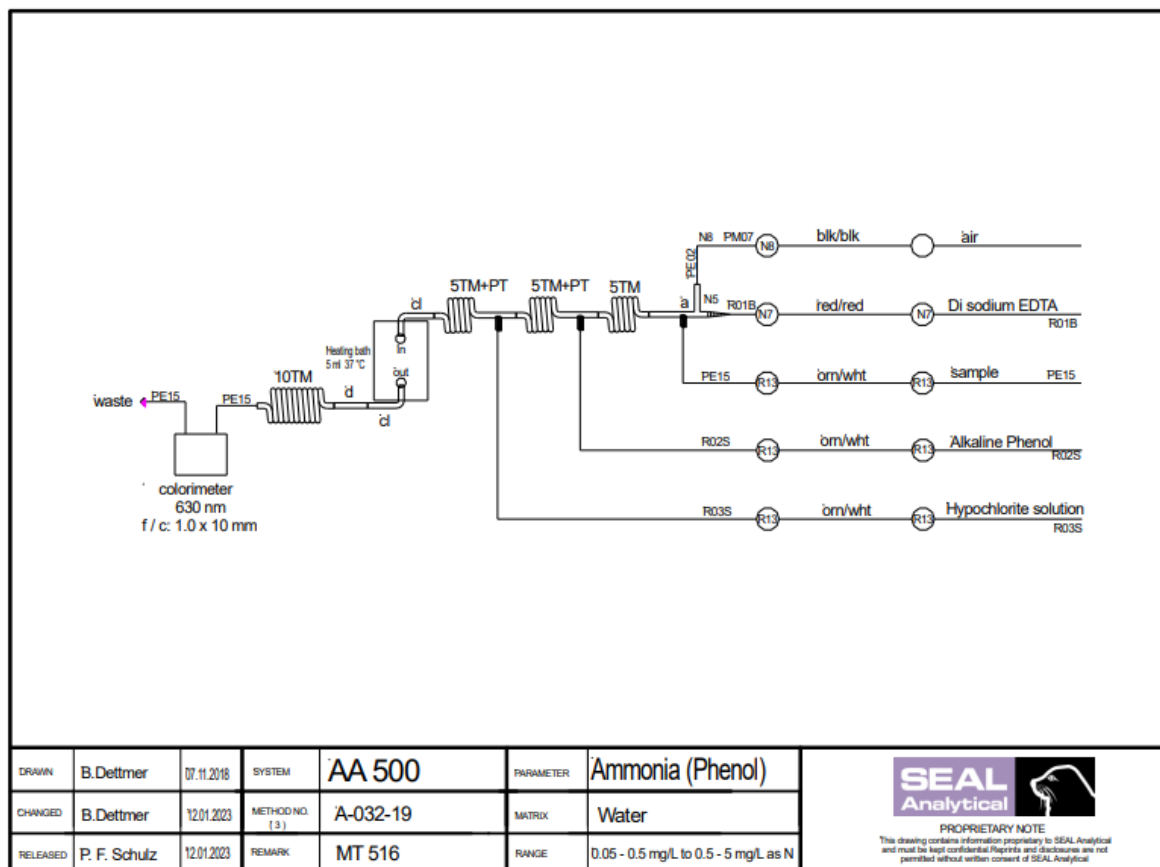


Figure 7. AA500 Platen

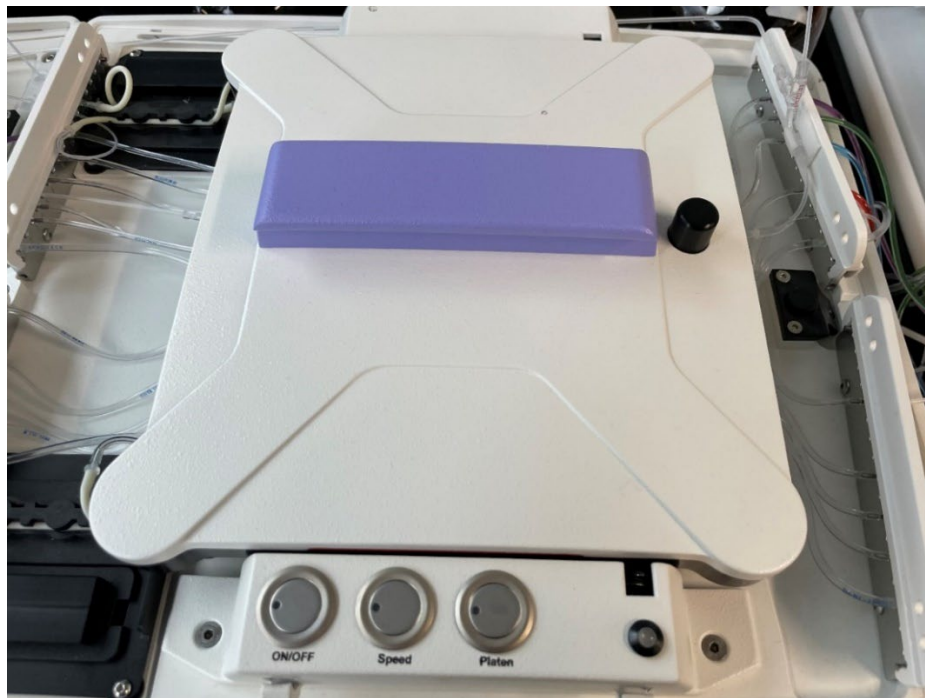
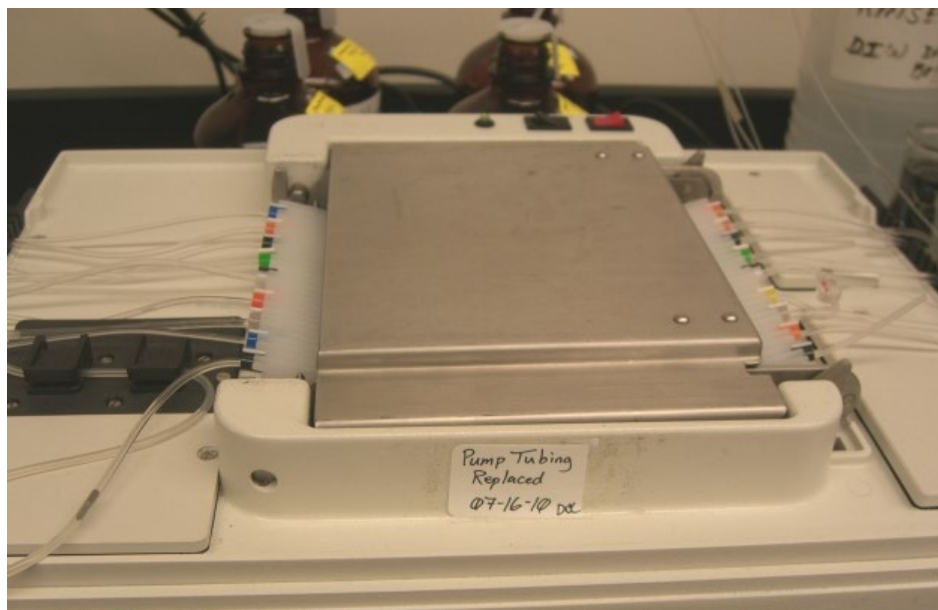
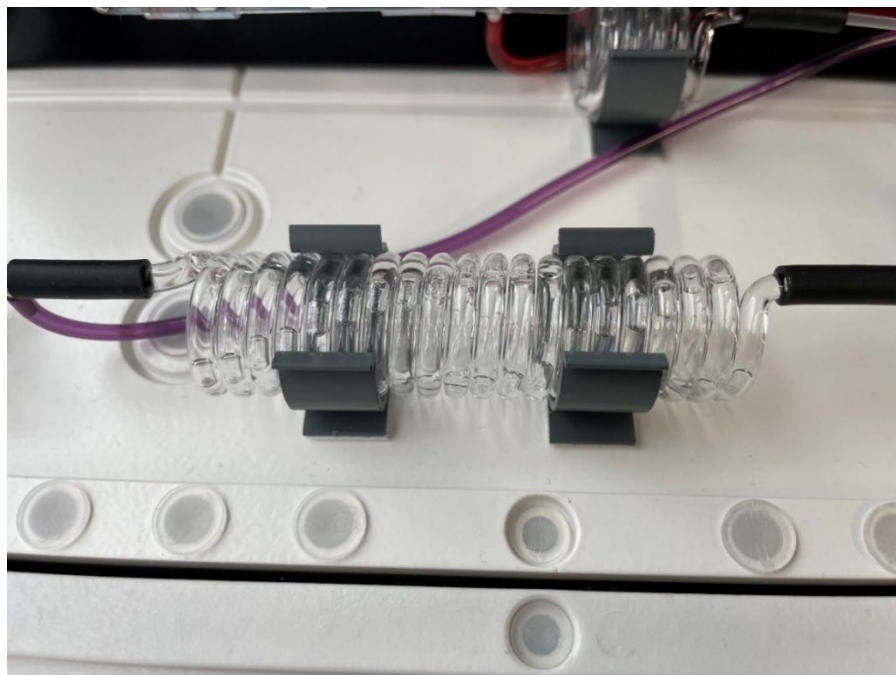


Figure 8. AA3 Platen



6.2.3 Once a reproducible diagonal bubble pattern in the mixing coil has been established (see Figure 9), prepare the flow system for analysis by feeding reagents through the appropriate lines while feeding wash water through the sample line.

Figure 9. Bubble Pattern



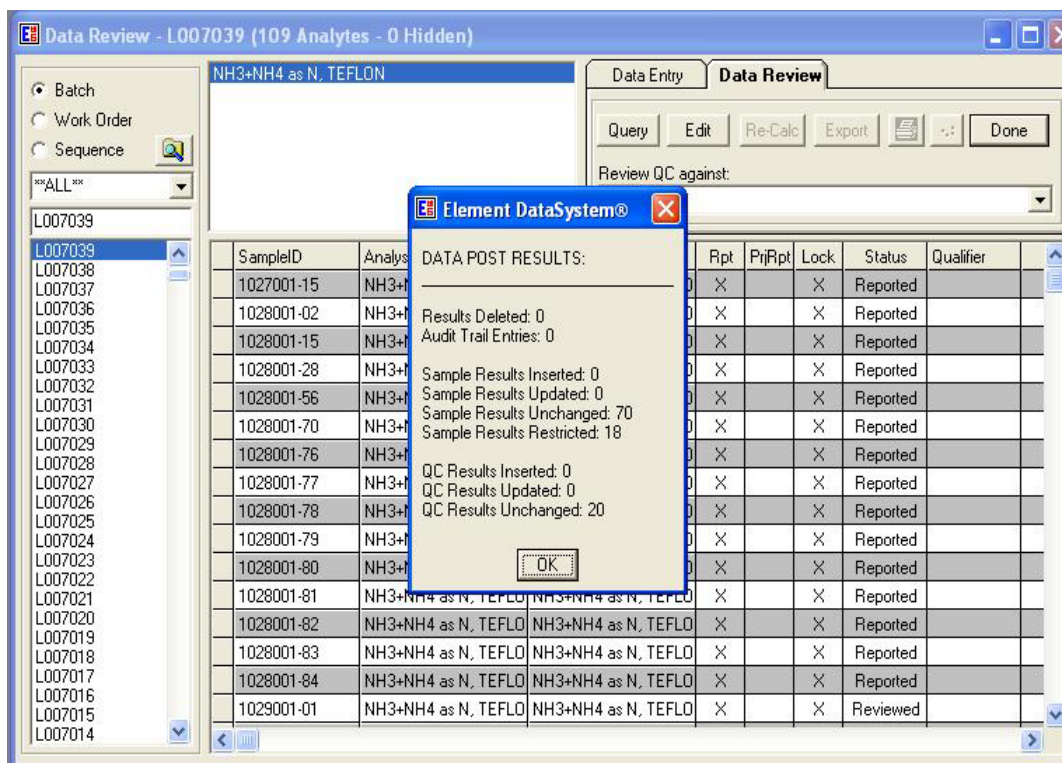
- 6.2.5 After the reagents have been pumped through the instrument for at least 20 minutes, check and adjust the baseline to 5 percent, if necessary. To adjust the baseline (while pumping reagents only), right click on the screen then click "Set Base". Note that large changes in the baseline reading may be an indication of contamination in the system or the reagents. The system can be cleaned by pumping a 1:2 Clorox solution through sample line for 10 minutes followed by 20 minute DI water rinse. Remake the reagents if necessary.
- 6.2.6 Check and adjust the full-scale response, if necessary, by analyzing the high standard and adjusting the gain such that its response is approximately 95 percent of the full scale of the instrument.
- 6.2.7 Place standards in the sampler in order of decreasing concentration. The high standard is analyzed twice, first as a primer then as a calibrant. Complete filling the sample tray with unknown samples.
- Notes:** 1. Use the 5 mL autosampler vials for the high standard, blank calibrant and CCVs. The 4 mL vials are used for the remaining standards and samples.
2. Verify that the run-log printout auto-sampler positions are correct; initial when complete.
- 6.2.8 Begin analysis. The operator's manuals provided by the manufacturer contain detailed information regarding optimization of instrument performance and optimum operating criteria.

- 6.2.9 Verify the reasonableness of blank carryover immediately following analysis of the standard curve. If carryover is determined to be unreasonable, investigate and correct the problem before continuing. Carryover correction may also be turned on within AACE.
- 6.2.10 Rerun any sample analyzed after a high sample for verification that there was not carryover if carryover correction is not turned on within the AACE software.
- 6.2.11 Verify that the baseline values are within \pm half of the established reporting limit (RL). Recalibrate, remake reagents, or troubleshoot if necessary.
- 6.2.12 After analysis, visually inspect the vials to confirm they have all been injected by the autosampler.

6.3 Data Analysis

- 6.3.1 Export the data to Element (see Figure 10) using the batch processing feature outlined in SOP GLO-3180-35 Element Batch Preparation (section 3.1.1.4).
- 6.3.2 The analyst should note any analytical anomalies in a separate batch narrative.
- 6.3.3 Assemble the data batch folder, including a hard copy of the Element data batch, copies of all run logs, certificates of analyses and processing methods, and any other necessary documentation.
- 6.3.4 Complete the batch folder checklists (Attachment B and C), and submit it for review and finalization.

Figure 10. Element Batch



6.4 Quality Control

- 6.4.1 Method blanks (BLK) must be analyzed at a frequency of one per daily extraction. BLK concentrations should not exceed twice the reporting limit for the method. The reporting limit is 0.02 µg/mL.
- 6.4.2 Blank Spike (BS) will be analyzed at a frequency of one for every analytical run. Spikes are prepared as outlined in SOP GLM-3180-001. The target concentration in the extract is 0.2 µg/mL.
- 6.4.3 A sample replicate (DUP) is analyzed at a frequency of 5 percent or every 20 samples. The criterion is ± 20 percent if the sample concentration is at least 5 times the reporting limit (≥ 0.1 µg/mL); or \pm the reporting limit if the sample concentration is less than 5 times the reporting limit (< 0.1 µg/mL).
- 6.4.4 The reference sample (SRM) must be run immediately following the daily calibration curve and at the end of the analyses. All values must be within 10 percent of their respective true values or the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified prior to sample analyses.
- 6.4.5 The CCV must be run after every 10 samples and at the end of the sample run to verify that the standard curve is still valid. The CCV is normally a 1.0 µg/mL standard and must be within ± 10 percent of expected value. If the CCV is not within the specified range, reanalyze the CCV. If the recovery is still outside acceptable limits, the analysis must be terminated and the instrument recalibrated. All samples following the last acceptable CCV must be reanalyzed.
- 6.4.6 If data are uploaded to the Clean Air Status and Trends Network database, the BLK, SRM, and DUP prefixes will be changed to MB, RF, and RP respectively upon ingestion.

6.5 Calculations

- 6.5.1 Calculations are performed with data reduction algorithms that reside in the instrument software.
- 6.5.2 Sample concentrations are calculated using the quadratic equation for the curve. The final concentration is uploaded into Element via DataTool.
- 6.5.3 Each Element analyses matrix includes the extraction volume conversion in a static data table. Final results are corrected for any sample dilutions in the Data Entry/Review section of Element™.

6.6 Corrective actions

Attachment A shows the corrective actions taken when the QC samples are not within acceptance criteria.

6.7 Data review

The checklists used by the analyst, peer reviewer, and supervisor in reviewing the analytical data are shown in Attachments B and C.

7.0 REFERENCES

SEAL Analytical. 2023. Method No. A-032-919 Rev. 13 (multitest MT516), Ammonia in Water, February 2023.

SEAL Analytical. 2019. SEAL Analytical AACE 8.02 Software Rev 0 No. MB7-60EN-41, September 2019.

Bran & Luebbe. 2006. Bran & Luebbe AACE Software 6.03 Rev. 2 No. MT7-60EN-03, September 2006.

Bran & Luebbe. 1983. Technicon Auto Analyzer II Method No. 696-82W, Ammonia in Water and Waste-Water, Technicon Industrial Systems, April 1983.

U.S. Environmental Protection Agency (EPA). 2007. *Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents*. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington DC. April.

U.S. Environmental Protection Agency (EPA). 1993. Determination of Ammonia Nitrogen by Semi-Automated Colorimetry (EPA 350.1) EPA-600/4-79-020, Revision 2.0, August 1993.

U.S. Environmental Protection Agency (EPA). 1983. *Methods for Chemical Analysis of Water and Wastes* (EPA 150.1), EPA 600/4-79-020, revised March 1983.

8.0 ATTACHMENTS

Attachment A – Corrective Actions

Attachment B – Batch Folder Checklist

Attachment C – Batch Peer Review Checklist

Attachment D – Revisions Table

ATTACHMENT A
Summary of Corrective Action Procedures for $\text{NH}_3 + \text{NH}_4^+$ as N

Quality Control	Acceptance Criteria	Corrective Action
Calibration curve correlation coefficient	≥ 0.995	Rerun calibration standards. If still out of control, prepare new calibration standards and recalibrate the instrument, or document why data are acceptable.
Calibration curve responses	Brackets all samples	Dilute and reanalyze samples within the calibration curve range, or document why data are acceptable.
Reference sample (SRM)	$\pm 10\%$ of the certified true value	Rerun SRM. If still out of control, recalibrate instrument and reanalyze samples, or document why data are acceptable.
Control standard (CCV)	$\pm 10\%$ of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV, or document why data are acceptable.
Method Blank (BLK)	< 2 times the RL	Determine the cause of blank problem. Reanalyze samples, if necessary, or document why data are acceptable.
Blank Spike (BS)	$\pm 20\%$	No corrective action established yet.
Sample Replicate (DUP)	$\pm 20\%$ RPD if the sample is greater than 5 times the RL	Determine the cause of the problem. Reanalyze the sample, if necessary, or document why data are acceptable.
Note: RL = Detection limit. RPD = Relative percent difference.		

Source: WSP

ATTACHMENT B
Batch Folder Checklist



Folder Checklist

Batch # _____

Initial or NA

ELEMENT batch printout

Method reference

Instrument logbook copies

Reagent/Standard prep log sheets

Original raw data

Analyst

Date

Batch Folder Reviewed by

Date

Notes:


ELEMENT Reviewed by

Date

GLF-3180-001/ Rev. 3

ATTACHMENT C

Batch Peer Review Checklist



Batch Folder and ELEMENT Batch Review Checklist

Batch _____

Section 1.

This section is to be completed by the analyst before submitting the batch and counter-signed during peer review. Peer reviewer also checks each statement for accuracy (indicated by a check preceding the item). Any discrepancies must be corrected before the batch can be accepted. Any "No" response must have a comment.

	<u>Yes</u>	<u>No</u>	<u>Comments</u>
_____ 1. All samples uploaded correctly.	_____	_____	_____
_____ 2. All duplicate sources entered correctly.	_____	_____	_____
_____ 3. All QC results within established criteria:			
_____ MB	_____	_____	_____
_____ BS	_____	_____	_____
_____ CCV	_____	_____	_____
_____ SRM	_____	_____	_____
_____ DUP	_____	_____	_____
_____ 4. All curve coefficients ≥ 0.995 .	_____	_____	_____
_____ 5. All responses within calibration range.	_____	_____	_____
_____ 6. All dilution factors entered correctly.	_____	_____	_____
_____ 7. Other electronic flags in the ELEMENT batch?	_____	_____	If Yes, describe in Additional

Comments _____

below.

Analyst: _____ Date: _____

Reviewed By: _____ Date: _____

Section 2.

This section is to be completed by the reviewer. Initial each item. All items must be found to be true and be initialed before the batch can be accepted.

1. Instrument run log matches ELEMENT batch.
(Exceptions allowed with sufficient documentation) _____
2. All appropriate documentation present.
(Includes, but is not limited to, standard prep logs, COA, code sheets, method print-outs, schedule print-outs, and run log copies.) _____
3. Raw data (chromatograms, spectra intensities, etc.) is acceptable.
(Additional documentation may be required.) _____

Reviewed By: _____ Date: _____

Additional Comments:



GLF-3180-002/ Rev. 3

ATTACHMENT D

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
11.0	Attachment D	Addition of this table.
	6.2.6	Inserted – Note: <i>Verify that the run-log printout auto-sampler positions are correct; initial when complete.</i>
12.0	Signature page	Updated Laboratory Manager to Katherine Barry. Removed Garry Price.
	Entire SOP	Changed company name to Amec Foster Wheeler
	7.0	Updated SOP preparation reference
	Attachment B	Updated Figure
	Attachment C	Updated Figure
13.0	4.2	Updated NaOCL dilution instructions to add an example calculation
	6.0	Added statement to clarify extraction procedure: <i>“see GLM-3180-001 Section 6.1”</i> .
	Attachment A	Corrected criteria for Dup and Method Blank from <i>“DL”</i> to <i>“RL”</i> .
14.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
14.1	3.3	Added 3.3 Environmental Conditions
15	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	4.2	Amec Foster Wheeler Special Mix replaced by 1 ppm calibration standard.
	6.2	Added post analysis inspection of vials.
16	All	Modified to reconcile procedure with AA500 instrument from previous model AA3. Added photos of instrument.
	3.1	Added method interferences per SEAL method.
	4	Added list of chemicals and reagents used with the SEAL AA500.
	6.2	Updated instrument diagram.

	7.0	Added SEAL Ammonia method No. G-102-93
	Attachment B	Updated image
	Attachment C	Updated image
17	All	Update company name to WSP and apply WSP font formatting
	3.0	Deleted comment about EDTA only used for AA3
	4.2	Added EDTA to chemical list
	4.3	Updated reagents for corrected AA500 method
	6.2.1	Updated flow diagrams for both instruments
	6.2.2	Changed reagent water to wash solution
	7.0	Updated SEAL AA500 method and manuals
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
17.1	All	Add "USA Environment & Infrastructure, Inc." to company name in footers and for initial use.
18.0	All	Update company name to WSP USA Inc.
	4.5	Add: "High Purity Standards or equivalent..." "Alternatively, calibration standards may be prepared manually at the above concentrations using a NIST-traceable solution at $\geq 2.00 \mu\text{g/mL}$."
	6.2	Add descriptions of carryover correction and baseline evaluation.
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	

TITLE: INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROMETRY: PERKIN-ELMER AVIO 220 MAX (MODIFIED EPA METHOD 6010-B)

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations
Manager

Topie, Nathaniel (USNT719661) Digitally signed by Topie, Nathaniel (USNT719661)
Date: 2025.02.25 11:36:29 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager

Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 16:40:53
-05'00'

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- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Safety
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- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

INDUCTIVELY COUPLED ARGON PLASMA-OPTICAL EMISSION SPECTROMETRY: PERKIN-ELMER AVIO 220 MAX (MODIFIED EPA METHOD 6010-B)

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the determination of inorganic cations in air filters, water, and annular denuders by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES).

2.0 SCOPE

This method is applicable to the determination of the cations in rainwater, cloud water, lake water, snow, and in Teflon filter extract media as dry deposition. The cations in solution that are routinely analyzed by this method and their reporting limits are as listed in Table 1.

Table 1. Cations and their Reporting Limits

Cations	Reporting Limit
Calcium (Ca^{2+})	0.006 ppm
Magnesium (Mg^{2+})	0.003 ppm
Potassium (K^{+})	0.006 ppm
Sodium (Na^{+})	0.005 ppm

Note: ppm = parts per million.

3.0 SUMMARY OF METHOD

This method measures element-emitted light by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced via radio frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer and the intensities of the lines are measured hybrid-simultaneously by dual backside illuminated charge-coupled device (DBI-CCD) detector. This instrument can be operated in the traditional mode of viewing the torch radially or by viewing the torch axially to achieve much lower detection limits.

3.1 Method Interferences

Atomic spectrometry can experience both positive and negative analytical biases from a number of sources. Root causes for bias are generally due to spectral overlap and variation between the sample and standard matrix.

Spectral overlap, the incomplete resolution of closely spaced photo-peaks, can be addressed in more than one way. Different (fully resolved) peaks can be chosen for quantitation. In many cases it is impractical or impossible to completely decouple analytical peaks and the analyst may wish to generate inter-element correction factors (IEC). IECs are determined by analyzing coupled elements

in single element solutions to determine the relative bias on the determination of the other elements. IECs must be determined on a regular basis and verified prior to each analytical run. Data acquisition and reduction software then generates a sample result by solving the systems of equations generated by the analytical signal and the IEC.

Variation between the sample and standard matrix can also produce analytical bias. The most accepted solution to the problem is to closely match the calibration and reference matrices to the sample matrix. This approach can prove impractical or impossible when the sample matrix is unknown or when a number of disparate sample matrices are encountered. One possible solution for this case is the standard addition method of determining sample analyte concentration.

3.2 Deviations from the Method

A general overview of the steps described in this SOP is depicted in Figure 1. Deviations from the analytical method described in this SOP are not permitted.

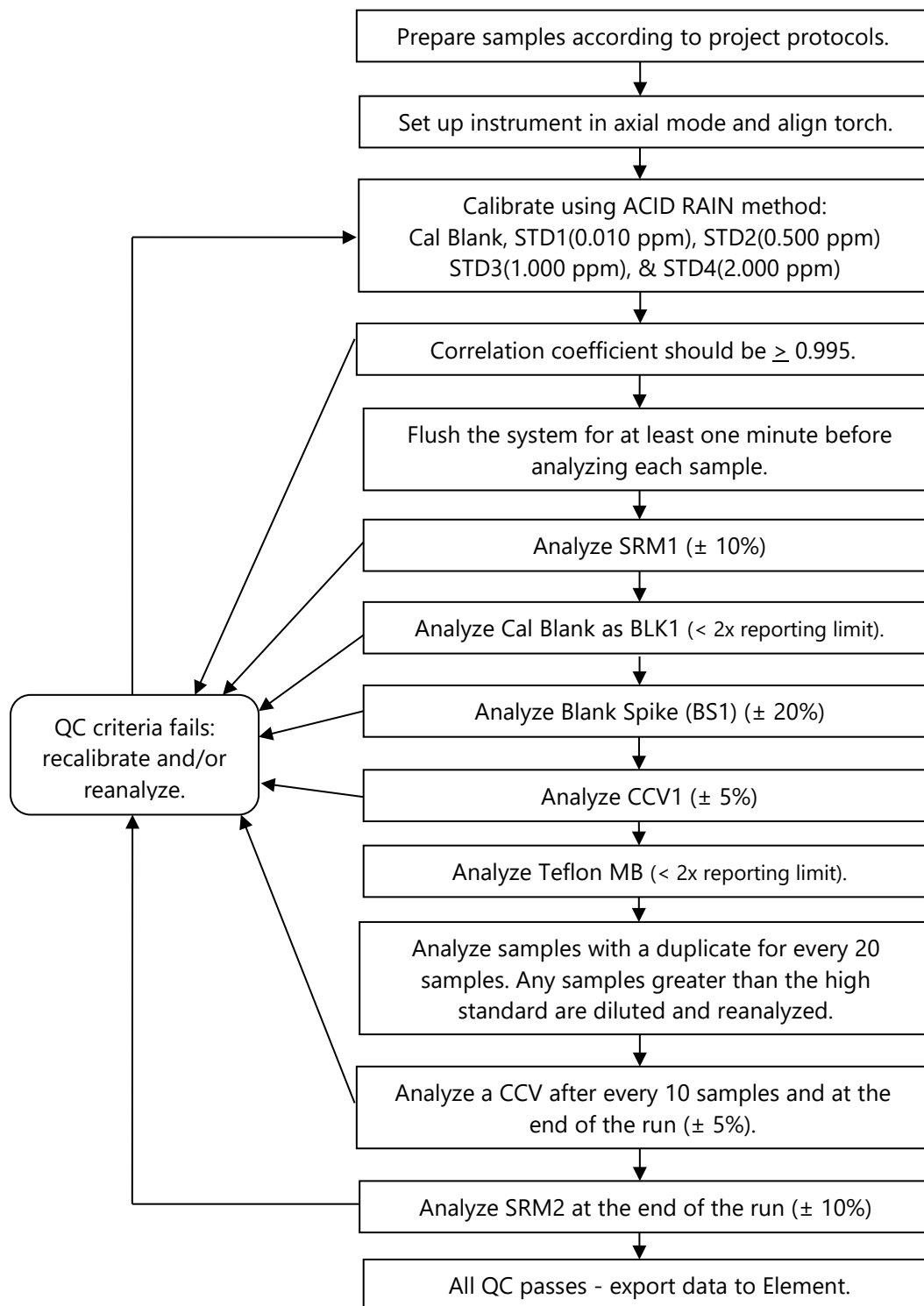
3.3 Environmental Conditions

The ICP-OES has a large working range: 15-35 degrees Celsius (°C) and 20-80 % relative humidity with no condensation. However, the laboratory should be maintained at a temperature and humidity within this range that is comfortable for the analyst. Also, rapid fluctuations in temperature (>5 °C) have the potential to cause peak shifting, so should be avoided. If the laboratory is not within comfortable working conditions, the laboratory manager should be notified and a service call will be placed.

The instrument must be properly vented according to the manufacturer's specifications.

It is the responsibility of the analysts(s) working in each lab to keep their areas organized and clean.

Figure 1. Overview – Laboratory Operations Procedures for ICP-OES

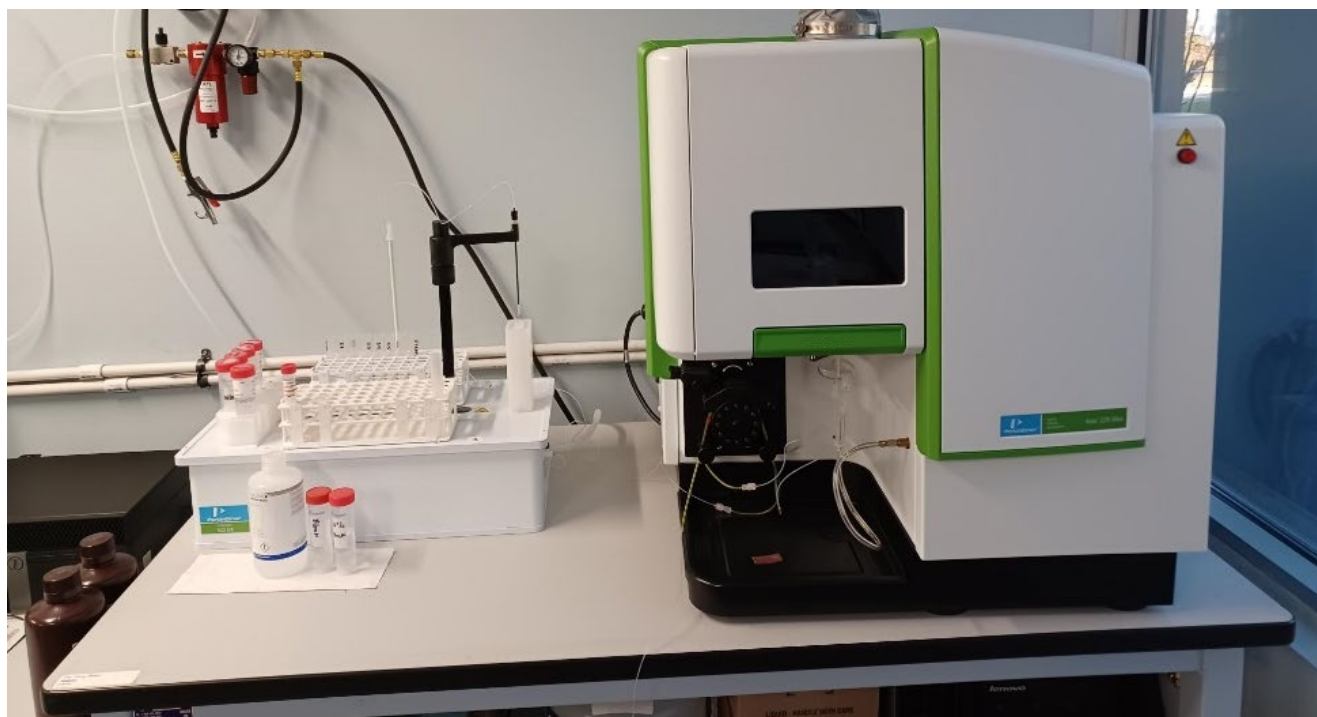


4.0 MATERIALS

4.1 Apparatus

- Perkin-Elmer Avio 220 Max Cross Flow ICP-OES Optical Emission Spectrometer-Plasma viewing axially (see Figure 2).
- SC2DX Autosampler
- NESLAB CFT-33m refrigerated recirculator or equivalent.
- Research Grade Argon.
- Class A volumetric flasks [200 and 100 milliliter (mL)].
- Adjustable Eppendorf micropipettes or equivalent.

Figure 2. Perkin-Elmer Avio 220 Max ICP-OES



4.2 Reagents

- Reagent Water: Deionized (DI) water of electrical resistivity of 15 mega Ohms ($M\Omega$) or greater, derived from mixed bed ion exchangers, activated carbon filters, and polishing exchangers. Water should contain particles no larger than 0.20 micrometers.
- High Purity Standards/ESE Special Mix #1 (see Table 2). Certificates of Analysis are required for all stock solutions purchased and are kept on file (see Figure 3). These are National Institute of Standards & Technology (NIST)-traceable Solutions obtained from High Purity Standards, Inc. of Charleston, SC.
- Mixed calibration standards made according to the outline in Table 2.

Table 2. Acid Rain Standards

Acid rain standards are made using the High Purity "SM-405-012 ESE Special Mix #1" 100 micrograms per milliliter ($\mu\text{g/mL}$) Ca^{2+} , Mg^{2+} , Na^+ , K^+ stock solution. Lot: XXXXXX Expiration: XX/XX	
2.0 ppm	2.0 mL of stock solution is brought to a final volume of 100 mL with DI water.
1.0 ppm	1.0 mL of stock solution is brought to a final volume of 100 mL with DI water.
0.5 ppm	1.0 mL of stock solution is brought to a final volume of 200 mL with DI water.
0.010 ppm	This standard is not made daily – pre-made SM-405-005 ESE SR Mix from High Purity at 10-microgram per liter ($\mu\text{g/L}$) concentration. Expiration is six months from shipping date.
Solutions diluted date XX/XX/XX expiration XX/XX/XX All standards are dated upon receipt and preparation.	

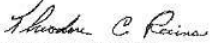
- Standard Reference Material (SRM) (obtained from Inorganic Ventures). The concentrations shown in Table 3 are the targeted values for each component. Each lot from Inorganic Ventures comes with a certificate of analysis indicating the certified values. The SRM is used to verify the instrument calibration.
- Control Standards are continuing calibration verification (CCV) standards. The 0.5 ppm calibration standard in Table 2 is used to ensure calibration accuracy throughout each analytical run.

Table 3. SRM

Components	Concentration ($\mu\text{g/mL}$)
Sodium (Na^+)	0.40
Potassium (K^+)	0.10
Calcium (Ca^{2+})	0.05
Magnesium (Mg^{2+})	0.05

Note: $\mu\text{g/mL}$ = micrograms per milliliter

Figure 3. Certificate of Analysis

HIGH-PURITY STANDARDS		<small>PO Box 1175 Chelmsford, MA 01824 Tel: 949 267 7500 Fax: 949 267 7535</small>	
<h2>Certificate of Analysis</h2> <p>SM-405-012 (ESE SP MX #1) Lot # <u>1004215</u></p>			
Source	Source Purity	Matrix	Standard Concentration
High Purity Metals, Salts or Oxides	99.98+%	HNO ₃ , 1%	100 µg/mL ± 0.5% Calcium Magnesium Potassium Sodium
<p>This spectrometric standard solution has been prepared from high-purity reference materials. Sub-boiling distilled high-purity acid has been used to place the materials in solution and to stabilize the standard. The matrix is as noted above in 18 megohm deionized water. The reference materials have been assayed by inductively coupled plasma optical emission spectrometry (ICP-OES).</p> <p>The standard has been prepared gravimetrically by weighing the reference material to 5 significant figures. Volumetric glassware has been calibrated gravimetrically to 5 significant figures. The standard concentration has been verified by ICP-OES against an independent source which is directly traceable to National Institute of Standards and Technology, Standard Reference Material No. 3100 series.</p> <p>This standard is valid for one year from the shipping date provided the solution is kept tightly capped and stored under normal laboratory conditions.</p>			
Exp Date: FEB 12 2011 MSDS ATTACHED		 Theodore C. Rains, Ph.D. President	
		Rec. 02-18-10 DCL	

5.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Safety Data Sheets (SDS) must be consulted. The SDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

Liquid argon, a cryogenic gas, or pressurized argon is used in this procedure to generate a plasma environment for atomic spectra emission. The Chemical Abstracts System (CAS) number for argon is 7440-37-1. Argon is a simple asphyxiant, it constitutes a danger by reducing the oxygen level in confined spaces to below the concentration required to sustain life. This effect is particularly evident in the spills of liquid state argon. Each liter of liquid argon vaporizes to fill 0.78 normal cubic meters of

volume. Skin and eye contact with liquid argon is characterized by severe frostbite. Argon boils at (-) 185 degrees centigrade.

Care must be taken not to obstruct the overpressure vent on any cryogenic gas dewar. Obstructed vents can lead to violent rupture of the container, rapid vaporization of the liquid, and direct exposure to the cryogen.

6.0 PROCEDURE

6.1 Sample Extraction

See SOP GLM-3180-001, Section 6.1 for the extraction procedure.

6.2 Sample Analysis

- 6.2.1 Set up the instrument according to the manufacturer's recommendations. With the plasma lit, wait approximately 30 minutes while the instrument automatically optimizes the operating parameters (detector alignment and optics initialization).
- 6.2.2 Calibrate with the standards listed in Table 2, using the method ACIDRAINII in the instrument software. **Note:** *Verify that the run-log printout auto-sampler positions are correct; initial when complete.*
- 6.2.3 Flush the system with DI water for at least 1 minute before analyzing each sample.
- 6.2.4 NIST-traceable reference samples (SRM1 and SRM2) must be analyzed after calibration, before any samples are analyzed, and at the end of the sample analysis. All values must be within 10 percent of their respective certified values or the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified prior to sample analyses.
- 6.2.5 Control standards (CCV1, CCV2... CCV9, CCVA) must be analyzed after every 10 samples and at the end of the run. The measured concentrations of the elements for which calibration was performed must be within 5 percent of their respective true values. If the CCV does not pass these criteria, re-analyze the CCV. If the CCV still fails criteria, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified prior to continuing sample analyses. All samples run after the last acceptable CCV must be reanalyzed.
- 6.2.6 The method blank (BLK1) is analyzed prior to the analysis of samples. The method blank fails criteria if the results are greater than two times the reporting limit. If the method blank fails criteria, re-calibrate with fresh DI water. The calibration blank (DI water) is analyzed as the method blank. An extraction blank is also analyzed as a sample called a TMBxx (Teflon Method Blank) xx representing the year.
- 6.2.7 Analyze the samples with two replicate readings per sample, making dilutions for any elements that exceed the linear range. If the relative percent difference (RPD) between the replicate readings is greater than 20 percent for an element whose concentration is 10 times

the instrument reporting limit, repeat the analysis once. There is no criterion for samples whose concentration is less than 10 times the reporting limit.

- 6.2.8 A replicate sample (DUP) is analyzed at a frequency of 5 percent (1 per 20). The acceptance criteria is ± 20 percent for samples greater than five times the reporting limit and is \pm the reporting limit if the sample concentration is less than five times the reporting limit.
- 6.2.9 Aqueous samples are reported in final concentration by the instrument. If a dilution was required, the concentration in the diluted sample and the dilution factor are reported in the data batch.
- 6.2.10 A blank spike (BS1) equivalent to a Laboratory Control Sample (LCS) is created during the extraction process as outlined in SOP GLM-3180-001. The target concentration in the extract for all four analytes is 0.1 $\mu\text{g/mL}$.
- 6.2.11 When possible after analysis, visually inspect the vials to confirm they have all been injected by the auto-sampler.

6.3 Data Analysis

- 6.3.1 Prepare the Element upload file using the export feature of the Syngistix software, and generate an upload file in final concentration as described in SOP GLO3180-35, Element Batch Preparation.
- 6.3.2 Generate data batch in Element and DataTool using the uploaded file (Figure 4). The analyst can note any analytical anomalies in a separate batch narrative. Print a hard copy of the data batch to be included in the data batch folder.

Figure 4. Element Data Transfer Completion

SampleID	Analysis	Analyte	Rpt	Pct	Lock	Status	Qualifier	IResult	CaResult	Units	Date	FResult	Type	Units	IMDL	FMDL	LOD
1027001-15	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		957118E-02			$\mu\text{g/mL}$	1	0.4893	PR	$\mu\text{g (total)}$	0.075	0.07500	
1027001-15	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		700505E-02			$\mu\text{g/mL}$	1	0.9251	PR	$\mu\text{g (total)}$	0.15	0.1500	
1027001-15	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		954006E-02			$\mu\text{g/mL}$	1	0.4885	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-02	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		574534E-02			$\mu\text{g/mL}$	1	0.6436	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-02	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		388926E-02			$\mu\text{g/mL}$	1	0.5997	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-02	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		141601E-02			$\mu\text{g/mL}$	1	1.035	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-02	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		0.143495			$\mu\text{g/mL}$	1	3.737	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-15	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		603468E-02			$\mu\text{g/mL}$	1	2.151	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-15	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		848538E-02			$\mu\text{g/mL}$	1	0.7121	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-15	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		734993E-02			$\mu\text{g/mL}$	1	1.184	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-15	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		1066099			$\mu\text{g/mL}$	1	2.665	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-28	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		448E-02			$\mu\text{g/mL}$	1	0.4941	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-28	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		623E-03			$\mu\text{g/mL}$	1	0.1895	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-28	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		408E-02			$\mu\text{g/mL}$	1	0.8479	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-28	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		835E-02			$\mu\text{g/mL}$	1	0.5340	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-56	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		3399516			$\mu\text{g/mL}$	1	8.495	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-56	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		737E-02			$\mu\text{g/mL}$	1	0.8534	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-56	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		886E-02			$\mu\text{g/mL}$	1	2.148	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-56	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		563E-02			$\mu\text{g/mL}$	1	0.4646	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-70	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		1272815			$\mu\text{g/mL}$	1	3.182	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-70	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		115E-02			$\mu\text{g/mL}$	1	0.5803	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-70	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		178E-02			$\mu\text{g/mL}$	1	1.298	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-70	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		535E-02			$\mu\text{g/mL}$	1	0.6889	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-76	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		2095351			$\mu\text{g/mL}$	1	5.238	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-76	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		376968E-02			$\mu\text{g/mL}$	1	1.094	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-76	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		971904E-02			$\mu\text{g/mL}$	1	1.243	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-76	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		131449E-02			$\mu\text{g/mL}$	1	0.7829	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-77	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		0.36			$\mu\text{g/mL}$	3	27	PR	$\mu\text{g (total)}$	0.15	0.45	
1028001-77	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		931415E-02			$\mu\text{g/mL}$	1	1.483	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-77	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		139698E-02			$\mu\text{g/mL}$	1	1.535	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-77	SODIUM, TEFLON	SODIUM, TEFLON	X	X	Reported		072017E-02			$\mu\text{g/mL}$	1	1.519	PR	$\mu\text{g (total)}$	0.125	0.1250	
1028001-78	CALCIUM, TEFLON	CALCIUM, TEFLON	X	X	Reported		0.256003			$\mu\text{g/mL}$	1	6.400	PR	$\mu\text{g (total)}$	0.15	0.1500	
1028001-78	MAGNESIUM, TEFLON	MAGNESIUM, TEFLON	X	X	Reported		991168E-02			$\mu\text{g/mL}$	1	1.748	PR	$\mu\text{g (total)}$	0.075	0.07500	
1028001-78	POTASSIUM, TEFLON	POTASSIUM, TEFLON	X	X	Reported		049749E-02			$\mu\text{g/mL}$	1	1.262	PR	$\mu\text{g (total)}$	0.15	0.1500	

- 6.3.3 Assemble the data batch folder, including the Element data batch, copies of all run logs, certificates of analyses and processing methods, hard copies of raw data, and any other necessary documentation.
- 6.3.4 Complete the batch folder check lists (Attachment B and C), and submit for review and finalization.
- 6.3.5 Archive all electronic files generated from data collection and processing in condensed form on the WSP network.
- 6.3.6 If data are uploaded to the Clean Air Status and Trends Network database, the BLK, SRM, and DUP prefixes will be changed to MB, RF, and RP respectively upon ingestion.

6.4 Quality Control

- 6.4.1 One MB is analyzed with each extraction unless specified differently by a project. The MB is deionized water for wet deposition samples. The MB for extracted samples is the applicable volume of extraction solution followed by the appropriate extraction procedure. The MB results must be less than or equal to two times the reporting limit for the analytes of concern.
- 6.4.2 A CCV is analyzed at a frequency of 10 percent for every analytical batch, unless specified differently by a project, as well as at the beginning and end of the run. The measured value of the CCV must be within ± 5 percent of the certified value.
- 6.4.3 A SRM is used for an initial and a final calibration verification. The measured value of the reference sample must be within ± 10 percent of the certified value.
- 6.4.4 Sample replicates (DUP) are analyzed at a frequency of ± 5 percent. For samples greater than five times the reporting limit, the relative percent difference (RPD) of the replicate samples must be with ± 20 percent. For samples with concentrations less than or equal to five times the reporting limit, the absolute difference between sample and replicate must be less than the reporting limit.
- 6.4.5 All curves must have a correlation coefficient greater than or equal to 0.995.

6.5 Calculations

- 6.5.1 All calculations are performed with data reduction algorithms that reside in the instrument's operating software (Syngistix).
- 6.5.2 Analytical signals from the calibration sources are used to generate a separate polynomial curve for each cation of interest. These calculations include the slope, intercept, uncertainty, and correlation coefficient of the curve. The calibration data is used to relate the sample's

analytical signal to a mass per volume concentration. The final concentration is uploaded into Element via DataTool.

- 6.5.3 Each Element analyses matrix includes the extraction volume conversion in a static data table. Any dilution factors are noted on the instrument analysis schedule and manually entered in the data entry section of Element.

6.6 Corrective actions

Attachment A shows the corrective actions taken when the QC samples are not within acceptance criteria. Most corrective actions within the scope of this SOP are responsive to failed QC parameters. Generally, optimizing the instrument analytical parameters and regenerating the analytical standards will alleviate these problems. Otherwise, a service technician should be consulted and the problem remedied.

6.7 Data review

The checklists used by the analyst, peer reviewer, and supervisor in reviewing the analytical data are attached as Attachments B and C.

7.0 REFERENCES

Perkin Elmer. 2020. Syngistix for ICP Software Guide, 0993-1145, November.

Perkin Elmer. 2020. Perkin Elmer Avio 220 Max Spectrometer Hardware Guide, 0993-1651, November.

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-0//001, EPA QA/G-6, US EPA, Washington, D.C. April.

U.S. Environmental Protection Agency (EPA). 1996. Method 6010B, 2nd Revision - Test Methods for Evaluating Solid Wastes, EPA SW 846 3rd Edition, December.

U.S. Environmental Protection Agency (EPA). 2020. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-20/006, November.

8.0 ATTACHMENTS

Attachment A – Corrective Actions

Attachment B – Batch Folder Checklist

Attachment C – Batch Peer Review Checklist

Attachment D – Revisions Table

Attachment A

Summary of Corrective Action Procedures for ICP

Quality Control	Acceptance Criteria	Corrective Action
Calibration curve correlation coefficient	≥ 0.995	Rerun calibration standards. If still out of control, prepare new calibration standards and recalibrate the instrument, or document why data are acceptable.
Calibration curve responses	Brackets all samples	Dilute and reanalyze samples within the calibration curve range, or document why data are acceptable.
Reference standard (SRM)	$\pm 10\%$ of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples, or document why data are acceptable.
Control standard (CCV)	$\pm 5\%$ of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV, or document why data are acceptable.
Method Blank (BLK)	<2 times the RL	Determine the cause of blank problem. Reanalyze the sample, if necessary, or document why data are acceptable.
Blank Spike (BS)	$\pm 20\%$ of target	Not established
Sample Replicate (DUP)	$\pm 20\%$ RPD if the sample is greater than 5 times the RL	Determine the cause of the problem. Reanalyze the sample, if necessary, or document why data are acceptable.
Note: RL = Detection limit. RPD = Relative percent difference.		

Source: WSP

Attachment B
Batch Folder Checklist



Folder Checklist

Batch # _____

Initial or NA

ELEMENT batch printout

Method reference

Instrument logbook copies

Reagent/Standard prep log sheets

Original raw data

Analyst

Date

Batch Folder Reviewed by

Date


Notes:

ELEMENT Reviewed by

Date

ATTACHMENT C

Batch Peer Review Checklist



Batch Folder and ELEMENT Batch Review Checklist

Batch _____

Section 1.

This section is to be completed by the analyst before submitting the batch and counter-signed during peer review. Peer reviewer also checks each statement for accuracy (indicated by a check preceding the item). Any discrepancies must be corrected before the batch can be accepted. Any "No" response must have a comment.

	<u>Yes</u>	<u>No</u>	<u>Comments</u>
____ 1. All samples uploaded correctly.	____	____	_____
____ 2. All duplicate sources entered correctly.	____	____	_____
____ 3. All QC results within established criteria:			
____ MB	____	____	_____
____ BS	____	____	_____
____ CCV	____	____	_____
____ SRM	____	____	_____
____ DUP	____	____	_____
____ 4. All curve coefficients ≥ 0.995 .	____	____	_____
____ 5. All responses within calibration range.	____	____	_____
____ 6. All dilution factors entered correctly.	____	____	_____
____ 7. Other electronic flags in the ELEMENT batch?	____	____	_____ If Yes, describe in Additional

Comments _____

below.

Analyst: _____

Date: _____

Reviewed By: _____

Date: _____

Section 2.

This section is to be completed by the reviewer. Initial each item. All items must be found to be true and be initialed before the batch can be accepted.

1. Instrument run log matches ELEMENT batch.
(Exceptions allowed with sufficient documentation) _____
2. All appropriate documentation present.
(Includes, but is not limited to, standard prep logs, COA, code sheets, method print-outs, schedule print-outs, and run log copies.) _____
3. Raw data (chromatograms, spectra intensities, etc.) is acceptable.
(Additional documentation may be required.) _____

Reviewed By: _____

Date: _____

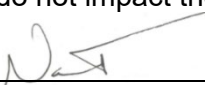
Additional Comments:


GLF-3180-002/ Rev. 3

ATTACHMENT D

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
9.0	Attachment D	Addition of this table.
	6.2.2	Inserted – Note: <i>Verify that the run-log printout auto-sampler positions are correct; initial when complete.</i>
10.0	Title	Changed “Atomic Emission” to “Optical Emission”
	1.0	Updated company name. Changed Atomic Emission to Optical Emission.
	3.2	Added STD4 to Figure 1.
	4.2	Added 2.0 ppm standard to Table 2.
	5.0	Changed MSDS to SDS.
	7.0	Deleted QAPP reference; updated EPA Guidance Document.
	Attachments	Replaced old versions of Attachment B & C with new Amec Foster Wheeler forms.
11.0	Attachment A	Acceptance criteria for Dups & Method Blank updated from DL to RL.
12.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
12.1	3.3	Added 3.3 Environmental Conditions
13.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	All	Standard Reference Material provider changed to Inorganic Ventures from High Purity Standards.
	6.2	Added post analysis inspection of vials.
14.0	All	Updated model of ICP instrument to Avio 220 Max
	3.0	Updated summary of method for new instrument
	3.3	Added comment about fluctuating room temperature
	4.1	Updated instrument models and photo
	5.0	Changed wording since liquid argon is not always used
	6.5.1	Updated software from WINLAB to Syngistix
	7.0	Updated references for new instrument/software
		The above revisions to this document do not impact the data generated by the procedure.
		Verified by: 

14.1	All	Update company name to WSP and apply WSP font formatting
15.0	4.2	Deleted no longer used low standard
	6.2.1	Updated start-up procedure for new instrument
	6.2.2	Updated method ID for new instrument
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
15.1	All	Add "USA Environment & Infrastructure, Inc." to company name in footers and for initial use.
16.0	All	Update company name to WSP USA Inc.

**TITLE: DETERMINATION OF HYDROGEN ION (pH) IN WATER
(ASTM D1293-12)**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations
Manager

Topie, Nathaniel
(USNT719661)

Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.27 16:22:55 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager

Marcus O. Stewart

Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.27 15:47:07
-05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Safety
- 6.0 Procedure
- 7.0 References
- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

DETERMINATION OF HYDROGEN ION (pH) IN WATER (ASTM D1293-12)

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the determination of hydrogen ion (pH) in water.

2.0 SCOPE

This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes, and acid rain (atmospheric deposition).

3.0 SUMMARY OF METHOD

The pH of a sample is determined potentiometrically using a combination electrode.

3.1 Method Interferences

Samples with very low or very high pH may give incorrect readings on the meter. For samples with a true pH of >10.0 , the measured pH may be incorrectly low. Using a low-sodium error electrode can minimize this error. Strongly acidic solutions with a true pH <1.0 may give incorrectly high pH measurements. Strongly acidic or basic solutions are unlikely in atmospheric deposition samples.

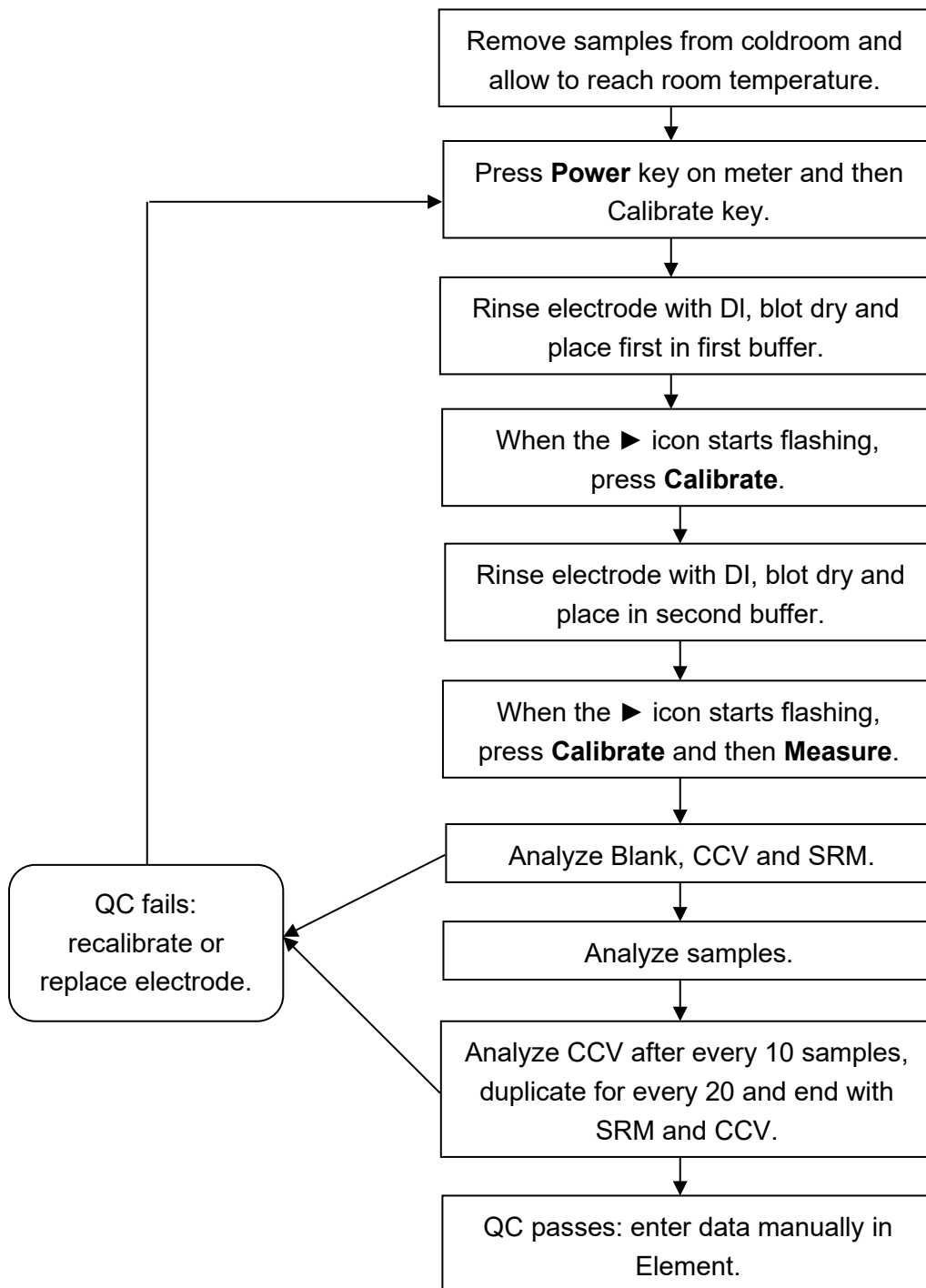
Temperature fluctuations will cause measurement errors including mechanical effects caused by changes in the electrode properties as well as chemical effects caused by equilibrium changes. Errors of this nature can be most effectively minimized by allowing all solutions to equilibrate to the same temperature before beginning analysis. Always record the temperature at which pH is measured.

Errors will occur when the electrode becomes coated with any type of adhering substance (i.e., oil or particulate matter). If this occurs, follow the steps outlined in the User's Guide to clean the electrode.

3.2 Deviations from the Method

A general overview of the steps described in this SOP is depicted Figure 1. Deviations from the analytical method described in this SOP are not permitted.

Figure 1. Overview – Laboratory Operations Procedures for pH Measurement

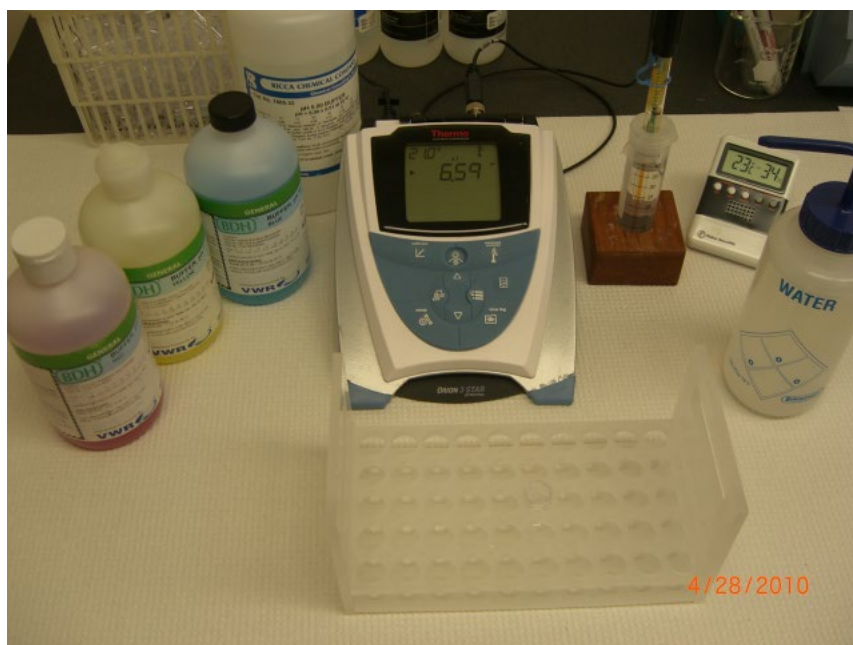


4.0 MATERIALS

4.1 Apparatus

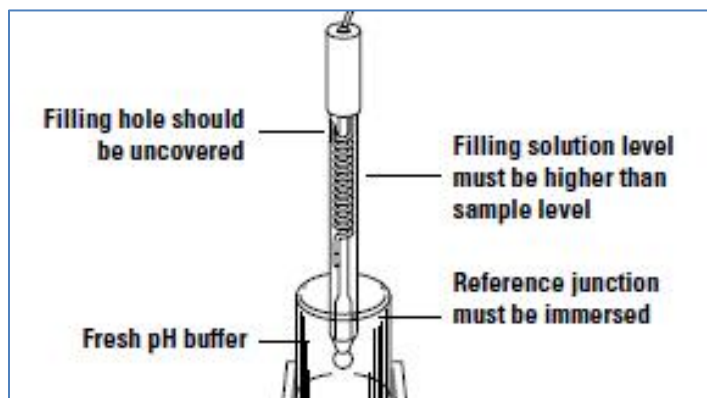
- pH meter with automatic temperature compensation (ATC) capabilities, Thermo Orion 3-Star pH bench-top meter, PN: 1112000, or equivalent (see Figure 2).

Figure 2. pH Meter



- Glass combination semi-micro electrode, Orion ROSS Ultra PN: 8103BNUWP, or equivalent.
- Analytical vessels capable of containing sufficient sample to cover the reference junction of the probe (see Figure 3). Use the smallest vessel capable of allowing sufficient submersion of the probe to obtain a reading.
- Kimwipes.
- Wash bottle filled with DI water for rinsing the probe between samples.
- Thermometer, for ambient room temperature readings.
- Digital scanning thermometer, for surface temperature readings of the solutions.

Figure 3. pH Electrode




4.2 Reagents

- Reagent water: DI water with resistivity of 15 mega ohms (MΩ) or greater, derived from mixed bed ion exchangers, activated carbon filters, and polishing exchangers. Water should contain particles no larger than 0.20 micrometers (μm).
- Standard buffer solutions of 4, 7, and 10 pH units, which are available from a commercial vendor. Alternatively, standard buffer solutions of 3, 5, and 8 pH units (also available commercially) may be used. A Certificate of Analysis and an expiration date is provided with each lot (see Figure 4).

Note: pH 10 buffer solution is subject to contamination from microbial growth. Store out of the light and away from heat to minimize the risk of contamination. Always have at least one extra unopened bottle of this buffer on hand.

- Electrode internal filling solution: 3 molar (M) potassium chloride (KCl) solution, or alternate solution as appropriate to the sample type, available from the electrode manufacturer or other vendor. See the probe User's Guide for instructions regarding the selection of an alternative filling solution.
- Electrode storage solution: Available from the manufacturer or other vendor. Alternatively, use a solution of 200 mL pH 7 buffer to which 1 g KCl has been added.
- Standard Reference Material (SRM) is purchased as a ready-to-use NIST-traceable standard solution (e.g., Simulated Rainwater #1 from High Purity Standards or equivalent) with a Certificate of Analysis and an expiration date. Note that the SRM is used to verify the calibration and must be from a source other than that of the calibration standards.
- Continuing calibration verification (CCV) is purchased from commercial vendor. A Certificate of Analysis and an expiration date is provided with each lot. The CCV is used to ensure calibration accuracy and check for drift during each analysis.

Figure 4. Certificate of Analysis



1310 Goshen Parkway
West Chester, PA 19380
phone: 1-800-932-5000

Certificate of Analysis

Buffer, Reference Standard, pH 7.00 ± 0.01 at 25°C (Color Coded Yellow)

Lot Number: 2912258 Product Number: BDH5046 Expiration Date: NOV 2011 Manufacture Date: 12/9/2009

The certified value for this product is confirmed in independent testing by a second qualified chemist.

Contains:

Name	CAS#	Grade
Inert Dye	Proprietary	Commercial Grade
Potassium Phosphate, Monobasic	7778-77-0	ACS
Preservative (No Mercury compounds or Formaldehyde)	Proprietary	Commercial Grade
Sodium Phosphate, Dibasic	7558-79-4	ACS
Water, Deionized	7732-18-5	ACS, ASTM D 1193 (Type I), EP, USP


Test Name	Assay Method	Specification	Result
Appearance	Clarity, Color, Odor	Clear, yellow, odorless	Passed Test
pH at 25 °C (traceable to NIST SRM 186 & 191)	pH determination	7.00 ± 0.01 pH at 25.0 °C	7.01 pH at 25.0 °C


Volumetric glassware complies with Class A tolerance requirements of ASTM E 288 and NIST Circular 434; it is calibrated before first use and recalibrated regularly in accordance with ASTM E 542 and NIST Procedure NBSIR 74-461. Balances are calibrated regularly with weights certified traceable to the NIST national mass standard. Thermometers and temperature probes are calibrated before first use and recalibrated regularly with a thermometer traceable to NIST standards. All products are prepared according to master documents that assure manufacture according to validated methods. Batch records document raw material traceability and production and testing history for each lot manufactured.


Shelf Life (unopened container):

Part Number	Shelf Life
BDH5046-16	24 months

Recommended Storage: 15°C - 30°C (59°F - 86°F)


LaNelle Ohlhausen
Quality Assurance





This Certificate of Analysis is designed to comply with ISO Guide 31 "Reference Materials – Contents of Certificates and Labels."

Rec'd 2/3/10
/kw.b

Version: 0

5.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Materials Safety Data Sheets (MSDS) must be consulted. The MSDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

6.0 PROCEDURE

6.1 Electrode Preparation

- 6.1.1 Remove the electrode from the storage solution and rinse any salt deposits from the exterior with DI water.
- 6.1.2 Check the level of the filling solution. The filling solution should be at least at the end of the coil and no higher than to the bottom of the filling hole.
- 6.1.3 If the probe has been unused for longer than a week, drain the solution using a syringe fitted with a plastic pipette tip and refill the chamber with fresh solution.
- 6.1.4 If KCl deposits are noted on the interior of the probe, rinse with several successive portions of filling solution, or in extreme cases, DI water followed by filling solution, until no deposits are observed floating in the filled reservoir.

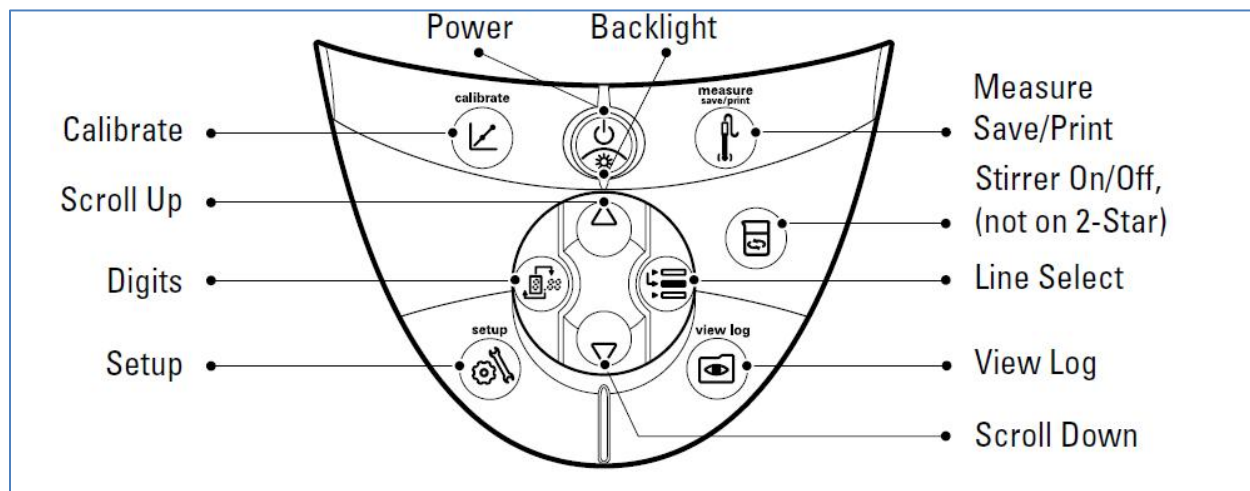
Note: *The deposits on the interior of the probe do not interfere with analysis, but if crystals break free of the inner walls and become suspended in the reference solution, changes in calibration can result requiring recalibration and subsequent reanalysis of affected samples. These deposits appear to be linked to prolonged periods of idleness. The probe should therefore be checked at least once a week to maintain optimum performance. See the User's Guide for directions on cleaning the probe.*

- 6.1.5 Keep the filling hole uncovered during analysis.

6.2 Set displayed meter temperature to match room temperature

See Figure 5 for a diagram of the keypad for the Orion 3-Star Bench-top pH Meter.

Figure 5. Diagram of Orion 3-Star Bench-top Meter Keypad



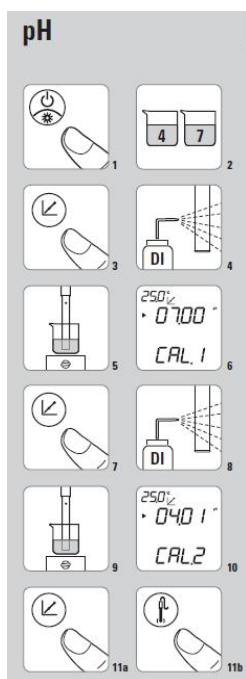
Key	Description	Key	Description
	Turns the meter on, if the meter is off.		Changes the measurement units of the selected line in the measurement mode.
	Toggles the backlight on and off, if the meter is on (3-Star, 4-Star and 5-Star meters only). If the meter is on, hold down the key for about three seconds to turn off the meter.		Changes the value on the selected line in the setup, methods and log view modes. Edits the value of the flashing digit for setup, password entry and calibration modes.
	Scrolls the arrow icon on left of screen among the three display lines, so the selected line can be edited or calibrated.		Selects the next digit to edit and moves the decimal point for setup, password entry and calibration modes.
	Starts the calibration for the selected line in the measurement mode. If the arrow icon points to the top line and the displayed units are pH, pressing the key will start a pH calibration. Each time the key is pressed in the calibration mode, the meter will accept the calibration point and move to the next point until the maximum number of calibration points are reached.		Prints and logs a measurement in the continuous or timed measurement modes. Prints, logs and freezes the display when the reading becomes stable in the AUTO-READ measurement mode. Exits the setup menu and returns to measurement mode. Accepts the calibration and returns to measurement mode.
	Enters the setup menu, starting with selected line in the measurement mode. If the arrow icon points to the top line and the displayed units are ISE, pressing the key will enter the ISE setup screen.		Enters the log view and download menu.
			Turns the stirrer on and off.

- 6.2.1 Turn on meter.
- 6.2.2 Determine the room temperature by reading the thermometer next to the meter. Record this temperature in the logbook next to the pH 7 buffer lot number.
- 6.2.3 Use the **Setup** key to access the Setup menus.
- 6.2.4 Select the General Instrument Setup Menu screen by using the [▼] four times. “gen” will be displayed on the top line of the screen; “degC” will be displayed on the line below. The current temperature set-point will be displayed on the third line.
- 6.2.5 Access the temperature by pressing the **Line Select** key twice to highlight the set temperature. The first digit (a zero) will be blinking.
- 6.2.6 Use the **Digits** key to scroll across to the digit of interest, then use [▲] or [▼] to increase or decrease the digit in increments of one as needed to match the room temperature.
- 6.2.7 Press the **Line Select** key again to return to the Manual Temperature Menu.
- 6.2.8 Press the **Measure Save/Print** key to save the change. The temperature displayed in the upper left corner of the meter display should now correctly match the room temperature.

6.3 Calibration

Note: This calibration method is for a two-point calibration utilizing the AutoBuffer recognition feature of the Orion 3-Star Bench-top pH meter (see Figure 6 for an overview of the calibration steps). Other calibration methods are listed in the manual for this meter and may be used in cases as approved by the Laboratory Manager and/or QA Manager.

Figure 6. pH Calibration Overview



- 6.3.1 Stir or gently agitate all buffers and standards prior to aliquoting and making measurements. Record the lot numbers of all buffers and standards used.
- 6.3.2 Fill two vessels with a portion of the pH 7 buffer (or alternately, the middle value buffer if points other than 4, 7, and 10 are being used). See Figure 6-2.
- 6.3.3 Press the **Calibrate** key to enter Calibration mode (see Figure 6-3). The “Calibrate” symbol will appear in the upper left corner of the display; “pH” and “CAL” will be displayed on two lines in the center of the screen for several seconds before displaying the measured pH.
- 6.3.4 Rinse the electrode with DI water and gently blot the probe free of drops with a Kimwipe (see Figure 6-4). Use care to not rub or wipe the surface of the probe when drying as static electric build-up could interfere with subsequent measurements.
- 6.3.5 Wait for the display to change to measure and immerse the probe in the first vessel (see Figure 6-5). Note: The pH of DI water is in the range of 5.6 – 5.8 pH units. The best sample results are obtained when the measured pH value displayed prior to immersing the probe in a new sample aliquot falls in this range. Avoid beginning a new measurement if the probe shows signs of drifting.
- 6.3.6 Swirl the probe gently to rinse before moving to the second aliquot. Stop swirling the probe and allow the electrode to equilibrate in the second aliquot.
- 6.3.7 When the meter recognizes the buffer the display will change to show the recognized value, and the first digit (a zero) will blink (see Figure 6-6).
- 6.3.8 Use the Digits key followed by [▼] or [▲] as needed to adjust the value to match the true value of the buffer. The true value of the buffer at various ambient temperatures should be listed on the side of the buffer bottle.
- 6.3.9 Press **Calibrate** (see Figure 6-7) to accept the value and move on to the second calibration point. “Cal 2” should now be displayed at the bottom of the screen.
- 6.3.10 Repeat steps 6.3.2 through 6.3.8 for the second buffer, usually pH 4 (see Figure 6-8 thru 6-11a).
- 6.3.11 Press **Measure Save/Print** (see Figure 6-11b) to accept the value and end the calibration procedure. The meter will automatically calculate the slope before proceeding to Measurement mode. Enter the slope in the logbook next to the lot number for the pH 4 buffer.

6.4 Verify Calibration

- 6.4.1 Fill two vessels with a portion of the pH 10 buffer.
- 6.4.2 Rinse the electrode with DI water and gently blot the probe free of drops with a Kimwipe. Wait for the display to change to measure and immerse the probe in the first vessel.

- 6.4.3 Swirl the probe gently to rinse before moving to the next aliquot. Stop swirling the probe and allow the electrode to equilibrate in the second aliquot.
- 6.4.4 A small “pH” will be blinking to the right of the measured value on the meter display when the electrode is equilibrating. This icon will stop blinking when a stable reading has been reached. Record the value of the stable reading.
- 6.4.5 A reading of 10.00 ± 0.05 pH units indicates that the electrode has been properly calibrated, and sample analysis can begin (6.6). If the reading is outside of the accepted range, proceed to 6.5.

6.5 Calibration Verification Failure

- 6.5.1 Repeat step 6.4.1 through 6.4.4 using a new bottle of pH 10 buffer. If the measurement of the new buffer falls within the accepted range, proceed with sample analysis (6.6).
- 6.5.2 If the measurement of the new buffer does not fall within the accepted range repeat Calibration (6.3) with fresh aliquots of buffer solutions. Use a scanning thermometer to verify the temperatures of the solutions if temperature differences are suspected. Solutions should be ± 1 °C of the recorded temperature.
- 6.5.3 If after recalibrating the value still falls outside of the accepted range, empty and refill the filling solution chamber before calibrating and verifying the calibration again.
- 6.5.4 If steps 6.5.1 through 6.5.3 do not correct the problem, see Users Guide and follow the directions for cleaning the pH probe.
- 6.5.5 If steps 6.5.1 through 6.5.4 do not correct the problem, check with the Laboratory Manager.
- 6.5.6 Re-equilibrate the electrode by placing the probe back into the pH 4 buffer until the reading reaches the value recorded in the logbook.

6.6 Sample Analysis

Note: Acid rain samples should not be stirred. Instead, swirl the samples gently for a few seconds after the introduction of the electrode. Allow the electrode to equilibrate. The air-water interface should not be disturbed while measurements are being made.

- 6.6.1 Fill two vessels with a portion of the sample.
- 6.6.2 Rinse the electrode with DI water and gently blot the probe free of drops with a Kimwipe and immerse the probe in the first vessel.
- 6.6.3 Swirl the probe gently to rinse before moving to the next aliquot. Stop swirling the probe and allow the electrode to equilibrate in the second aliquot.
- 6.6.4 Record the value in the logbook once the reading has stabilized. Ignore any drifting of the displayed values unless the “pH” icon begins to blink again, in which case wait until stability returns before recording the value.

6.7 Data Analysis

- 6.7.1 Enter the data in Element (see Figure 7) using the manual batch processing feature outlined in SOP GLO-3180-035 Element Batch Preparation (section 3.3).
- 6.7.2 The analyst should note any analytical anomalies in a separate batch narrative.
- 6.7.3 Assemble the data batch folder, including a hard copy of the Element data batch, copies of all run logs, certificates of analyses and processing methods, and any other necessary documentation.
- 6.7.4 Complete the batch folder checklists (see Attachments B and C), and submit it for review and finalization.

Figure 7. Element Manual Batch

SampleID	Analysis	Analyte	Rpt	P/Rpt	Lock	Status	Qualifier	IResult	FResult	Type	MDL	LOD	MRL	Units	Dir	Recovery
L001025	pH. LAB	pH. LAB	X	X		Reported		4.6	4.600	PR	0.000		0.000	std units	1	
L001024	pH. LAB	pH. LAB	X	X		Reported		4.6	4.600	PR	0.000		0.000	std units	1	
L001023	pH. LAB	pH. LAB	X	X		Reported		5.23	5.230	PR	0.000		0.000	std units	1	
L001022	pH. LAB	pH. LAB	X	X		Reported		4.63	4.630	PR	0.000		0.000	std units	1	
L001021	pH. LAB	pH. LAB	X	X		Reported		5.5	5.500	PR	0.000		0.000	std units	1	
L001020	pH. LAB	pH. LAB	X	X		Reported		5.59	5.590	PR	0.000		0.000	std units	1	
L001019	pH. LAB	pH. LAB	X	X		Reported		5.04	5.040	PR	0.000		0.000	std units	1	
L001018	pH. LAB	pH. LAB	X	X		Reported		5.02	5.020	PR	0.000		0.000	std units	1	
L001017	pH. LAB	pH. LAB	X	X		Reported		5.3	5.300	PR	0.000		0.000	std units	1	
L001016	pH. LAB	pH. LAB	X	X		Reported		5.03	5.030	PR	0.000		0.000	std units	1	
L001015	pH. LAB	pH. LAB	X	X		Reported		4.58	4.580	PR	0.000		0.000	std units	1	
L001014	pH. LAB	pH. LAB	X	X		Reported		5.64	5.640	PR	0.000		0.000	std units	1	
L001013	pH. LAB	pH. LAB	X	X		Reported		4.94	4.940	PR	0.000		0.000	std units	1	
L001012	pH. LAB	pH. LAB	X	X		Reported		5.79	5.790	PR	0.000		0.000	std units	1	
L001011	pH. LAB	pH. LAB	X	X		Reported		4.59	4.590	PR	0.000		0.000	std units	1	
L001010	pH. LAB	pH. LAB	X	X		Reported		6.86	6.860	PR	0.000		0.000	std units	1	
L001009	pH. LAB	pH. LAB	X	X		Reported		7.07	7.070	PR	0.000		0.000	std units	1	
L001008	pH. LAB	pH. LAB	X	X		Reported		5.39	5.390	PR	0.000		0.000	std units	1	
L001007	pH. LAB	pH. LAB	X	X		Reported		6.79	6.790	PR	0.000		0.000	std units	1	
L001006	pH. LAB	pH. LAB	X	X		Reported		6.78	6.780	PR	0.000		0.000	std units	1	
L001005	pH. LAB	pH. LAB	X	X		Reported		4.94	4.940	PR	0.000		0.000	std units	1	
L001004	pH. LAB	pH. LAB	X	X		Reported		6.92	6.920	PR	0.000		0.000	std units	1	
L001003	pH. LAB	pH. LAB	X	X		QC		0	ND (0.000)	NA	0.000		0.000	std units	1	
L001002	pH. LAB	pH. LAB	X	X		QC		4.96	4.960	NA				std units	1	99 (95-105)
L001001	pH. LAB	pH. LAB	X	X		QC		5.01	5.010	NA				std units	1	100 (95-105)
L912044	pH. LAB	pH. LAB	X	X		QC		4.99	4.990	NA				std units	1	100 (95-105)
L912043	pH. LAB	pH. LAB	X	X		QC		4.98	4.980	NA				std units	1	100 (95-105)
L912042	pH. LAB	pH. LAB	X	X		QC		5.57	5.570	NA	0.000		0.000	std units	1	
L912041	pH. LAB	pH. LAB	X	X		QC		6.93	6.930	NA	0.000		0.000	std units	1	
L912040	pH. LAB	pH. LAB	X	X		QC		3.75	3.750	NA				std units	1	99 (99-101)
L912039	pH. LAB	pH. LAB	X	X		QC		3.84	3.840	NA				std units	1	101 (99-101)

6.8 Quality Control

- 6.8.1 Method blanks (BLK), consisting of DI water, must be analyzed at the beginning of each day's analysis unless specified differently by a project.
- 6.8.2 Reference samples (SRM) must be analyzed at the beginning and at the end of each run. Acceptance criteria are ± 0.05 pH units of the certified value.

- 6.8.3 Control standards (CCV) must be analyzed at the beginning and end of each run, as well as at a frequency of 10 percent. Acceptance criteria are ± 0.05 pH units of the known value.
- 6.8.4 Duplicate samples (DUP) must be performed at a frequency of 20 percent. Reading should be ± 0.05 pH units of the original value.
- 6.8.5 If data are uploaded to the Clean Air Status and Trends Network database, the BLK, SRM, and DUP prefixes will be changed to MB, RF, and RP respectively upon ingestion.

6.9 Calculations

All calculations are performed internally by the pH meter including the determination of the calibration curve from the potentiometric values (in millivolts – mV) obtained during the two-step calibration procedure outlined in section 6.3. Sample results are displayed directly as pH values by the meter. No external calculations are performed.

6.10 Corrective actions

Attachment A shows the corrective actions taken when the QC samples are not within acceptance criteria.

6.11 Data review

The checklists used by the analyst, peer reviewer, and supervisor in reviewing the analytical data are shown in Attachments B and C.

7.0 REFERENCES

Clesceri, L.S., Greenberg, A.E., Trussel, R.R. (eds) 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th edition. APHA-AWWA-WPCF, Washington D.C.

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ASTM International D 1293 – 12 *Standard Test Methods for pH of Water* January 2012

8.0 ATTACHMENTS

Attachment A – Corrective Actions

Attachment B – Batch Folder Checklist

Attachment C – Batch Peer Review Checklist

Attachment D – Revisions Table

ATTACHMENT A

Corrective Actions

Quality Control	Acceptance Criteria	Corrective Action
pH 10 buffer	± 0.05 (9.95-10.05)	Repeat the analysis with a new pH 10 buffer. If the new buffer is not within the acceptance criteria, verify the buffer solutions are within $\pm 1^{\circ}\text{C}$ of room temperature and recalibrate. If still outside acceptance criteria, change electrode filling solution. Additional failure will require cleaning (see electrode User's Guide) or replacing the electrode.
Reference standard (SRM)	± 0.05 of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples, or document why data are acceptable.
Control standard (CCV)	± 0.05 of the certified true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV, or document why data are acceptable.
Sample Replicate (DUP)	± 0.05 of the certified true value	Determine the cause of the problem. Reanalyze the sample, if necessary, or document why data are acceptable.

Source: WSP

ATTACHMENT B
Batch Folder Checklist



Folder Checklist

Batch # _____

Initial or NA

ELEMENT batch printout

Method reference

Instrument logbook copies

Reagent/Standard prep log sheets

Original raw data

Analyst

Date

Batch Folder Reviewed by

Date


Notes:

ELEMENT Reviewed by

Date

ATTACHMENT C

Batch Peer Review Checklist



Batch Folder and ELEMENT Batch Review Checklist

Batch _____

Section 1.

This section is to be completed by the analyst before submitting the batch and counter-signed during peer review. Peer reviewer also checks each statement for accuracy (indicated by a check preceding the item). Any discrepancies must be corrected before the batch can be accepted. Any "No" response must have a comment.

	<u>Yes</u>	<u>No</u>	<u>Comments</u>
____ 1. All samples uploaded correctly.	____	____	_____
____ 2. All duplicate sources entered correctly.	____	____	_____
____ 3. All QC results within established criteria:			
____ MB	____	____	_____
____ BS	____	____	_____
____ CCV	____	____	_____
____ SRM	____	____	_____
____ DUP	____	____	_____
____ 4. All curve coefficients ≥ 0.995 .	____	____	_____
____ 5. All responses within calibration range.	____	____	_____
____ 6. All dilution factors entered correctly.	____	____	_____
____ 7. Other electronic flags in the ELEMENT batch?	____	____	If Yes, describe in Additional

Comments _____

below.

Analyst: _____ Date: _____

Reviewed By: _____ Date: _____

Section 2.

This section is to be completed by the reviewer. Initial each item. All items must be found to be true and be initialed before the batch can be accepted.

1. Instrument run log matches ELEMENT batch.
(Exceptions allowed with sufficient documentation) _____
2. All appropriate documentation present.
(Includes, but is not limited to, standard prep logs, COA, code sheets, method print-outs, schedule print-outs, and run log copies.) _____
3. Raw data (chromatograms, spectra intensities, etc.) is acceptable.
(Additional documentation may be required.) _____

Reviewed By: _____ Date: _____

Additional Comments:

GLF-3180-002/ Rev. 3

ATTACHMENT D

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
11.0	Attachment D	Addition of this table.
	Attachment B	Updated figure
	Attachment C	Updated figure
	Document title	Updated reference method from EPA 150.1 to ASTM D1293-12
	Signature page	Updated Laboratory Manager to Katherine Barry. Removed Garry Price.
	Entire SOP	Changed company name to Amec Foster Wheeler
	7.0	Updated SOP preparation reference
12.0	7.0	Updated <i>Standard Methods for the Examination of Water & Wastewater</i> from 17 th edition to 18 th .
13.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
14.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	6.7.1	Updated SOP name format to read GLO-3180-035.
15.0	All	Update company name to WSP and apply Arial font formatting
16.0	All	Update company name to WSP USA Inc.
	4.1	Delete "The electrode should be every six (6) months."

**TITLE: DETERMINATION OF SPECIFIC CONDUCTANCE FOR WET DEPOSITION
SAMPLES (EPA METHOD 120.1)**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations
Manager

Topie, Nathaniel (USNT719661)
Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.25 11:54:01 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager

Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 16:48:43
-05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Safety
- 6.0 Procedure
- 7.0 References
- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

DETERMINATION OF SPECIFIC CONDUCTANCE FOR WET DEPOSITION SAMPLES (EPA METHOD 120.1)

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the determination of the conductivity of water samples.

2.0 SCOPE

This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes, and acid rain (atmospheric wet deposition).

3.0 SUMMARY OF METHOD

The specific conductance of a sample is measured by the use of a self-contained conductivity meter, Wheatstone bridge-type, or equivalent.

Samples are preferably analyzed at 25 degrees Celsius (°C). Automatic Temperature Compensation (ATC) is used by the instrument to make temperature corrections to report the results at 25 °C.

3.1 Method Interferences

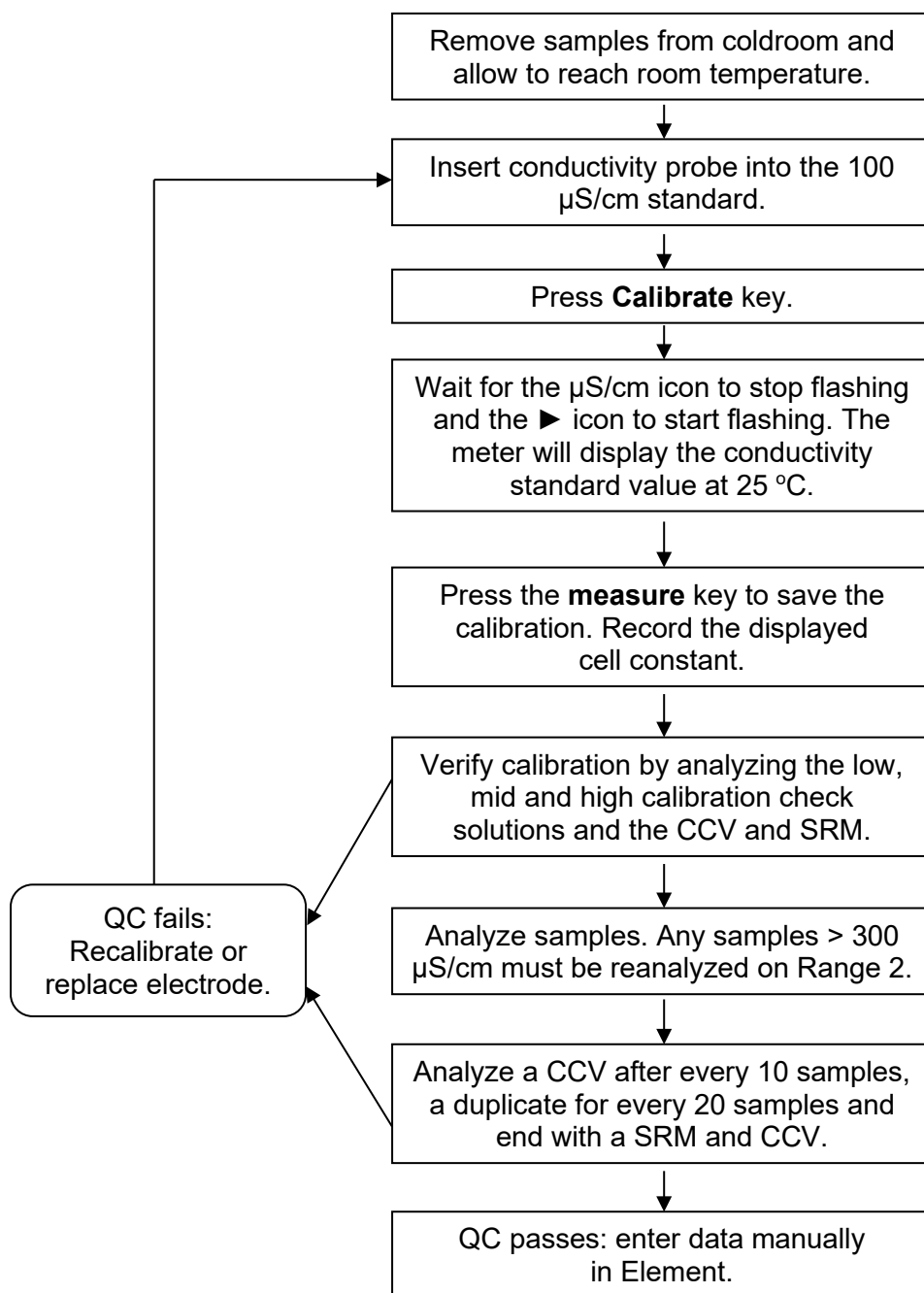
Electrolytic conductivity increases with temperature approximately 2.1 percent per °C. Significant differences exist between the temperature coefficients of conductivity when comparing different ions. Therefore, temperature variations and corrections represent the largest source of potential error. Dirty conductivity cells can cause erroneous readings.

Dissolved carbon dioxide (CO₂) and ammonia (NH₃) from the atmosphere increase the conductivity of samples. Protect all solutions and samples from the atmosphere as much as possible.

3.2 Deviations from the Method

A general overview of the steps described in this SOP is depicted Figure 1. Deviations from the analytical method described in this SOP are not permitted.

Figure 1. Overview – Laboratory Operations Procedures for Specific Conductance of Range 1 Samples (0-300 $\mu\text{S}/\text{cm}$)



4.0 MATERIALS

4.1 Apparatus

- Conductivity meter, with a range of 0 microSeimens per centimeter ($\mu\text{S}/\text{cm}$) to 200 milliSeimens per centimeter (mS/cm) with automatic temperature correction capabilities. The Orion 3 Star meter (see Figure 2) is currently in use in the laboratory, and instructions are based on the corresponding instrument manual.

Figure 2. Conductivity Meter



- Conductivity cell probe: Orion #013016MD – two-electrode steel conductivity probe, with a nominal cell constant: $K=0.1\text{ cm}^{-1}$. This probe is suitable for sample conductivity levels from $0.01\text{ }\mu\text{S}/\text{cm}$ to $300\text{ }\mu\text{S}/\text{cm}$ (Range 1) and is the current preferred probe. Follow manufacturer's directions for storage, cleaning, and maintenance of probe.
- Orion #013005D – four-electrode ceramic and graphite conductivity probe, with a nominal cell constant: $K=0.475\text{ cm}^{-1}$. It exhibits stable readings above $20\text{ }\mu\text{S}/\text{cm}$ and is used for Range 2. Follow manufacturer's directions for storage, cleaning, and maintenance of probe.
- Class A glass pipettes – 2, 3, 5, and 7 milliliter (mL)
- Class A volumetric flasks – 200, 250, 500, and 1000 mL
- Analytical balance sensitive to 0.0001 gram (g)
- Kimwipes
- Nalgene bottles – 30 mL, cleaned per SOP GLO-3180-001 or other appropriately sized vessels for use when sample volume is limited
- Wash bottle filled with reagent water for cleaning the probe
- Thermometer for ambient room temperature readings
- Digital scanning thermometer for surface temperature readings of the solutions

4.2 Reagents

- Reagent Water: Deionized (DI) water of resistivity of 15 mega ohms ($M\Omega$) or greater, derived from mixed bed ion exchangers, activated carbon filters, and polishing exchangers. Water should contain particles no larger than 0.20 micrometers.
- Laboratory-prepared Calibration Standards: If laboratory-prepared calibration standards are used, a commercially available control standard should be used for verification. Substituting a laboratory-prepared standard for a commercially unavailable conductivity level is acceptable. See Attachment A for conductivity target calculation procedure. Class A volumetric flasks and pipettes must be used for preparation of all solutions.
- Potassium Chloride (KCl) Stock Solutions
 - KCl Stock Solution I (0.050 Molar [M]) KCl: Dissolve 0.932 (g) of pre-dried (minimum of two hours at 105 °C) KCl in 250 mL of DI water. Conductivity of this solution should be 6668 $\mu\text{S/cm}$. Expiration is one year from preparation date.
 - KCl Stock Solution II (0.500 M KCl): Dissolve 9.32 (g) of pre-dried (minimum of two hours at 105 °C) KCl in 250 mL of DI water. Conductivity of this solution should be 58.64 mS/cm. Expiration is one year from preparation date.
 - KCl Stock Solution III (0.100 M KCl): Dissolve 1.864 (g) of pre-dried (minimum of two hours at 105 °C) KCl in 250 mL of DI water. Conductivity of this solution should be 12.90 mS/cm. Expiration is one year from preparation date.
- Calibration Standards, Range 1 (0-300 $\mu\text{S/cm}$):
 - Calibration Standard I – (0.500 millimolar mM KCl): Dilute 5.0 mL KCl Stock Solution I (0.050 M KCl) to 500 mL with DI water. Conductivity of the solution is 73.90 $\mu\text{S/cm}$. This standard may also be used as a Mid-level Calibration Check Standard for this range. Expiration is six months from preparation date.
 - High Calibration Check Standard I – (2.0 mM KCl): Dilute 2.0 mL Stock Solution II (0.500 M KCl) to 500 mL with DI water. Conductivity of the solution should be 289.7 $\mu\text{S/cm}$. This solution is also used as the Mid-level Calibration Check Standard for Range 2. Expiration is six months from preparation date.
- Calibration Standards, Range 2 (> 100 $\mu\text{S/cm}$):
 - Calibration Standard II – Range 2 (5.00 mM KCl): Dilute 2.0 mL KCl Stock Solution II (0.500 M KCl) to 200 mL with DI water. Conductivity of the solution should be 717.8 $\mu\text{S/cm}$. Expiration is six months from preparation date.
 - Low Calibration Check Standard – Range 2 (1.5 mM KCl): Dilute 3.0 mL of Stock Solution III (0.100 M KCl) to 200 mL with DI water. Conductivity of the solution should be 218.4 $\mu\text{S/cm}$. Expiration is six months from preparation date.
 - High Calibration Check Standard II – Range 2 (14.0 mM KCl): Dilute 7.0 mL Stock Solution II (0.500 M KCl) to 250 mL with DI water. Conductivity of the solution should be 1955 $\mu\text{S/cm}$. Expiration is six months from preparation date.
- Control Standard Solutions:

- Control Standard Solution II – Range 2 (7.5 mM KCl): Dilute 3.0 mL of Stock Solution II (0.500 M KCl) to 200 mL DI water. Conductivity of the solution should be 1065 $\mu\text{S}/\text{cm}$. Expiration is six months from preparation date.
- Commercial Solutions - commercial National Institute of Standards and Technology (NIST) traceable calibration, reference and calibration standards from different manufacturers are all acceptable for usage. A Certificate of Analysis and expiration date must be supplied with all commercial standards and reference solutions (see Figure 3).
 - Commercial Calibration Standard I – Range 1: Thermo Scientific 100 $\mu\text{S}/\text{cm}$ standard conductivity solution, or equivalent.
 - Commercial Calibration Standard II – Range 2: Thermo Scientific 1413 $\mu\text{S}/\text{cm}$ standard conductivity solution, or equivalent.
 - Commercial Low Calibration Check Standard I – Range 1: Commercial NIST traceable standard conductivity solution of approximately 10 $\mu\text{S}/\text{cm}$.
 - Commercial Low Calibration Check Standard II – Range 1: Commercial NIST traceable standard conductivity solution of approximately 5 $\mu\text{S}/\text{cm}$.
 - Commercial Reference Solution I – Range 1: High-Purity Standards Simulated Rainwater 1, or equivalent. This standard should be in the range of 20-30 $\mu\text{S}/\text{cm}$.
 - Commercial Reference Solution II – Range 2: Commercial mid-range NIST traceable standard conductivity solution in the range of 200-500 $\mu\text{S}/\text{cm}$.
 - Commercial Control Solution – Range 1: Commercial NIST traceable standard solution of approximately 15 $\mu\text{S}/\text{cm}$ concentration.

Figure 3. Certificate of Analysis

DF17001

**HIGH PURITY
STANDARDS**
www.highpuritystandards.com

P.O. Box 41767
 Charleston, SC 29423
 Phone: (843) 767-7600
 Fax: (843) 767-7606

Certificate of Analysis

Product Description:

Name: Simulated Rainwater Level I
 Part number: **SR-1**
 Lot number: **0935107**
 Material Purity: 99.99-99.999%
 Matrix: H₂O

Rec'd 6/17/10 KWB
Exp 6/15/11

Certified Values:

Component	Certified Value (mg/L)	NIST SRM ID	NIST SRM Lot #
Chloride	0.216 ± 0.003	3182	060925
Fluoride	0.053 ± 0.003	3183	050721
Nitrate	0.502 ± 0.018	3185	050517
Sulfate	2.56 ± 0.03	3181	080603
Sodium	0.20 ± 0.01	3152a	010728
Potassium	0.049 ± 0.002	3141a	051220
Calcium	0.011 ± 0.001	3109a	050825
Magnesium	0.020 ± 0.001	3131a	050302

Parameter	Certified Value	NIST SRM ID	NIST SRM Lot #
pH	4.28 ± 0.10, at 20.1°C	*	*
Specific Conductance	23.6 ± 3 µS/cm, at 25.0°C	3191	050403

The Certified values are based on gravimetric and volumetric preparations and verified against SRM 3100 Series developed by the National Institute of Standards and Technology (NIST), via inductively coupled plasma optical emission spectrometry (ICP-OES) and Ion Chromatography using an internally developed laboratory method. The uncertainty in the certified value is calculated for a 95% confidence interval.

* Refer to Traceability Information, Section C.

Reference Values:

Component	Value (mg/L)	NIST SRM ID	NIST SRM Lot #
Ammonium	0.10	*	*

Preparation Information:

The highest purity source materials were purchased from qualified vendors per ISO 9001:2008 guidelines and assayed by inductively coupled plasma optical emission spectrometry (ICP-OES) and ion chromatography (IC) for conformity prior to use. This standard was prepared using methods developed at the National Institute of Standards and Technology for the preparation of SRM Spectrometric Standard Solutions. The matrix is 18 megohm deionized water.

Lot No.: 0935107
 Rev. No.: 1.0.0
 Page 1 of 2

5.0 SAFETY

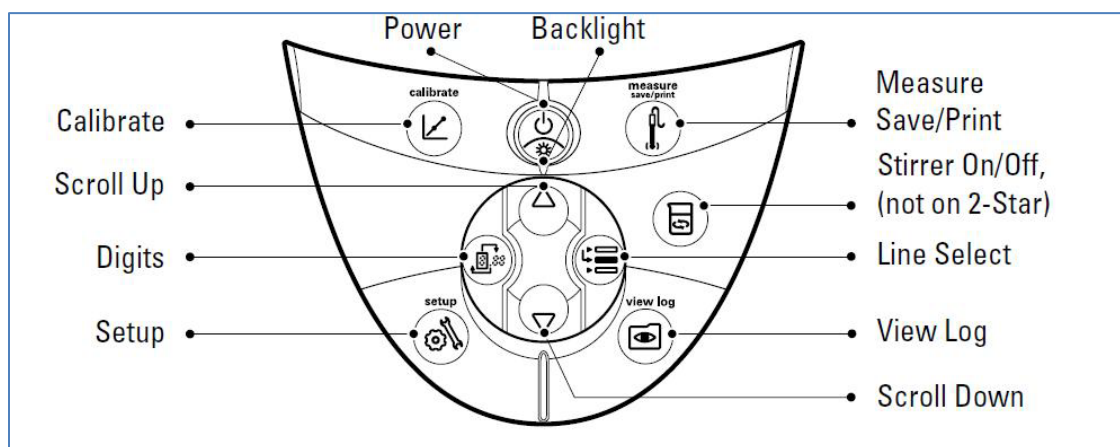
The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Materials Safety Data Sheets (MSDS) must be consulted. The MSDS by chemical and brand can be

found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

6.0 PROCEDURE

6.1 Calibration

Figure 4. Diagram of Orion 3-Star Conductivity Bench-top Meter Keypad



Key	Description	Key	Description
	Turns the meter on, if the meter is off. Toggles the backlight on and off, if the meter is on (3-Star, 4-Star and 5-Star meters only). If the meter is on, hold down the key for about three seconds to turn off the meter.		Changes the measurement units of the selected line in the measurement mode.
	Scrolls the arrow icon on left of screen among the three display lines, so the selected line can be edited or calibrated.		Changes the value on the selected line in the setup, methods and log view modes. Edits the value of the flashing digit for setup, password entry and calibration modes.
	Starts the calibration for the selected line in the measurement mode. If the arrow icon points to the top line and the displayed units are pH, pressing the key will start a pH calibration. Each time the key is pressed in the calibration mode, the meter will accept the calibration point and move to the next point until the maximum number of calibration points are reached.		Selects the next digit to edit and moves the decimal point for setup, password entry and calibration modes.
	Enters the setup menu, starting with selected line in the measurement mode. If the arrow icon points to the top line and the displayed units are ISE, pressing the key will enter the ISE setup screen.		Prints and logs a measurement in the continuous or timed measurement modes. Prints, logs and freezes the display when the reading becomes stable in the AUTO-READ measurement mode. Exits the setup menu and returns to measurement mode. Accepts the calibration and returns to measurement mode.
			Prints and logs a measurement in the continuous or timed measurement modes.
			Prints, logs and freezes the display when the reading becomes stable in the AUTO-READ measurement mode.
			Exits the setup menu and returns to measurement mode.
			Accepts the calibration and returns to measurement mode.
			Enters the log view and download menu.
			Turns the stirrer on and off.

Note: This calibration method is for Range 1- a one-point calibration utilizing the AutoBuffer recognition feature of the Orion 3-Star Bench-top conductivity meter (see Figure 4 for a diagram of the keypad and Figure 5 for an overview of the calibration steps). Other calibration methods are listed in the manual for this meter and may be used in cases as approved by the Laboratory Manager and/or QA Manager.

Figure 5. Conductivity Calibration Overview

- 6.1.1 Turn the on the meter (see Fig 5-1). The display will show the room temperature (see Fig 5-2).
- 6.1.2 Select the Thermo Scientific Orion conductivity standard for Range 1: 100 $\mu\text{S}/\text{cm}$ (see Fig 5-3).
- 6.1.3 In the **Setup** Mode enter the nominal cell constant value for the conductivity probe (0.102) (see Fig 5-4).
- 6.1.4 Rinse the conductivity probe with DI and blot dry with a Kimwipe® (see Fig 5-5) and insert into the 100 $\mu\text{S}/\text{cm}$ standard (see Fig 5-6). Probe should be inserted in the liquid far enough to cover the ports (see Figure 6).
- 6.1.5 Press the **Calibrate** key (see Fig 5-7). The meter will show the manual calibration display for about five seconds. Do not press any keys. The meter will then proceed to the autocalibration display (see Fig 5-8).
- 6.1.6 Wait for the $\mu\text{S}/\text{cm}$ icon to stop flashing and the ► icon to start flashing. The meter will display the conductivity standard value at 25 °C (see Fig 5-9). The displayed value should be within $\pm 5\%$ of the certified value. If the displayed value is not within acceptable limits, use a fresh standard and recalibrate.
- 6.1.7 Press the **Measure** key (see Fig 5-10) to save and end the calibration. The calculated cell constant will be displayed and then the meter will proceed to the measurement mode. Record the cell constant.

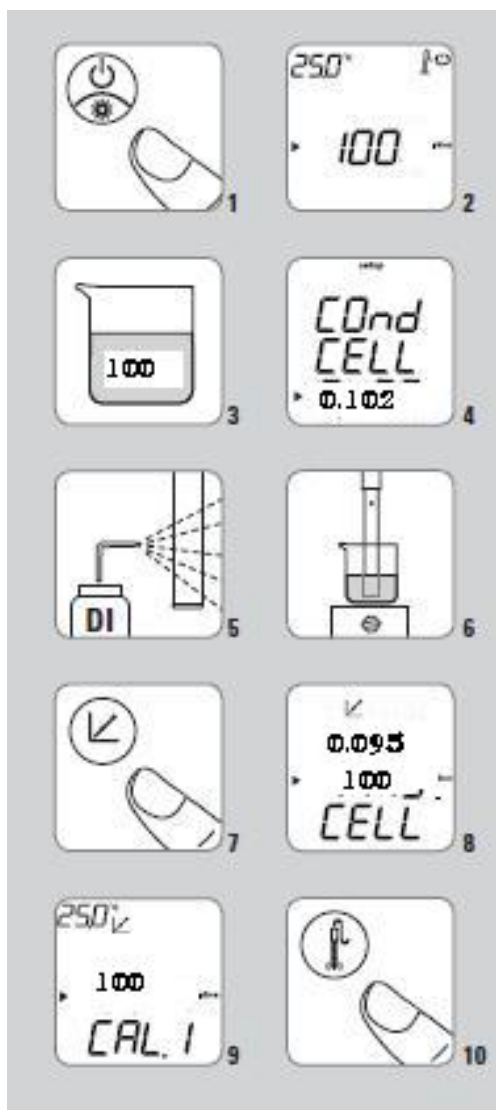


Figure 6. Immersion Depth for Probe



6.2 Verify Calibration

- 6.2.1 The meter is typically in AUTO-READ mode. Press the **Measure** key to take a measurement. Once the reading stabilizes, the **AR** icon will stop flashing and the display will freeze. Press the **Measure** key again to take a new measurement.
- 6.2.2 Rinse the probe with DI water and blot excess water from the outside surfaces with a Kimwipe prior to immersing the probe in the next sample. Store the probe in DI water between samples.
- 6.2.3 Check the calibration using the low, mid, and high calibration check solutions. The acceptance criterion is ± 10 percent of the certified or calculated value. If the calibration check standards do not fall within range, re-calibrate the meter. If the readings are within the acceptance range, record the values and temperature on the Conductivity Calibration logbook page (see Attachment B).
- 6.2.4 Analyze a control and reference sample. The values must be within ± 15 percent of the certified or calculated value or the meter must be recalibrated.
- 6.2.5 If re-calibrating the meter does not give conductivity readings within the acceptable criteria, clean the conductivity cell following the manufacturer's instructions.
- 6.2.6 If cleaning the conductivity cell does not give conductivity readings within the acceptable criteria, consult the Analytical Laboratory Manager. The conductivity cell may need to be replaced or replatinized.

6.3 Sample Analysis

Note: Acid rain samples should not be stirred. Instead, swirl the samples gently for a few seconds after the introduction of the probe.

- 6.3.1 Allow the unpreserved samples to come to room temperature, prior to analyses.
- 6.3.2 Fill a vessel with the sample. The 30 mL Nalgene bottles require a minimum of 20 mL of sample to properly immerse the probe. If there is insufficient sample available, 7 mL scintillation vials may be used (the minimum sample volume for the vial is 3 mL). If the smaller vial is used a note should be made in the instrument logbook (see Attachment C).
- 6.3.3 Follow the analysis procedure detailed in Verify Calibration (section 6.2).
- 6.3.4 Record the results, temperature, and any pertinent comments in the appropriate place in the Conductivity Logbook.
- 6.3.5 If any samples are found to be outside of Range 1, recalibrate the meter using the alternate probe and Range 2 standards. Reanalyze the high sample. Include the data from any reanalysis and the QC with the initial analysis.
- 6.3.6 For overnight or long-term storage, the conductivity cell should be thoroughly rinsed and stored dry.

6.4 Data Analysis

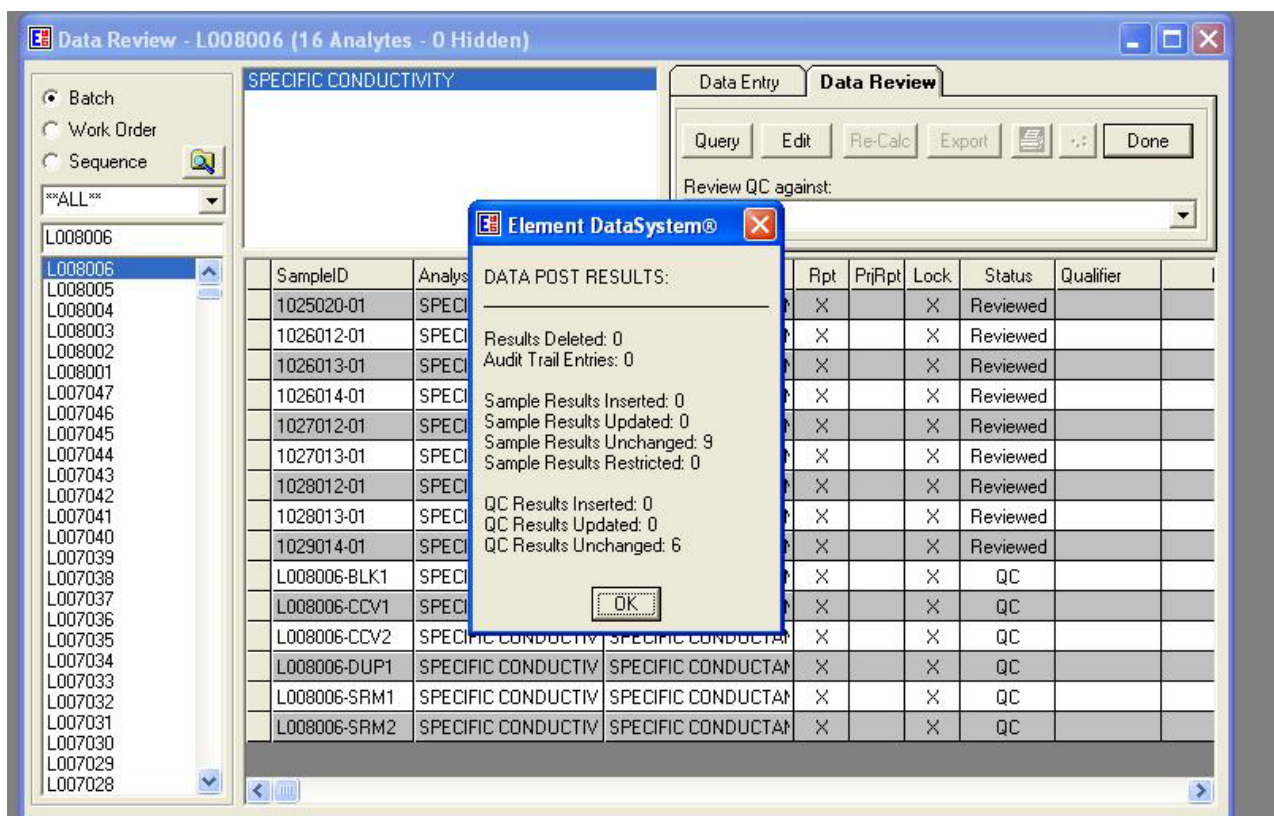
- 6.4.1 Enter the data in Element (see Figure 7) using the manual batch processing feature outlined in SOP GLO-3180-035 Element Batch Preparation (section 3.3).
- 6.4.2 The analyst should note any analytical anomalies in a separate batch narrative.
- 6.4.3 Assemble the data batch folder, including a hard copy of the Element data batch, copies of all logbooks, certificates of analyses and processing methods, and any other necessary documentation.
- 6.4.4 Complete the batch folder checklists (Attachment E and F), and submit it for review and finalization.

6.5 Quality Control

- 6.5.1 A method blank (BLK) must be analyzed at the beginning of each run. BLK consists of DI water. A method blank should also be analyzed with any samples reanalyzed at a different calibration range.
- 6.5.2 Replicate samples (DUP) must be analyzed at a frequency of 5 percent for every analytical batch unless specified differently by a project. Value must be within ± 15 percent.
- 6.5.3 Reference samples (SRM) are analyzed at the beginning and end of each run. Value must be within ± 15 percent of the certified value. Additional reference samples are analyzed with any samples reanalyzed at a different calibration range.

- 6.5.4 Control standards are continuing calibration verification (CCV) standards that are analyzed every 10 samples. Values must be within ± 15 percent of the certified value. Additional control standards are analyzed with any samples reanalyzed at a different calibration range.
- 6.5.5 If data are uploaded to the Clean Air Status and Trends Network database, the BLK, SRM, and DUP prefixes will be changed to MB, RF, and RP respectively upon ingestion.

Figure 7. Element Manual Batch



6.6 Calculations

Calculations are performed internally by the conductivity meter from the calibration obtained during the autocalibration procedure outlined in section 6.1 and include temperature correction based on the stored temperature coefficient (2.1 percent). Sample results are displayed directly as specific conductance, $\mu\text{S}/\text{cm}$ at 25 °C by the meter. No external calculations are performed.

6.7 Corrective actions

Attachment D shows the corrective actions taken when the QC Samples are not within acceptance criteria.

6.8 Data review

The checklists used by the analyst, peer reviewer, and supervisor in reviewing the analytical data are shown in Attachments E and F.

7.0 REFERENCES

Clesceri, L.S., Greenberg, A.E., Trussel, R.R. (eds). 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th edition APHA-AWWA-WPCF, Washington DC.

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U.S. Environmental Protection Agency (EPA). 1983. *Methods for Chemical Analysis of Water and Wastes* (EPA 120.1), EPA 600/4-79-020, revised March 1983.

8.0 ATTACHMENTS

Attachment A – Calculating Conductivity Targets

Attachment B – Conductivity Logbook page

Attachment C – Corrective Actions

Attachment D – Batch Folder Checklist

Attachment E – Batch Peer Review Checklist

Attachment F – Revisions Table

ATTACHMENT A
Calculating Conductivity Targets
Conductivity of KCl Solutions at 25 °C

	Concentration	Equivalent Conductivity	Conductivity
8.1	M	<i>mho/cm/equiv.</i>	<i>μS/cm</i>
	0	149.85	
	0.0001	149.43	14.94
	0.0005	147.81	73.90
	0.001	146.95	147.0
	0.005	143.55	717.8
	0.01	141.27	1413
	0.02	138.34	2767
	0.05	133.37	6668
	0.1	128.96	12900
	0.2	124.08	24820
	0.5	117.27	58640
	1	111.87	111900

Standard Methods for the Examination of Water and Wastewater, 17th edition, 1989.

Edited by Clesceri, L.S., Greenberg, A.E., Trussel, R.R. APHA-AWWA-WPCF, Washington D.C.

p. 2-60

To calculate conductivity for a solution:

$$k = c\lambda 10^3$$

where k is measured conductivity in $\mu\text{S/cm}$
 λ is equivalent conductivity in mho/cm/equiv.
and c is equivalent concentration (molar concentration
for KCl)

Use closest equivalent conductivity for calculation.

ATTACHMENT C
Summary of Corrective Action Procedures for Conductivity Measurements

Quality Control	Acceptance Criteria	Corrective Action
Autocalibration standard	$\pm 5\%$ of the certified or calculated true value	Repeat the calibration with a new standard; clean the probe; replatinize or replace the probe.
Low, Mid, and High Calibration check standards	$\pm 10\%$ of the certified or calculated true value	Rerun check standard. If still out of control, recalibrate instrument clean the probe, replatinize, or replace the probe.
Reference standard (SRM)	$\pm 15\%$ of the certified or calculated true value	Rerun reference. If still out of control, recalibrate instrument and reanalyze samples, or document why data are acceptable.
Control standard (CCV)	$\pm 15\%$ of the certified or calculated true value	Rerun standard. If still out of control, recalibrate instrument and reanalyze samples run since last acceptable CCV, or document why data are acceptable.
Sample Replicate (DUP)	± 15 of the original value.	Determine the cause of the problem. Reanalyze the sample, if necessary, or document why data are acceptable.

Source: WSP

ATTACHMENT D
Batch Folder Checklist



Folder Checklist

Batch # _____

Initial or NA

ELEMENT batch printout

Method reference

Instrument logbook copies

Reagent/Standard prep log sheets

Original raw data

Analyst

Date

Batch Folder Reviewed by

Date


Notes:

ELEMENT Reviewed by

Date

ATTACHMENT E

Batch Peer Review Checklist



Batch Folder and ELEMENT Batch Review Checklist

Batch _____

Section 1.
This section is to be completed by the analyst before submitting the batch and counter-signed during peer review. Peer reviewer also checks each statement for accuracy (indicated by a check preceding the item). Any discrepancies must be corrected before the batch can be accepted. Any "No" response must have a comment.

	<u>Yes</u>	<u>No</u>	<u>Comments</u>
____ 1. All samples uploaded correctly.	____	____	_____
____ 2. All duplicate sources entered correctly.	____	____	_____
____ 3. All QC results within established criteria:			
____ MB	____	____	_____
____ BS	____	____	_____
____ CCV	____	____	_____
____ SRM	____	____	_____
____ DUP	____	____	_____
____ 4. All curve coefficients ≥ 0.995 .	____	____	_____
____ 5. All responses within calibration range.	____	____	_____
____ 6. All dilution factors entered correctly.	____	____	_____
____ 7. Other electronic flags in the ELEMENT batch?	____	____	If Yes, describe in Additional

Comments _____ below.

Analyst: _____ Date: _____

Reviewed By: _____ Date: _____

Section 2.
This section is to be completed by the reviewer. Initial each item. All items must be found to be true and be initialed before the batch can be accepted.

1. Instrument run log matches ELEMENT batch.
(Exceptions allowed with sufficient documentation) _____
2. All appropriate documentation present.
(Includes, but is not limited to, standard prep logs, COA, code sheets, method print-outs, schedule print-outs, and run log copies.) _____
3. Raw data (chromatograms, spectra intensities, etc.) is acceptable.
(Additional documentation may be required.) _____

Reviewed By: _____ Date: _____

Additional Comments:

GLF-3180-002/ Rev. 3

ATTACHMENT F

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
10.0	Signature page	Updated Laboratory Manager to Katherine Barry. Removed Garry Price.
	Entire SOP	Changed company name to Amec Foster Wheeler
	7.0	Updated SOP preparation reference
	Attachment E	Updated figure
	Attachment F	Updated figure
	Attachment G	Addition of this table
11.0	7.0	Updated <i>Standard Methods for the Examination of Water & Wastewater</i> from 17 th Edition to 18 th .
12.0	Attachment B	Deleted. Information is now in instrument logbook.
	Attachment C	Replaced outdated version with new logbook page.
	Attachment C-G	Renumbered B-F due to deletion of original Attachment B
13.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
14.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	4.1 & 6.4	Updated SOP name format to read GLO-3180-001 and GLO-3180-035 respectively.
15.0	All	Update company name to WSP and apply Arial font formatting
16.0	All	Update company name to WSP USA Inc.

TITLE: WASHING OF FILTER PACK EQUIPMENT

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations
Manager

Topie, Nathaniel
(USNT719661)

Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.25 11:55:15 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager



Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 17:05:30
-05'00'

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- 1.0 Purpose
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- 3.0 Materials
- 4.0 Safety
- 5.0 Training
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- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

WASHING OF FILTER PACK EQUIPMENT

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for the cleaning of filter pack equipment to minimize any contamination.

2.0 SCOPE

This SOP applies to filter packs and sample bottles used for the Clean Air Status and Trends Network (CASTNET) and similar projects.

3.0 MATERIALS

Powder-free disposable nitrile gloves

Various sizes of plastic tubs dedicated to this procedure

Brushes dedicated to this procedure

Resealable plastic bags

Resealable plastic containers

Drying oven

Deionized (DI) water of resistivity of 15 mega ohms (MΩ) or greater, derived from mixed bed ion exchangers, activated carbon filters, and polishing exchangers. Water should contain particles no larger than 0.20 micrometers.

4.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Safety Data Sheets (SDS) must be consulted. The SDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.


5.0 TRAINING

5.1 All technicians performing this procedure will be trained following the steps listed here:

- Read and understand this SOP.
- Observe a trained technician performing the washing procedures.
- Perform the washing procedures following the SOP while observed by a trained technician.

- 5.2 The trainer will complete a check-list of the activities performed (see Figure 1).
- 5.3 The first set of washed filter pack parts will be tested in the laboratory for base cations.
- 5.4 The trainee will be cleared to perform the procedure when the tested parts pass the laboratory's acceptance criteria for base cations outlined in the CASTNET Quality Assurance Project Plan (QAPP).

Figure 1. Washing of Filter pack Equipment Training Checklist.



Washing of Filter Pack Equipment Training Checklist

Trainee: _____

Evaluator: _____

Laboratory Activity	Date	Pass/Fail	Comments
1. Standard Operating Procedure GLO-3180-002 R-_____ has been reviewed.			
2. Observed cleaning procedures performed by trained technician.			
3. Powder-free gloves worn.			
4. Inspected for worn, damaged or broken parts.			
5. Support rings, grids, end caps and forceps placed in pre-cleaned tubs and filled with Deionized Water (DI), agitated then allowed to soak.			
6. Filter collar and bottom support washed under DI & grooves scrubbed with brush.			
7. Support rings, grids, end caps & forceps rinsed at least 3 times with DI.			
8. Excess water shaken from parts.			
9. Clean parts placed in pre-cleaned tub.			
10. Tubs placed in drying oven for approx. 2 hours. Tubs and parts checked for dryness.			
11. Tubs with clean dry parts covered with lid. Forceps in clean plastic bag.			
12. 10 filter packs from this cleaning session: assembled & unpacked by trained technician, then tested for cations.			
Date packs assembled: _____ Assembled by: _____		Date analyzed: _____ Analyzed by: _____	
Score (% Passed)			
Training Completed	Yes / No	Comments:	

GLF-3180-015 R1

page 1 of 1

6.0 PROCEDURE

Note: Powder-free gloves are to be worn throughout all steps of this procedure. These procedures are performed in the washroom where all required components are available.

6.1 Filter Pack Equipment

- 6.1.1 Take the filter pack apart. Any parts which appear worn, damaged, or broken are to be replaced.
- 6.1.2 Place the filter support rings, grids, end caps and forceps in separate precleaned tubs filled with DI water. Agitate the items by hand for a few minutes and then allow to soak for a minimum of one hour.
- 6.1.3 Wash the filter collar and bottom support under a continuous flow of DI water. Scrub these parts clean using brushes. Make sure all grooves and places where particulate matter may collect are thoroughly cleaned.
- 6.1.4 Rinse the sample bottles, filter support rings, grids, end caps and forceps a minimum of three times with DI water. Shake as much excess water from these parts as possible before placing them in a clean tub (see Figure 2).

Figure 2. Tubs with parts for soaking and drying.



- 6.1.5 Place the tubs in the project drying oven at 70 degrees Celsius ($^{\circ}\text{C}$) for approximately two hours or until dry.
- 6.1.6 Once dry, remove the tubs and immediately cover them with a lid. Filter packs can be stored this way for up to three days.
- 6.1.7 Store the forceps in resealable plastic bags until used.
- 6.1.8 For long-term storage, the filter packs or various parts are placed in resealable plastic bags and then stored in large resealable plastic containers.

7.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. *Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents*. EPA/600/B-01/001, EPA QA/G-6, US EPA, Washington DC. April.

WSP USA Environment & Infrastructure Inc. (WSP) formerly known as Wood USA Environment & Infrastructure Inc. 2022. Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.5. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. 68HERH21D0006. Gainesville, FL.
<https://java.epa.gov/castnet/documents.do>.

8.0 ATTACHMENTS

Attachment A – Revisions Table

ATTACHMENT A

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
7.0	Signature page	Updated Laboratory Manager to Katherine Barry. Removed Garry Price.
	Entire SOP	Changed company name to Amec Foster Wheeler
	4.0	Update Materials Safety Data Sheets to Safety Data Sheets
	6.0	Updated SOP preparation reference
	7.0	Addition of this table
8.0	Signature page	Removed "Denuders" from title, Added Training Section 5.0
	All	Update name from Amec Foster Wheeler to Wood Environment & Infrastructure Solutions, Inc.
	1.0	Removed "denuders" from section.
	3.0	Add "dedicated to this procedure" to plastic tubs; removed aluminum foil, squeeze bottle and MeOH.
	5.0	Added training section
	6.0	1.2 changed soaking time to "a minimum of one hour", Removed 1.3 "Line with aluminum foil" Figure 1 – replaced pictures 1.7 replaced "cover with aluminum foil" with "cover with lid" Removed section 6.2 "Denuders"
	7.0	Added CASTNET QAPP to list of references.
9.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
9.1	2.0	Added "and sample bottles".
	6.1.4	Added "sample bottles".
10.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	5.2	Added Figure 1, training checklist and renumbered subsequent figures.
11.0	All	Update company name to WSP and apply Arial font formatting
12.0	All	Update company name to WSP USA Inc.

**TITLE: CENTRAL SAMPLE STORAGE ORGANIZATION FOR DRY AND WET DEPOSITION
SAMPLES**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations
Manager

Topie, Nathaniel (USNT719661)
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Reviewed by: Marcus O. Stewart
QA Manager


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Marcus (USMS719399)
Date: 2025.02.24 17:07:30
-05'00'

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Annual Review			
Reviewed by:	Title:	Date:	Signature:

CENTRAL SAMPLE STORAGE ORGANIZATION FOR DRY AND WET DEPOSITION SAMPLES

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for the storage of samples at the Gainesville Laboratory.

2.0 SCOPE

This SOP applies to all dry deposition filters, denuders, extracts, and wet deposition for Clean Air Status and Trends Network (CASTNET) and other project samples.

3.0 MATERIALS

Samples, pre- and post-extraction
Standard refrigerators
Walk-in Coldrooms
Traceable/ISO Calibrated Thermometers
Temperature log books

4.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Safety Data Sheets (SDS) must be consulted. The SDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

5.0 PROCEDURE

5.1 Short-term Storage Areas

- 5.1.1 Extracted samples are stored overnight, prior to analysis, in refrigerators in the analytical area of the laboratory (see Figure 1). The boxes of extracted samples are labeled with field groups, extraction and analysis dates, and the appropriate initials. After analysis, the samples are transferred to the main coldroom (see Figure 2).

Figure 1. Laboratory Refrigerator



Figure 2. Laboratory Walk-in Coldroom



5.1.2 The main laboratory walk-in coldroom, located in the hallway, is used for storage of analyzed extracts and all other samples. The shelves are organized as follows (see Figure 3):

- 5.1.2.1 Filters to be extracted are stored in the appropriate box (Teflon, nylon, or cellulose) immediately inside the coldroom on the right-hand side of the door.
- 5.1.2.2 Citric Acid filters, denuder samples, and gray-label nylon samples are stored on the right side of the coldroom.
- 5.1.2.3 Wet deposition samples are placed in large plastic tubs on the floor or shelves immediately inside the coldroom on the right-hand side of the door.
- 5.1.2.4 Performance evaluation samples from Environment and Climate Change Canada (ECCC) and US Geological Survey (USGS) are placed on the shelves immediately inside the coldroom on the right-hand side of the door.
- 5.1.2.5 Analyzed Teflon and nylon samples are stored on the left-hand side, with nylon samples closest to the door.
- 5.1.2.6 Analyzed cellulose samples are stored along the back of the coldroom.

Figure 3. Sample Organization in Walk-in Coldroom



5.2 Long-term Storage

Samples are stored in the main laboratory coldroom for two years after extraction. They can be discarded after two years.

5.3 Temperature Monitoring

- 5.3.1 Monitoring of all sample storage refrigerators and the walk-in coldroom is done on a daily basis, excluding weekends and holidays. The temperature displayed on the thermometer (see Figure 4) is recorded in the appropriate logbook.

Figure 4. Thermometer



5.3.2 The temperature of all sample storage refrigerators and walk-in coldrooms shall be maintained at 4 degrees Celsius ($^{\circ}\text{C}$) $\pm 2^{\circ}\text{C}$ [2-6 $^{\circ}\text{C}$]. If the temperature deviates from this range, the coldroom should be checked to ensure the refrigeration system is operating and then the temperature checked again within 2 hours. If the temperature is still out of range, the Laboratory Operations Manager will be notified immediately and a service call will be placed. Actions taken for out of range conditions will be noted in the logbook.

5.4 Corrective Actions

When necessary, samples may be reanalyzed to determine if there was any adverse effect from being stored in a location that did not meet the temperature requirements. Select 2 samples at random from each of the last 4 weeks of analyses for comparison with the original analyses, focusing on methods GLM-3180-001 and -004. Results must meet the replicate sample requirement for the established method. If a sample fails, EPA shall be notified and provided a list of samples stored but not yet analyzed along with the failing analyte(s). WSP will follow subsequent EPA guidance for the affected samples.

6.0 REFERENCES

Clesceri, L.S., Greenberg, A.E., Trussel, R.R. (eds). 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th edition. APHA-AWWA-WPCF, Washington, DC.

U.S. Environmental Protection Agency (EPA). 2007. *Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents*. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington DC. April.

U.S. Environmental Protection Agency (EPA). 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Revised March 1983.

7.0 ATTACHMENTS

Attachment A – Temperature Log

Attachment B – Revisions Table

ATTACHMENT A

Temperature Log



TEMPERATURE LOG

Corrected Temperature Range

_____ 2 _____ To _____ 6 _____ °C

[illegible]



ACTIONS TAKEN FOR OUT OF RANGE CONDITIONS:

Initials: _____ Date: _____

ATTACHMENT B

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
9.0	Signature page	Updated Laboratory Manager to Katherine Barry. Removed Garry Price.
	Entire SOP	Changed company name to Amec Foster Wheeler
	4.0	Update Materials Safety Data Sheets to Safety Data Sheets
	6.0	Updated SOP preparation reference
	7.0	Addition of this table
10.0	7.0	Updated <i>Standard Methods for the Examination of Water & Wastewater</i> from 17 th Edition to 18 th .
	7.0	Removed method reference 305.2 from <i>Methods for Chemical Analysis of Water & Wastes</i>
11.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
11.1	Attachment A	Update
	5.2.1	Added “unless directed otherwise by the client.”
12.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	5.1.2.4	ECAN updated to ECCC.
	5.4	Added description of sample reanalysis requirements.
13.0	5.1	Updated photos for new building. Updated coldroom and contents locations.
	5.2	Updated long term storage to two years in coldroom, deleted outdoor coldroom
	5.3	Deleted references to outdoor coldroom
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
14.0	All	Update company name to WSP and apply Arial font formatting
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
15.0	All	Update company name to WSP USA Inc.

**TITLE: CELLULOSE FILTER PREPARATION WITH
POTASSIUM CARBONATE**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie

Laboratory Operations Manager

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QA Manager



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Date: 2025.02.24 17:09:49
-05'00'

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- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

WHATMAN CELLULOSE FILTER PREPARATION WITH POTASSIUM CARBONATE

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the preparation of cellulose filters for Clean Air Status and Trends Network (CASTNET) filter packs.

2.0 SCOPE

This method is applicable to all prepared Whatman cellulose filters used to capture sulfur dioxide (SO₂) in the atmosphere.

3.0 SUMMARY

Cellulose filters are rinsed to remove potential sulfate and nitrate contamination and then impregnated with a potassium carbonate solution.

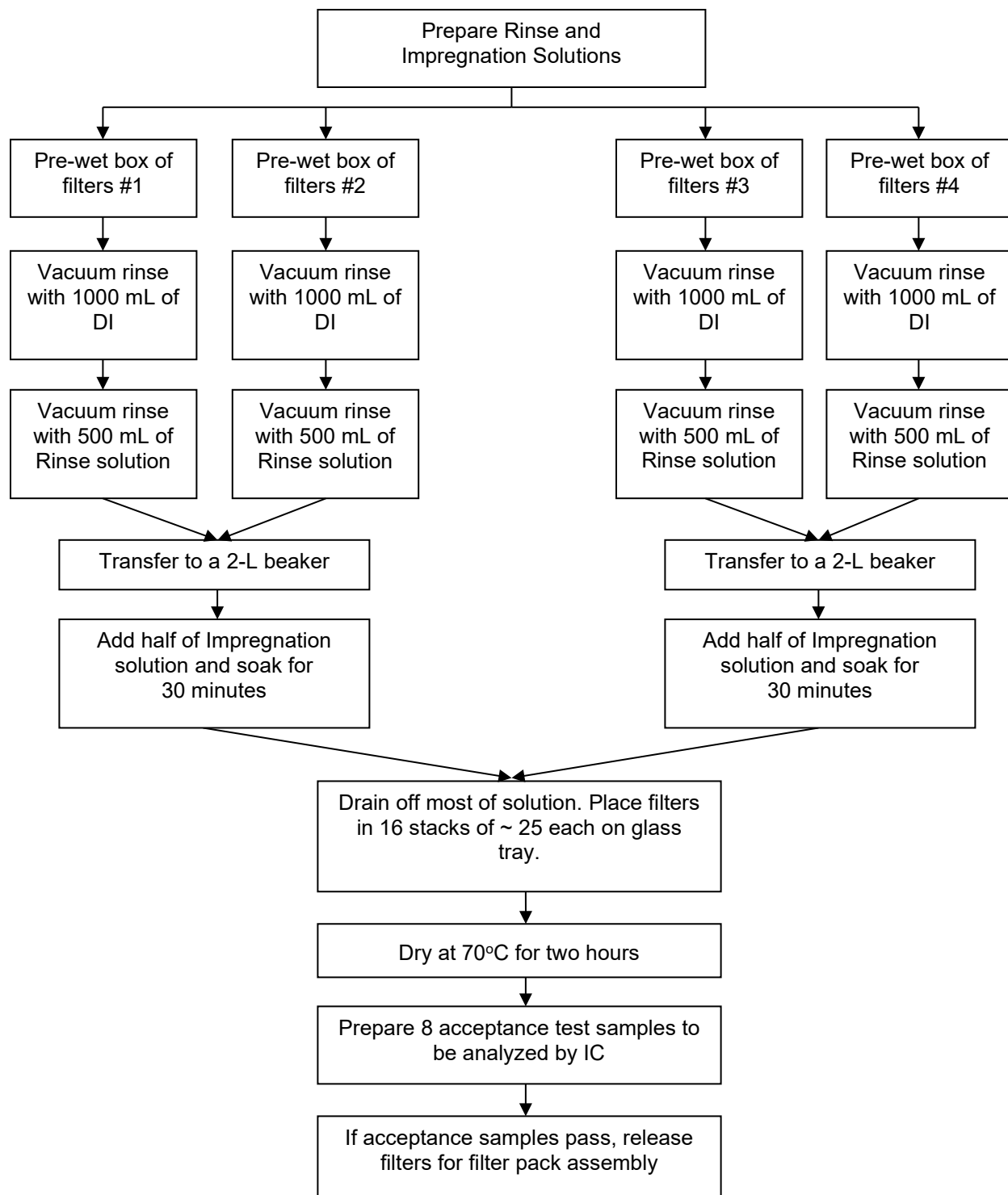
3.1 Method Interferences

Reagents from new vendors and those without a Certificate of Analysis listing the sulfate concentration should be tested for the presence of sulfate prior to use in the impregnation solution.

3.2 Deviations from the Method

A general overview of the steps described in this SOP is depicted in Figure 1. Deviations from the analytical method described in this SOP are not permitted.

Figure 1. Overview – Laboratory Operations Procedures for Whatman Filter Preparation



4.0 MATERIALS (SUFFICIENT FOR ONE IMPREGNATION GROUP)

4.1 Apparatus (see Figure 2)

Two 2-liter (L) Class A volumetric flasks

Glass trays

Two 2-L glass beakers

100-milliliter (mL) graduated cylinder

Large weighing boats

Powder-free gloves

Plastic forceps

Drying oven

Parafilm paraffin/polyethylene material

Buchner funnel

Timer

Three high-density polyethylene (HDPE) wash bottles

Whatman Grade No. 41, 47-millimeter (mm) -diameter ashless cellulose filters or equivalent

Resealable plastic bags and appropriate labels

Plastic-backed absorbent paper

KimWipes, large and small sizes

Vacuum apparatus, pump, side-arm vacuum flask, and appropriate tubing

Filter Impregnation Logbook

60-mL Nalgene bottle

4.2 Reagents

Reagent water: DI water with resistivity of 15 mega ohms ($M\Omega$) or greater, derived from mixed bed ion exchangers, activated carbon filters, and polishing exchangers. Water should contain particles no larger than 0.20 micrometer (μm).


Anhydrous Potassium Carbonate (K_2CO_3) granular CAS#584-08-7

Glycerol, American Chemical Society (ACS) reagent or better grade CAS# 56-81-5 with Certificate of Analysis (see Figure 3)

Figure 2. Cellulose Filter Impregnation Apparatus



Figure 3. Glycerol Certificate of Analysis

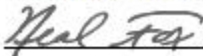


Certificate of Analysis


Product: BDH Glycerol
Cat: BDH1172-1LP
Lot: 021610G
Date of Manufacture: 02/17/10
Use Before: 08/18/11

<u>Test</u>	<u>Specification</u>		<u>Result</u>	<u>Units</u>
	<u>Min.</u>	<u>Max.</u>		
Appearance	Clear		Clear	
Identification	Passes test		Passes test	
Water		0.3	0.048	%
Residue after Ignition		0.01	<0.01	%
Assay	99.7		99.9	%
Color (APHA)		20	<20	
Specific Gravity (25°C/25°C)	1.2613		1.2616	
Chlorides		10	<10	ppm
Sulfates		20	<20	ppm
Heavy Metals (as Pb)		5	<5	ppm
Chlorinated Compounds		30	<30	ppm
Fatty Acids and Esters	Passes test		Passes test	

Quality Control Approval



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INTEGRATION

5.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Materials Safety Data Sheets (MSDS) must be consulted. The MSDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

6.0 PROCEDURE

6.1 Filter Impregnation Solution

- 6.1.1 Add 300 – 500 mL DI water to a 2-L volumetric flask.
- 6.1.2 Weigh 250 grams (g) of K_2CO_3 into a weighing boat. Quantitatively transfer the K_2CO_3 to the volumetric flask and swirl to dissolve. Vent the stopper on the flask frequently since some effervescence will occur.
- 6.1.3 Repeat step 6.1.2 (for a total of 500 g of K_2CO_3 in the flask).
- 6.1.4 Measure 100 mL of glycerol and then carefully pour the glycerol into the flask. Cap and shake the solution carefully to ensure thorough mixing, being sure to vent the flask often during this process.
- 6.1.5 Bring up to volume with DI water. Cap securely and invert at least 10 times to ensure thorough mixing, being sure to vent the flask periodically.

6.2 Filter Rinse Solution

- 6.2.1 Weigh 28 g of K_2CO_3 into a weighing boat.
- 6.2.2 Add 300-500 mL DI water to a 2-L volumetric flask. Quantitatively transfer the K_2CO_3 to the volumetric flask and swirl to dissolve. Vent the stopper on the flask periodically since some effervescence will occur.
- 6.2.3 Cap and shake the solution carefully to ensure thorough mixing, being sure to vent the flask often during this process.
- 6.2.4 Bring up to volume with DI water. Cap securely and invert at least 10 times to ensure thorough mixing. Vent periodically.

6.3 Impregnation Procedure

- 6.3.1 Pre-wet one box of cellulose filters (approximately 100 filters) under a stream of DI water. Use plastic forceps (see Figure 4).

Figure 4. Rinsing Filters



6.3.2 Wearing powder-free plastic gloves, place one box of filters (approximately 100 filters) in a small Buchner funnel inserted into the vacuum flask. Using vacuum aspiration, rinse the filters with approximately 1000 mL of DI water (see Figure 5).

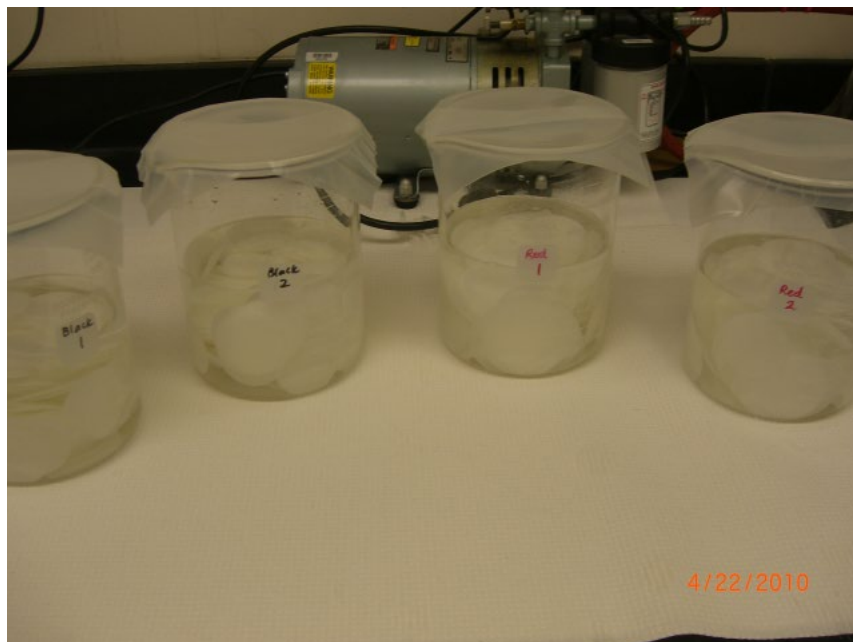
Note: A wash bottle works well (contains 500 mL) and allows the analyst to direct the water stream around and between the filters. Proper washing is required to remove potential sulfate and nitrate contamination.

Figure 5. Buchner Funnel Rinse



- 6.3.3 Aspirate filters to near dryness.
- 6.3.4 Rinse the filters with approximately 500 mL of the Filter Rinse solution. Aspirate to near dryness.
- 6.3.5 Carefully transfer filters into a 2-L beaker. Cover with Parafilm.
- 6.3.6 Repeat this procedure with another set of 100 filters until a total of 200 filters are in the 2-L beaker. Use another 2-L beaker for the remaining 200 filters.
- 6.3.7 Fill a 60-mL Nalgene bottle with approximately 50 mL of the Impregnation Solution before proceeding.
- 6.3.8 Carefully divide the impregnation solution between the two large 2-L beakers (see Figure 6). Swirl the filters gently in the solution and the cover the beaker with Parafilm.

Figure 6. Filters Soaking in Beakers



- 6.3.9 Allow the filters to soak in the solution for at least for 30 minutes, swirling the filters in the solution at least two more times.
- 6.3.10 Rinse the glass drying trays with copious amounts of DI water using gloved hands to rub the surfaces clean. Sit the trays out to dry on the absorbent paper. Blot excess water from trays using KimWipes.
- 6.3.11 Preheat the drying oven to 70 degrees Celsius (°C).
- 6.3.12 Fill out information required in the Impregnation notebook (see Attachment A).
- 6.3.13 After the filters have soaked for the appropriate amount of time, drain off most of the Impregnation Solution into the appropriately marked waste receptacle. With clean plastic forceps, carefully remove the filters a few at a time and place in 16 small stacks per clean glass tray (approximately 25 per stack). Work quickly to prevent contamination (see Figure 7).

Figure 7. Filters Stacked and Drying



- 6.3.14 **Place** the trays in the oven for two hours to dry, checking on the filters periodically.
- 6.3.15 **Remove** the trays from the oven. Continue working quickly to prevent contamination.
- 6.3.16 **Eight** acceptance test samples are prepared for each impregnation group. Each sample consists of two filters. The necessary labels are kept in the extraction area.
- Label the appropriate number of 60-mL Nalgene bottles with preprinted sample labels: 9 bottles total per Impregnation group (8 bottles for filters and one empty bottle to test 1 mL of the Impregnation Solution).
 - Label a resealable plastic bag and the reserved bottle of impregnation fluid with impregnation labels (see Attachment B).
 - Discard the top two filters of each stack. Place one filter from the middle of each stack into the bottles, two filters per bottle. The middle filters of two stacks comprise one sample. Place the remaining filters from each stack, discarding the two bottom filters, in the resealable plastic bag.
 - After all filters are bagged and bottled, place the acceptance test samples, the bagged filters, and the reserved impregnation fluid in the extraction area to be tested.
 - Submit the date of impregnation and the sample names of the acceptance tests to data services via e-mail for sample log-in.

6.3.17 **Rinse** all used equipment with DI water and return to designated storage area.

6.4 Corrective actions

Cellulose filters are acceptance tested after the impregnation procedure. Between 400 and 800 filters are prepared at one time. The filters are assigned to an impregnation group of 400 filters that is uniquely associated both with the impregnation date and a group of acceptance test samples. Each impregnation group is isolated throughout the entire impregnation procedure and is stored separately before use. Acceptance testing is performed on 4 percent of the filters contained in each impregnation group. The acceptance test samples are prepared with two cellulose filters per sample and are extracted and analyzed according to normal procedures. Acceptance test results for an impregnation group are considered satisfactory if no more than one sample in the group shows sulfate contamination above 3.83 micrograms (μg) (equivalent to an approximate ambient concentration of 0.17 μg per cubic meter [$\mu\text{g}/\text{m}^3$] as SO_2). All cellulose filter acceptance test results are stored in Element. The impregnation group used for each filter pack is referenced in the filter pack preparation logbook. If the analytical results fail the acceptance limits, the batch is discarded.

7.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April.

8.0 ATTACHMENTS


Attachment A – Potassium Carbonate Filter Impregnation Log

Attachment B – Impregnation Label

Attachment C – Revisions Table

ATTACHMENT A

Potassium Carbonate Filter Impregnation Log



Potassium Carbonate Filter Impregnation Log

Date: _____
Analyst: _____

K₂CO₃ CAS# 584-08-7 Group A Lot: _____
Group B Lot: _____
Glycerol CAS# 56-81-5 Lot: _____

<div>Filter Lot#</div> <div>No. Filters</div>		<div>Filter Lot#</div> <div>No. Filters</div>
Group A: _____		Group B: _____
_____		_____
_____		_____
_____		_____
WAT IDs: _____		WAT IDs: _____
WSOL IDs: _____		WSOL IDs: _____

Soaking
Start Time: _____ End time: _____
Comments: _____

Drying Oven Temp (°C): _____
Start Time: _____ End time: _____

Date: _____
Analyst: _____

K₂CO₃ CAS# 584-08-7 Group A Lot: _____
Group B Lot: _____
Glycerol CAS# 56-81-5 Lot: _____

<div>Filter Lot#</div> <div>No. Filters</div>		<div>Filter Lot#</div> <div>No. Filters</div>
Group A: _____		Group B: _____
_____		_____
_____		_____
_____		_____
WAT IDs: _____		WAT IDs: _____
WSOL IDs: _____		WSOL IDs: _____

Soaking
Start Time: _____ End time: _____
Comments: _____

Drying Oven Temp (°C): _____
Start Time: _____ End time: _____

B – 1928

Page 0050

ATTACHMENT B Impregnation Label

TYPE:	<u>Wintmar - A</u>
DATE:	<u>4/23/10</u>
NUMBER:	<u>1025007 (1-8, 17)</u>
PREP BY:	<u>KWB</u>

This is a copy of a recent actual label. Red and black marks are used to differentiate between the impregnation groups when more than one group is prepared on a given day. (This label is for the black group for that day.)



1025007 (1-8) Refers to the range of Element identification (ID) numbers of the filter acceptance test samples for these filters.

1025007-17 Refers to the Element IDs of the impregnation fluid acceptance test sample for these filters. This sample is prepared in the same manner as the Method Blank for cellulose filters (GLM-3180-001).

ATTACHMENT C

Revisions Table

Table – Revisions

Document Revision No.	Section	Revision
6.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	7.0	Update references
	Attachment C	Addition of this table.
7.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
7.1	Attachment A	Updated
8.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	6.3.16	Updated to 1 mL of impregnation solution for acceptance tests, consistent with GLM-3180-001.
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
9.0	All	Update company name to WSP and apply Arial font formatting
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
10.0	All	Update company name to WSP USA Inc.

TITLE: COATING AND EXTRACTION OF AMBIENT AIR DENUDER TUBES

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations Manager

Topie, Nathaniel
(USNT719661)

Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.25 12:13:07 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager



Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 17:11:08
-05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Safety
- 6.0 Procedure
- 7.0 References
- 8.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

COATING AND EXTRACTION OF AMBIENT AIR DENUDER TUBES

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) personnel for the coating and extraction of denuder tubes used in ambient air collection.

2.0 SCOPE

This SOP applies to all denuders that are prepared for the CASTNET and CASTNET-like ambient air projects.

3.0 SUMMARY OF METHOD

A general overview of the steps described in this SOP for coating denuders is depicted Figure 1. Figure 2 depicts an overview of the extraction steps. Deviations from the analytical method described in this SOP are not permitted.

Figure 1. Overview – Laboratory Operations Procedures for Coating Denuder Tubes

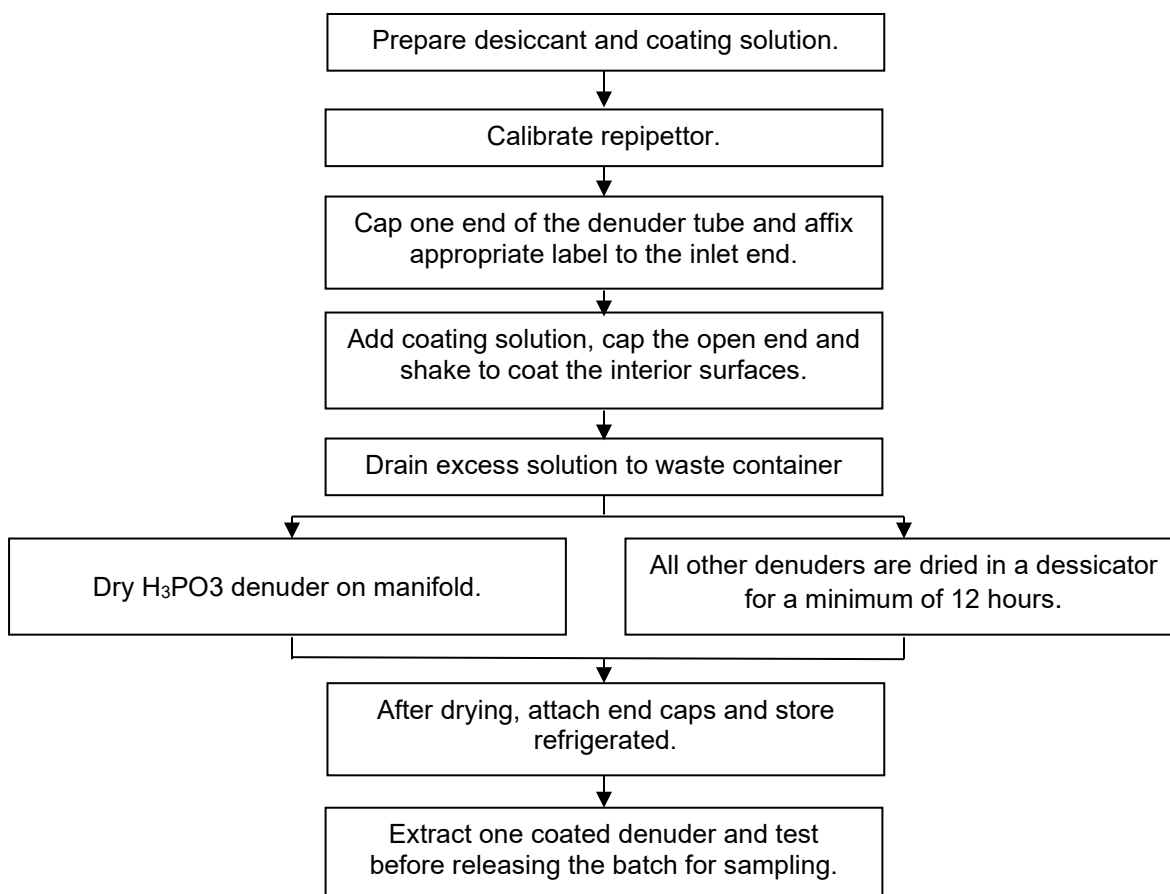
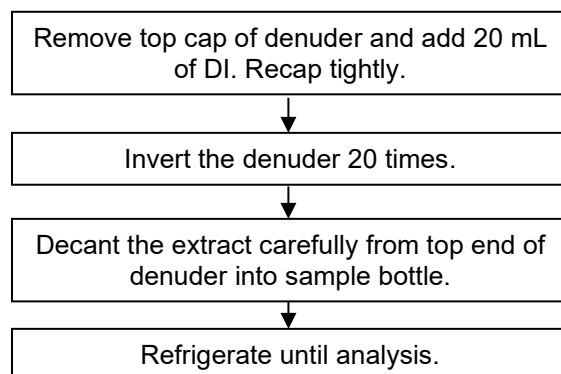


Figure 2. Overview – Laboratory Operations Procedures for Extracting Exposed Denuder Tubes



4.0 MATERIALS

4.1 Apparatus

Desiccator
Coating labels for tubes
Repipettors
Powder-free gloves
Desiccant
Pre-cleaned denuders
Large metal trays
Drying oven
Class A volumetric flasks, 1000 mL
Nitrogen cylinder
Nalgene extract bottles, 30 mL

4.2 Reagents

- Reagent Water: Deionized (DI) water of resistivity of 15 mega Ohms ($M\Omega$) or greater, derived from mixed bed ion exchangers, activated carbon filters and polishing exchangers. Water should contain particles no larger than 0.20 micrometers.
- Methanol (MeOH), ACS reagent grade or better, CAS # 67-56-1.
- Glycerol, ACS reagent grade or better, CAS # 56-81-5.
- Citric Acid, ACS reagent grade or better, CAS # 5949-29-1.
- Sodium Carbonate(Na_2CO_3), ACS reagent grade or better, CAS # 497-19-8
- Potassium Chloride(KCl), ACS reagent grade or better, CAS # 7447-40-7
- Phosphorus Acid (H_3PO_3), ACS reagent grade or better, CAS #13598-36-2
- Citric Acid Coating Solution (1 percent): Dissolve 10 g of citric acid in 900 mL of MeOH in a 1000 mL volumetric flask. Dilute to volume with DI.

- Sodium Carbonate Coating Solution (1 percent): Dissolve 10 g of Na_2CO_3 and 10 g of glycerol in 500 mL of DI in a 1000mL volumetric flask. Dilute to volume with MeOH.
- Potassium Chloride Coating Solution (1 percent): Dissolve 10 g of KCl in 500 ml of DI in a 1000 mL volumetric flask. Dilute to volume with MeOH.
- Phosphorus Acid Coating Solution (1 percent): Dissolve 10 g of H_3PO_3 in 500 mL of MeOH in a 1000 mL volumetric flask. Add another 400 mL of MeOH and dilute to volume with DI.

5.0 SAFETY

The analyst must be aware of the hazards associated with the chemicals used in this method. Reducing the possibility of accidental absorption or ingestion minimizes the hazards. Eating and drinking are not permitted in areas where chemicals are used or stored. Laboratory coats, gloves, and safety glasses must be worn at all times when handling these chemicals. If the analyst is not familiar with the hazards associated with the chemicals being used, the Safety Data Sheets (SDS) must be consulted. The SDS by chemical and brand can be found in the WSP laboratory or at the Web sites <http://www.msdssearch.com> or <http://www.hazard.com/msds/index.php> using the CAS number.

6.0 PROCEDURE

6.1 Denuder Coating

- 6.1.1 Prepare the desiccant by drying it 2-4 hours or until dry at 105 degrees Celsius ($^{\circ}\text{C}$). Pour the dried desiccant into the metal trays and place in the desiccator.
- 6.1.2 Obtain the appropriate coating solution. Coating solutions are made in the laboratory and are given to the CASTNET technician responsible for coating the denuders.
- 6.1.3 Calibrate the repipettors (see Figure 3) prior to each day's use by determining the mass of deionized water delivered. Adjust the repipettor to deliver 10.0 ± 0.5 g.

Figure 3. Repipettors



- 6.1.4 Securely cap the bottom of the denuder tube. The quartz inner tube is recessed approximately one inch on the top end (inlet side) of the denuder. On the bottom (outlet) of the denuder, the inner quartz tube is recessed about $\frac{1}{8}$ inch from the end of the aluminum tube (see Figure 4 and 5).

Figure 4. Denuder top (inlet)



Figure 5. Denuder bottom (outlet)



- 6.1.5 Affix a denuder coating identification label to the outside of the denuder tube at the inlet end (see Figure 6). Labels are color-coded to aid in identification: citric acid – yellow, sodium carbonate – green, potassium chloride – orange, phosphorous acid – red.

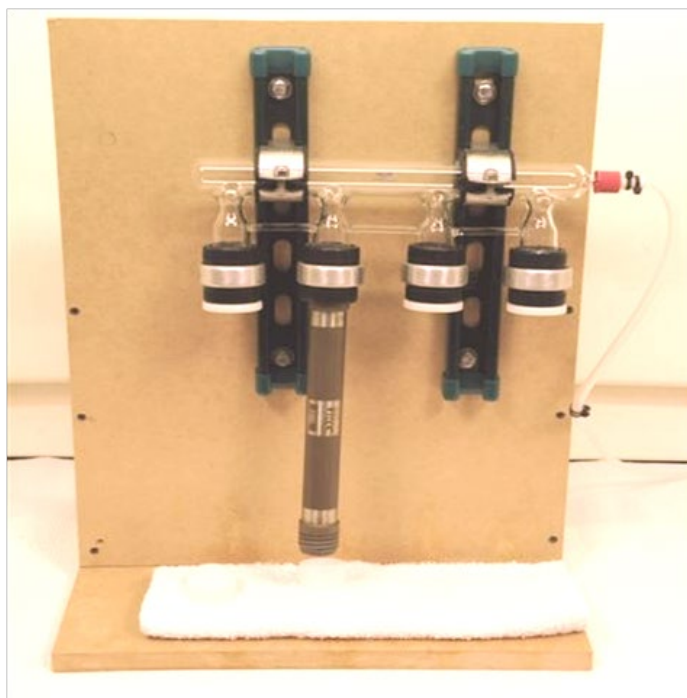
Figure 6. Denuder tubes with labels



- 6.1.6 Using the repipettor, deliver 10 mL of the coating solution directly into the top of the denuder tube. Securely cap the open end of the denuder. Invert the denuder 20 times, alternately using a figure eight motion and vertical shaking to thoroughly coat the interior surfaces of the denuder.

- 6.1.7 Carefully open both ends of the denuder and drain the excess solution out into an appropriate waste container. **Note: never dispose of coating solutions (or any chemicals) in laboratory sinks.**
- 6.1.8 Phosphorous acid denuders are screwed securely into the URG drying manifold so that the direction of flow is downward (see Figure 7). Dry for approximately 20 minutes with a 5 liter per minute nitrogen purge. The “honeycomb” quartz inside the URG denuder will cloud when dry.

Figure 7. URG Drying Manifold.



- 6.1.9 Citric acid, carbonate and potassium chloride denuders and end caps are placed inside the assigned desiccator to dry for a minimum of 12 hours (see Figure 8).

Figure 8. Dessicator



6.1.10 Once dry, attach the end caps and refrigerate until shipment.

6.1.11 For each coating batch, one denuder will be extracted following the procedure outlined in section 6.2. The results must be less than or equal to two times the reporting limit for the batch to be used.

6.1.12 Prior to shipment, a color coded Lab sample identification label will be attached to the denuder.

6.2 Extracting Exposed Denuders.

6.2.1 Ensure the bottom cap of the denuder is attached firmly and remove the top cap.

6.2.2 Using a repipettor, add 20 mL of DI water into the denuder and cap tightly. Invert the denuder 20 times.

6.2.3 Tap the top cap a couple of times. Unscrew the top cap and set aside.

6.2.4 Decant the extract carefully from top end of the denuder into the sample extract bottle.

6.2.5 Remove the color coded Lab sample identification label from the denuder and attach it to the sample extract bottle.

6.2.6 Refrigerate until analysis.

7.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-0//001, EPA QA/G-6, US EPA, Washington, D.C. April.


8.0 ATTACHMENTS

Attachment A – Revisions Table

ATTACHMENT A

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
5.0	Signature page	Remove Garry Price and add Katherine Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	5.0	Update Materials Safety Data Sheets to Safety Data Sheets
	7.0	Update references
	Attachment A	Addition of this table.
6.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
7.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
7.1	All	Update company name to WSP and apply Arial font formatting
8.0	All	Update company name to WSP USA Inc.

**TITLE: CLEAN AIR STATUS AND TRENDS NETWORK (CASTNET) THREE-STAGE
AMBIENT AIR FILTER PACK RECEIPT, DISASSEMBLY AND LOGIN**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie

Laboratory Operations Manager

Topie, Nathaniel
(USNT719661)

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(USNT719661)
Date: 2025.02.25 12:20:20 -05'00'

Reviewed by: Marcus O. Stewart

QA Manager



Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 17:13:31
-05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
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- 6.0 References
- 7.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

CLEAN AIR STATUS AND TRENDS NETWORK (CASTNET) THREE-STAGE AMBIENT AIR FILTER PACK RECEIPT, DISASSEMBLY AND LOGIN

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for receiving and unpacking the three-stage filter packs, and logging the samples into the Laboratory Information Management System (LIMS).

2.0 SCOPE

This SOP applies to all filter packs that are prepared for the CASTNET and CASTNET-like ambient air projects.

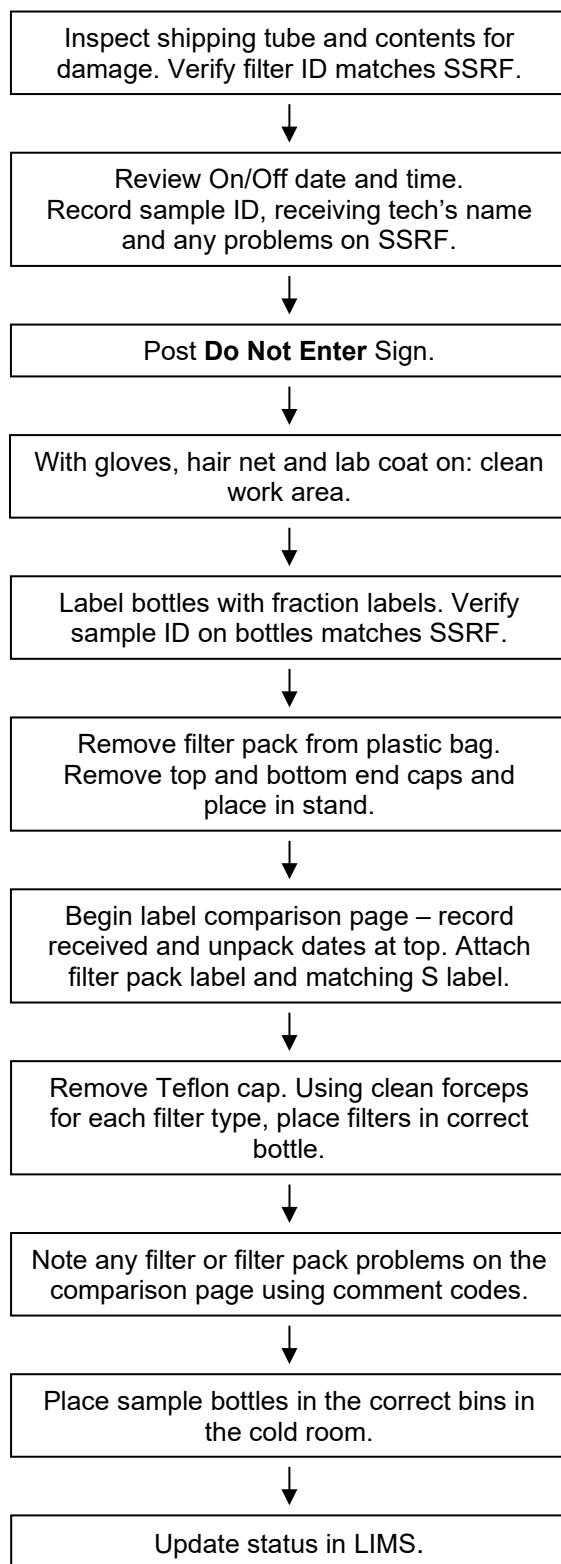
3.0 SUMMARY OF METHOD

A general overview of the steps described in this SOP is depicted Figure 1. Deviations from the analytical method described in this SOP are not permitted.

4.0 MATERIALS

- Powder-free disposable nitrile gloves
- Hair net
- Laboratory coat
- Clean forceps
- Clean high-density polyethylene (HDPE) bottles (30 mL, 60 mL)
- Large plastic trays
- Filter packing/unpacking stand
- Filter pack wrench
- Kimwipes
- Field group folder with fraction labels (see Attachment A):
 - S - Sample Log-in, white label
 - T - Teflon filter, white label
 - N - Nylon filter, orange label
 - W – Cellulose (K_2CO_3 impregnated) filter, blue label
- Filter packing notebook
- Site Status Report Form (SSRF)

Figure 1. Overview – Laboratory Operations Procedures for Filter Pack Disassembly



5.0 PROCEDURE

5.1 Receipt, Initial Inspection, and Assignment of Sample Number to CASTNET Filter Packs

- 5.1.1 The filter pack shipping tubes are received at the designated WSP shipping/receiving area. The tubes are normally shipped to WSP by the U.S. Postal Service using Priority Mail Return Labels. Other shipping providers are acceptable.
- 5.1.2 The filter pack shipping tubes are then delivered by the WSP shipping/receiving technician directly to the CASTNET filter pack receiving area and are placed into the custody of the CASTNET filter pack technician.
- 5.1.3 Examine the shipping container for damage from shipping and note any variances in the filter-packing notebook.
- 5.1.4 Place the “Do Not Enter” sign on the door to the receiving area (see Fig 4). Open the shipping tube and remove the filter pack and Site Status Report Form (SSRF) (see Figure 2). Verify that the filter identification (ID) number on the filter pack agrees with the filter ID number stated on the chain of custody label on the SSRF. The site number listed on the chain of custody label is also verified with the site number entered by the site operator in the top left corner of the form. If these are not in agreement or not completed, note it in the shaded Comments area of the form (see Figure 3).

Figure 2. Shipping tubes and filter pack.



5.1.5 Initial and date the SSRF form in the shaded box labeled “Lab Use Only” (see Figure 3).

Figure 3 SSRF

CASTNET SITE STATUS REPORT FORM (SSRF)				
SITE NAME / NO.: RED 1004		FILTER PACK INFO (ACTUAL FILTER PACK SAMPLED)		SITE OBSERVATIONS AT FILTER INSTALLATION
VISIT DATE / DAY OF THE WEEK: 8-7-18, Tues.		FILTER PACK ID# 1831004-05		CIRCLE IF PRESENT: DEW FROST SNOW FOG RAIN
FIELD OPERATIONS COORDINATOR CALLED: (name) Herdi		DATE FILTER ON 7/31/18	DATE FILTER OFF 8/7/18	WHAT % OF LEAVES: 0-25% 26-50% 51-75% 76-100%
OZONE MONITORING SITES ONLY		TIME (24 HR) 0833	1238	HAVE DROPPED <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
OZONE CHECKS (FOR FILTER ON DATE)		DATA LOGGER FLOW (FLOW RATE) 2999	3017	HAVE FALL COLOR <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
A B		ROTAMETER (WEARIST 0.05 LPM) 3.00	3.00	ARE GREEN <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
NOISE <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		MFC DISPLAY (PUMP ON) 2958	2958	CURRENT 5-MINUTE AVERAGES
LEAK CHECK <250 mmHg <input type="checkbox"/> <input type="checkbox"/>		MFC (PUMP OFF) 0900	0900	9-m TEMPERATURE (°C) (TEMP. AVG.) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
OUTSIDE FILTER CHANGE <input type="checkbox"/> <input type="checkbox"/>		MFC LEAK CHECK 0003	0003	BLOWER WORKING? Y N N/A
WATER IN LINE / TRAP <input type="checkbox"/> <input type="checkbox"/>		ELAPSED TIME (IF APPLICABLE) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	METEOROLOGICAL MONITORING SITES ONLY
DESICCANT CHANGED (1ST CANISTER) <input type="checkbox"/> <input type="checkbox"/>		RETURN SHIPMENT PREPARED BY: <i>J. Malinski</i> (SIGNATURE)	Malinski (PRINT LAST NAME)	DELTA TEMP (°C) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
DESICCANT CHANGED (2ND CANISTER) <input type="checkbox"/> <input type="checkbox"/>		LAB USE ONLY	1831004-05 RED004	BLOWER WORKING? Y N N/A
SHELTER TEMPERATURE (°C) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		LAB SAMPLE NO.: 725	18/10/18 DATE	RAINFALL (INCHES) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
SITE OPERATOR NOTES: (Barring, dust, site activities like mowing, use of fertilizer, herbicides and pesticides, filter pack run out of sequence, etc.)		LAB TECH RECEIPT	725	CLEAN & LEVEL <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
		LAB COMMENTS:		TIP CHECK <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				WIND DIRECTION (°) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				WIND SPEED (m/s) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				RELATIVE HUMIDITY (%) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				SOLAR RAD (w/m²) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				CLEAN & LEVEL <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				WETNESS SENSOR <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				CLEAN & LEVEL <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				TEST RESPONSE <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				AMEC Call-In Number: 888-224-5663
WEEK 31 2018		Filter Pack ID #: 1831004-05	Site: RED004	
		Scheduled On Date: 07/31/2018		
		SHIPMENT OPENED BY: J. Malinski	DATE: 7-23-18	
		PACKED BY: 2328		

WHITE COPY: in tube with filter pack
WHITE COPY and logbook page: in tube with filter pack
PINK COPY: site operator's notebook

5.1.6 Review the filter pack On/Off Date and Time, for completeness and correctness. If these data are incomplete or inconsistencies exist, note it on the form and initial and date. If there are extensive problems with the SSRF, notify the Project Manager.

5.1.7 Assign the WSP sample number according to the recorded filter On Date. Each Tuesday is assigned a CASTNET sample week number. The On Date on the SSRF corresponds to a sample week number on the CASTNET calendar. This sample week number is used to determine the correct field group folder to use.

The field group setup follows this example:

XXYY001-Z, Where: XX = year,
YY = week number, and
Z = assigned number for each site.

The last digit "1" denotes the Element project. This number represents the CASTNET base program

Clearly write the WSP sample number in the shaded box labeled “Lab Use Only” on the SSRF.

5.2 Unpacking Procedure:

- 5.2.1 Prior to unpacking, post the Do Not Enter sign on the disassembly room door (see Figure 4).

Figure 4. Do Not Enter Sign



- 5.2.2 Powder-free gloves, hair nets and lab coats must be worn when performing this procedure. Gloves must be changed after any potential contamination has occurred (touching anything other than the filter pack, forceps, labels, pen and bottles).
- 5.2.3 Clean the work area, pens to be used and packing/unpacking stand with Kimwipes. Items needed in the work area for unpacking are as follows: a bag of clean forceps; 30 and 60 mL bottles; Teflon, nylon, and K_2CO_3 -impregnated cellulose fraction and sample tracking labels (T, N, W, S labels); a large plastic tub; and paper for the label comparison sheet.
- 5.2.4 Label the bottles with the preprinted computer fraction labels. Attach the blue W fraction label to the 60 mL bottle. The other fraction labels are for the 30 mL bottles. Verify that the sample numbers on the bottles match the sample number recorded on the SSRF form.
- 5.2.5 Remove the filter pack from the resealable plastic bag, and remove the top and bottom end caps.
- 5.2.6 Begin the label comparison page by removing the Filter Pack ID label from the filter pack and attaching it to one side of a sheet of paper. Next to the Filter Pack ID label, attach

the corresponding S label. The S label should agree with the sample fraction labels attached to the small sample bottles in Step 5.2.4. Record the received date and the unpacking date at the top of the label comparison page (see Figure 5).

Figure 5. Label Comparison Page

7/13/18

1827001-02	S	SITE: ALH157	Filter pack SITE: ALH157 Sampled: 07/03/18	T4, W3
1827001-12	S	SITE: CDR119	Filter pack SITE: CDR119 Sampled: 07/03/18	T4, W3
1827001-13	S	SITE: CKT136	Filter pack SITE: CKT136 Sampled: 07/03/18	T4, W3
1827001-16	S	SITE: COW137	Filter pack SITE: COW137 Sampled: 07/03/18	T4, W3
1827001-20	S	SITE: DUK008	Filter pack SITE: DUK008 Sampled: 07/03/18	W3
1827001-23	S	SITE: GAS153	Filter pack SITE: GAS153 Sampled: 07/03/18	T4, W3
1827001-24	S	SITE: GTH161	Filter pack SITE: GTH161 Sampled: 07/03/18	T4, T4
1827001-28	S	SITE: IRL141	Filter pack SITE: IRL141 Sampled: 07/03/18	T4, W3
1827001-31	S	SITE: LRL117	Filter pack SITE: LRL117 Sampled: 07/03/18	over T4, W3
1827001-33	S	SITE: MCK231	Filter pack SITE: MCK231 Sampled: 07/03/18	T4, W3 Rw 7/17/18

5.2.7 Put the gray collar on the packing/unpacking stand (see Figure 6). Loosen the filter pack with the green vinyl packing wrench. Remove the clear Teflon cap, and place it in the plastic tub to be washed later. Be careful not to let the filter stick to the Teflon cap during removal.

Figure 6. Unpacking Stand



- 5.2.8 Using clean forceps for each filter type and each sample, remove the filters one at a time. The first filter removed is the Teflon filter; it is placed in the white T fraction label bottle. The second filter removed is the nylon filter; it is placed in the orange-label N fraction bottle. The last two filters are the cellulose filters, both filters are placed in one bottle with a blue W fraction label.
- 5.2.9 During the unpacking process, observe the filters for possible filter, or filter pack problems. Possible problems include the following: torn/ripped filters, excessively dirty filters, extremely wet filters, raised grids, bugs or anything else that is not normally observed. Record on the label comparison page any observations noted, using the CASTNET Comment Codes (Attachment B) as a guide.
- 5.2.10 Place all filter parts and used forceps in a pan to be washed.
- 5.2.11 Put caps securely on the bottles and place samples in the appropriate sample box in the cold room.
- 5.2.12 After the unpacking is completed, the Label Comparison page and SSRF are given to the sample log-in technician.

5.3 Sample Log In:

- 5.3.1 Scanning arriving samples into Element (LIMS).

- 5.3.1.1 Select **Sample Control**, select **Custody**
- 5.3.1.2 Click on **Container ID**, hit spacebar to clear
- 5.3.1.3 Begin scanning barcode **S** labels of sample arrivals
- 5.3.1.4 When finished scanning last sample of each received date, right-click, **Select All**, right-click, select **Edit Internal Custody**; pick from the drop-down the **Custody Date**, from the drop-down change **Disposition** to **Available (In)**, pick from the drop-down initials of who **Checked In/Out**, click **Apply**.
- 5.3.1.5 Right-click, select **Update Pending. Status** of the samples will change to **Received**.
- 5.3.2 Update Work Order
 - 5.3.2.1 Select Sample Control then Samples.
 - 5.3.2.2 The work order that was logged in will appear under Work Order. Using the Label Comparison page, select the sample to be updated.
 - 5.3.2.3 Click Edit at the bottom of the screen.
 - 5.3.2.4 On the Sample tab in the upper right hand corner of the screen, check the sampled date (see Figure 7). If different than the actual sampled date, use the drop down to access the calendar and select the correct date.

Figure 7. Sample Tab

Sample Information Containers Qualifiers

Name: ABT147

Aliases:

Regulatory ID:

Comments:

QC Source: ☐ Cross-Table

Field Data: Sample Details Location Well Data

Lab Matrix: Filter [v] Sampled [Eastern] [07/03/18 00:00]

Report Matrix: Filter [v] Sampled Begin [07/03/18 00:00]

Sample Type: Field Sample Sampled By: Environmental Prote

Work Analyses

Analysis	Subanalysis	Comments	TAT	Due	Hold
DD03+CL			35	08/21/18 00:00	35
DD03+CL	CALCIUM, TEFLON	T4	35	08/21/18 00:00	35/35
DD03+CL	CHLORIDE, TEFLON	T4	35	08/21/18 00:00	35/35
DD03+CL	MAGNESIUM, TEFLON	T4	35	08/21/18 00:00	35/35
DD03+CL	NH3+NH4 as N, TEFLON	T4	35	08/21/18 00:00	35/35
DD03+CL	NO3 AS N, NYLON		35	08/21/18 00:00	35/35
DD03+CL	NO3 AS N, TEFLON	T4	35	08/21/18 00:00	35/35
DD03+CL	POTASSIUM, TEFLON	T4	35	08/21/18 00:00	35/35
DD03+CL	SO4-NYL		35	08/21/18 00:00	35/35
DD03+CL	SO4-TEF	T4	35	08/21/18 00:00	35/35
DD03+CL	SO4-WHT		35	08/21/18 00:00	35/35

Add Save Copy Delete Group Edit Field Data << Work Orders Cancel

- 5.3.2.5 Go to the Details tab and check the sample Logged In date (see Figure 8). Update using the drop down calendar.

Figure 8. Details Tab

Field Data	Field Info	Field Info	Memos
Sample	Details	Location	Well Data
Received Date: 07/12/18 00:00 By: RWWyrosdick			
Logged In Date: 07/13/18 09:40 By: Richard Humes			
Field Tested Date: 07/03/18 00:00 By: Environmental Prote			

Figure 9. Comments Menu

Sample	Analysis	Subanalysis	Comments	TAT	Due	Hold	Subcontract	Status	Price
0003+CL	CALCIUM, TEFLON	T4		35	08/21/18 00:00	35		Reported	\$179.00
0003+CL	CHLORIDE, TEF...	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	MAGNESIUM, TEF...	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	NITROGEN, TEFLON	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	NITROGEN, NYLON	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	POTASSIUM, TEF...	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	SODIUM, TEF...	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	SODIUM, TEF...	T4		35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	SODIUM, TEF...	T4		35	08/21/18 00:00	35/35		Reported	\$16.18

- 5.3.2.6 Check Received By and update by using the drop down and selecting the correct name.
- 5.3.2.7 Check Sample Logged In by and update by using the drop down and selecting the correct name.
- 5.3.2.8 If the filter pack off-date is different than expected (7 days from the expected on-date), click the Field Info tab and enter a comment with the off-date (e.g., Off 7/11/18).
- 5.3.2.9 For each succeeding sample, highlight and roll the center of the mouse to enter the correct information.
- 5.3.2.10 To enter filter pack comment codes, select the filter type and hold down the CTRL key until all have been highlighted. Right-click and select **Comment** from the list (see Figure 9). "Analysis Properties" pop-up will appear (see Figure 10). Type in the correct code(s) from the Label Comparison page and click Apply then Save.

Figure 10. Analysis Properties

Analysis	Subanalysis	Comments	TAT	Due	Hold	Subcontract	Status	Price
0003+CL	CALCIUM, TEFLON	T4	35	08/21/18 00:00	35		Reported	\$179.00
0003+CL	CHLORIDE, TEFLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	MAGNESIUM, TEFLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	NITROGEN, TEFLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	NITROGEN, NYLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	POTASSIUM, TEFLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	SODIUM, TEFLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18
0003+CL	SODIUM, TEFLON	T4	35	08/21/18 00:00	35/35		Reported	\$16.18

- 5.3.3 When all samples have been updated, select **Done**.
- 5.3.4 Print Custody Log.
 - 5.3.4.1 Under the **Print** tab, select **Custody Log**.
 - 5.3.4.2 Print the Internal Chains of Custody (see Figure 11) for samples just entered using **ico_AMEC.rpt**.
- 5.3.5 The Label Comparison page is stored with the field group folder in the filter pack prep area.

Figure 11. Internal Chain of Custody

Amec Foster Wheeler		1827001	
Work Order Receipt Report			
Client:	Environmental Protection Agency 2018 (C5)	Received:	07/13/18 14:09:21
Project:	CNET V EPA Base 2018	Logged In By:	RAH
Number:	6064160003.0014	Temp (°C):	
			Printed: 8/8/2018 7:08:02AM
1827001-01 (ABT147) Sampled 07/03/18 00:00:00			
1827001-01 A [Filter Pack]		Received Date	
6064		07/13/18 14:09:23 by RAH	
1827001-02 (ALH157) Sampled 07/03/18 00:00:00			
1827001-02 A [Filter Pack]		Received Date	
6064		07/17/18 08:40:47 by RAH	
1827001-03 (ANA115) Sampled 07/03/18 00:00:00			
1827001-03 A [Filter Pack]		Received Date	
6064		07/24/18 08:27:43 by RAH	
1827001-04 (ARE128) Sampled 07/03/18 00:00:00			
1827001-04 A [Filter Pack]		Received Date	
6064		07/17/18 08:41:50 by RAH	
1827001-05 (ASH135) Sampled 07/03/18 00:00:00			
1827001-05 A [Filter Pack]		Received Date	
6064		07/17/18 08:41:50 by RAH	
1827001-06 (BEL116) Sampled 07/03/18 00:00:00			
1827001-06 A [Filter Pack]		Received Date	
6064		07/17/18 08:41:50 by RAH	
1827001-07 (BFT142) Sampled 07/03/18 00:00:00			
1827001-07 A [Filter Pack]		Received Date	
6064		07/13/18 14:09:23 by RAH	
1827001-08 (BVL130) Sampled 07/03/18 00:00:00			
1827001-08 A [Filter Pack]		Received Date	
6064		07/17/18 08:41:50 by RAH	
1827001-09 (BWR139) Sampled 07/03/18 00:00:00			
1827001-09 A [Filter Pack]		Received Date	
6064		01/01/80 00:00:00 by	
1827001-10 (CAD150) Sampled 07/03/18 00:00:00			
1827001-10 A [Filter Pack]		Received Date	
6064		07/13/18 14:09:23 by RAH	
1827001-11 (CAT175) Sampled 07/03/18 00:00:00			
1827001-11 A [Filter Pack]		Received Date	
6064		07/17/18 08:41:50 by RAH	
1827001-12 (CDR119) Sampled 07/03/18 00:00:00			

Page 1 of 6

6.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) For Quality-Related Documents. EPA/600/B-0//001, EPA QA/G-6, US EPA, Washington, D.C. April.

WSP USA Environment & Infrastructure Inc. (WSP) formerly known as Wood Environment & Infrastructure Solutions, Inc. 2022. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.5*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC.

7.0 ATTACHMENTS

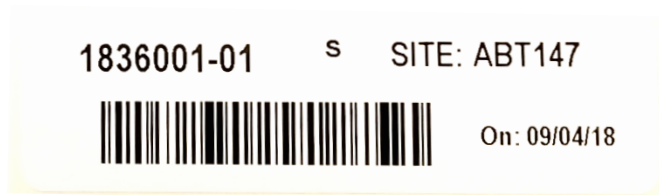
Attachment A – Labels

Attachment B – CASTNET Filter Pack Comment Codes

Attachment C – Revisions Table

ATTACHMENT A Labels

S Label



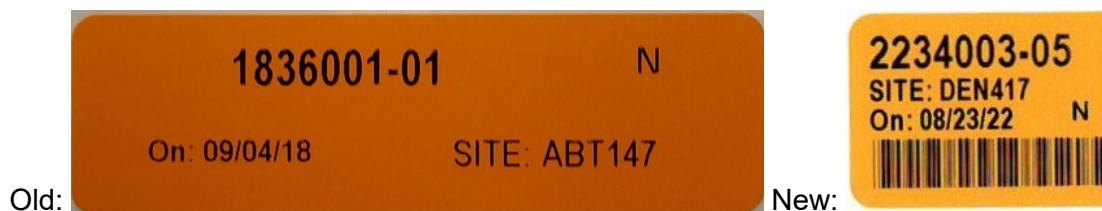
Filter Pack Label



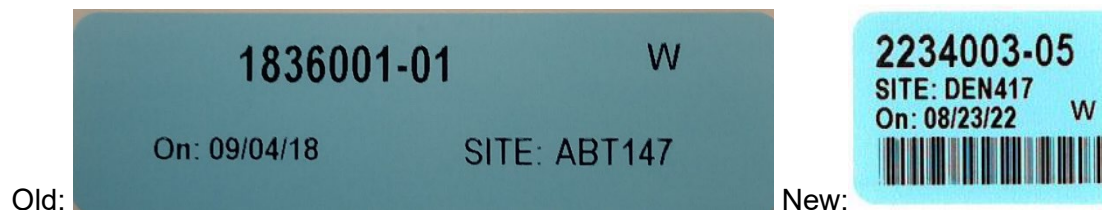
Teflon Label



Nylon Label



Cellulose Label



ATTACHMENT B

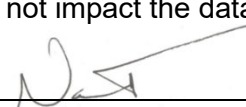
CASTNET Filter Pack Comment Codes

- 1 – Unidentified debris or particles on filter.
- 2 – Torn, hole, or ripped filter noted during unpacking.
- 3 – Excessively wet filter noted during unpacking.
- 4 – Excessively dirty filter noted during unpacking.
- 5 – Filter pack loose upon arrival, possible leakage during sampling period.
- 6 – Apparent solenoid problem.
- 7 – Filter pack end caps cracked or missing upon receipt.
- 8 – Outside of filter pack excessively dirty upon receipt.
- 9 – Support screen raised up, noted during unpacking.
- 10 – Insect inside filter pack, noted during unpacking.
- 11 – Laboratory accident.
- 12 – Filter pack on tower incorrect length of time.
- 13 – Filter pack not run in field.
- 14 – Unusual odor noticed during unpacking.
- 15 – Low extraction efficiency off filter.
- 16 – On/off dates and times are assumed.
- 17 – Filter given to EPA for analysis.
- 18 – Field accident.
- 19 – Field equipment problem/Power outage.
- 20 – Filter used for special study.
- 21 – Forest fire or agricultural activity in area.
- 22 – Site closed down.
- 23 – Site Status Report Form (SSRF) not received with filter pack.
- 24 – Chain of Custody incomplete or incorrect.
- 25 – Filter pack run on wrong week.
- T – Teflon filter
- N – Nylon filter
- W – K₂CO₃ impregnated filter

ATTACHMENT C

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
9.0	All	Update from Amec Foster Wheeler to Wood Environment & Infrastructure, Inc.
	4.0	Added “disposable nitrile” to gloves; added hair net and laboratory coat. . Removed duplicate entry for plastic tub/bin.
	Fig. 1	Added hair net & lab coat.
	5.1.4	Added “Place the Do Not Enter sign on the door to the filter pack receiving area.
	Fig. 3, 5, 8, 10, & 11	Updated to recent copies.
	5.2.1	Added “on the disassembly room door”.
	5.2.2	Added “hair nets and lab coats”.
	6.0	Added QAPP.
	Attachment A	Updated to recent copies.
	Attachment C	Added Revisions Table
10.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
11.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	5.1.1	Changed Merchandise Return Labels to Priority Mail Return Labels.
	5.2.7	Changed “clamp nut” to “collar” for consistency
	5.3	Added comment about including off-date as needed when logging in samples
	Attachment A	Added images of updated sample labels.
	Attachment B	Added Power Outages to Code 19
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
11.1	All	Update company name to WSP and apply Arial font formatting
12.0	All	Update company name to WSP USA Inc.

**TITLE: PREPARING AND SHIPPING THE CLEAN AIR STATUS AND TRENDS
NETWORK (CASTNET) THREE-STAGE FILTER PACKS**

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations Manager

Topie, Nathaniel
(USNT719661)

Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.28 09:38:11 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager



Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.28 09:32:01
-05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Procedure
- 6.0 References
- 7.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

PREPARING AND SHIPPING THE CLEAN AIR STATUS AND TRENDS NETWORK (CASTNET) THREE-STAGE FILTER PACKS

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to WSP USA Inc. (WSP) laboratory personnel for the preparing and shipping of three-stage filter packs and associated use of the laboratory information management system (LIMS).

2.0 SCOPE

This SOP applies to all filter packs prepared for CASTNET and CASTNET-like ambient air projects.

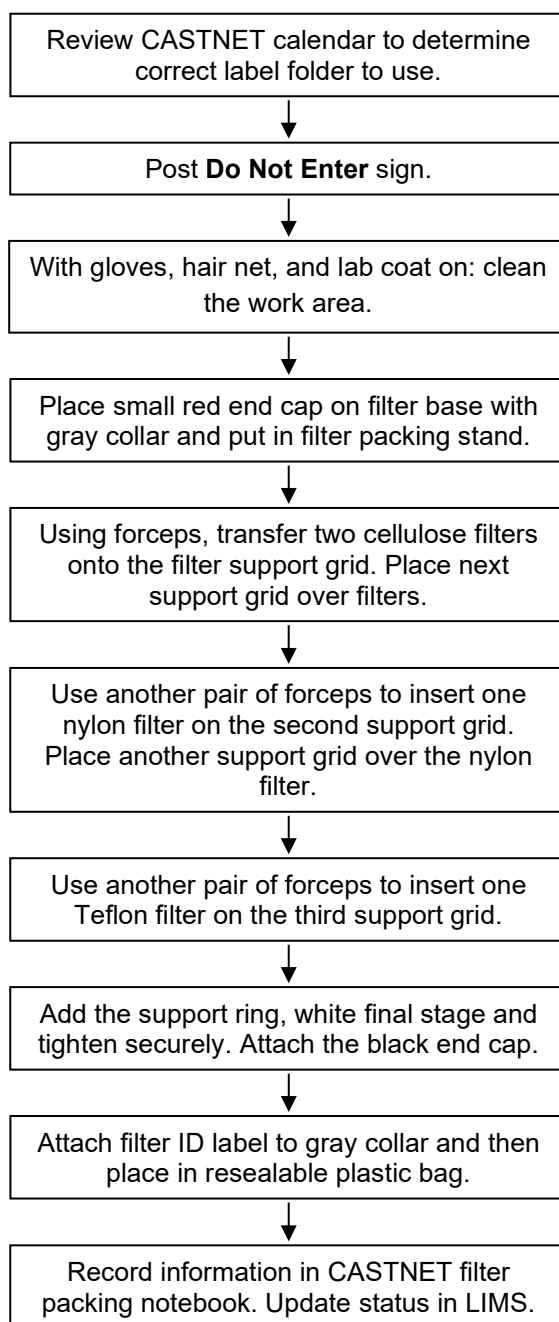
3.0 SUMMARY OF METHOD

A general overview of the steps described in this SOP is depicted Figure 1. Deviations from the analytical method described in this SOP are not permitted.

4.0 MATERIALS

- Powder-free disposable nitrile gloves
- Hair net
- Laboratory coat
- Pre-cleaned plastic forceps
- Filter packing assembly/ disassembly device
- Clean filter packs, support rings with grid, Teflon filter support ring and end caps
- Field group folder (see Attachment A):
 - Site Status Report Form (SSRF) Chain of Custody label
 - Filter pack identification (ID) label
 - Shipping Tube/FedEx Site ID Label
- CASTNET calendar
- Resealable plastic bags
- Polyvinyl chloride (PVC) and cardboard shipping tubes
- Packing notebook
- Filters:
 - Teflon filters that have passed acceptance testing
 - Nylon filters that have passed acceptance testing
 - Potassium carbonate (K_2CO_3)-impregnated Whatman cellulose No. 41 filters that have passed acceptance testing
- SSRF
- United States Postal Service (USPS) prepaid return label
- Kimwipes

Figure 1. Overview – Laboratory Operations Procedures for Preparing Filter Packs



5.0 PROCEDURE

5.1 Preparing the three-stage filter pack

- 5.1.1 Prior to beginning filter assembly, post the Do Not Enter Sign on the door to the filter packing room (see Figure 2).

Figure 2. Do Not Enter Sign



- 5.1.2 Review the CASTNET calendar (see Figure 3) to determine the correct field group folder to use for packing. Starting with the first Tuesday of the year, each week is assigned a CASTNET sample week number. This sample week number is used to determine the correct field group folder to use. The Laboratory Information System (LIMS) Lab ID numbers are set up with this pattern:

XXYY001-Z	001	=	CASTNET Base Program
	XX	=	Year (last two digits)
	YY	=	Week number(1-52) *
	Z	=	Assigned number for each site

* If the calendar year starts on Wednesday through Saturday, the second calendar week will be the first CASTNET week and numbering will be 2-53.

Each field group folder contains the WSP field log sheet, sample fraction labels, chain of custody labels, shipping/FedEx Site ID labels, and filter pack ID labels. Remove the filter pack ID labels, chain of custody labels, and shipping/contents labels from the folder and place in the designated filter packing area.

Figure 3. CASTNET Calendar

AUGUST 2018						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
			219	214	215	216
5	6	7	8	9	10	11
217	218	219	220	221	222	223
12	13	14	15	16	17	18
224	225	226	227	228	229	230
19	20	21	22	23	24	25
231	232	233	234	235	236	237
26	27	28	29	30	31	
238	239	240	241	242	243	

← July 2018

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

September 2018 →

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Semi-Annual Calibration Schedule
August/February

ARE128, PA IRL141, FL
BEL116, MD PED108, VA
BWR139, MD PSU106, PA
CAD150, AR SUM156, FL
CTH110, NY VPI120, VA
CVL151, MS WSP144, NJ

Quarterly Calibration Schedule (Trace only)
DUK008, NC ROM206, CO
PND165, WY

Audit Schedule
TBD

Gas Monitoring PE Audit
TBD

Field Contacts
Mike Smith, 352-333-6620
Anthony Ward, 352-333-6635
Cody Gibbons, 352-333-6615

Project Contacts
Kemp Howell, 352-333-6612
Susie Rogers, 352-333-6601

Tuesday Call-In Number
1-888-224-5663

Ship to:
404 SW 140th Terrace
Newberry, FL 32669-3000
Amec Foster Wheeler
352-332-3318

5.1.3 Attach one chain of custody label to the SSRF in the designated location (see Figure 4).

Figure 4. SSRF with Chain of Custody Label Attached

CASTNET SITE STATUS REPORT FORM (SSRF)			
SITE NAME / NO.:		FILTER PACK INFO (ACTUAL FILTER PACK SAMPLED)	
VISIT DATE / DAY OF THE WEEK:		DATE FILTER ON: / / DATE FILTER OFF: / /	
FIELD OPERATIONS COORDINATOR CALLED:		WHAT % OF LEAVES: 0-25% 25-50% 51-75% 76-100%	
(Name):		HAVE DROPPED: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
OZONE MONITORING SITES ONLY		HAVE FALL COLOR: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
OZONE CHECKS (FOR FILTER ON DATE)		ARE GREEN: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
NOISE: A <input type="checkbox"/> B <input type="checkbox"/>		CURRENT 5-MINUTE AVERAGES: YES NO	
LEAK CHECK: YES NO		BLOWER WORKING? Y N N/A	
OUTSIDE FILTER CHANGE: <input type="checkbox"/> <input type="checkbox"/>		METEOROLOGICAL MONITORING SITES ONLY	
WATER IN LINE / TRAP: <input type="checkbox"/> <input type="checkbox"/>		DELTA TEMP (°C): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
DESICCANT CHANGED (VET CARTRIDGE): <input type="checkbox"/> <input type="checkbox"/>		BLOWER WORKING? Y N N/A	
DESICCANT CHANGED (DVC CARTRIDGE): <input type="checkbox"/> <input type="checkbox"/>		RAINFALL (INCHES): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
SHELTER TEMPERATURE (°C): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		CLEAN & LEVEL: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
SITE OPERATOR NOTES:		TIP CHECK: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
(During, dust, also include the location, use of indicator, hardware and prediction, after pack run size of sequence, etc.)		WIND DIRECTION (°): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
LAB COMMENTS:		WIND SPEED (mi/h): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
LAB USE ONLY		RELATIVE HUMIDITY (%): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
LAB SAMPLE NO.:		SOLAR RAD (mw): <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
LAB TECH RECEIPT		CLEAN & LEVEL: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
DATE: / /		WETNESS SENSOR: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
SHIPMENT OPENED BY: DATE: / /		CLEAN & LEVEL: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
PACKED BY: 2128		TEST RESPONSE: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
WEEK 35 2018		AMEC Call-In Number: 888-224-5663	
Filter Pack ID #: 1835004-01 Site: ALCI88			
Scheduled On Date: 08/28/2018			

WHITE COPY: in tube with filter pack. WHITE COPY and logbook page: in tube with filter pack. PINK COPY: site operator's notebook.

- 5.1.4 Keep forms, labels, and filter packs in order to avoid any mix-ups.
- 5.1.5 With gloves on, clean off the filter-packing stand and surrounding work area using Kimwipes. Organize all items needed around the packing area, including filters, filter packs, screens, forceps, resealable plastic bags, laboratory cart, filter pack end caps, and notebook (see Figure 5). Gloves should be changed after touching anything other than the filter packing equipment and supplies in order to prevent contamination.

Figure 5. Filter Pack Components



- 5.1.6 Verify the orientation of the Teflon filters (see section 5.1.12) by manually tearing the top filter in the box. Also, re-verify the Teflon orientation halfway through the packing procedure.
- 5.1.7 As each filter pack is assembled, inspect each part for physical damage that could permit air leaks (cracks, thread damage, etc.). If there is any filter part damage, send the part to the Laboratory Operations Manager.

Note: Pay particular attention to the filter pack outlet near the threaded quick connector. This plastic part is prone to stress fatigue damage. The damage may appear as tiny cracks. Inspect this part carefully. Discard this part at the first indication of damage or impending failure.

- 5.1.8 Begin the filter packing process by removing one filter base and gray collar from the storage container. Place a small red end cap on the base fitting and place the filter base into the filter packing stand (see Figure 6).

Figure 6. Filter Packing Stand



- 5.1.9 Prior to placing each filter in the filter pack, inspect it for physical defects (pinholes, thin or thick areas, tears, and abnormal color) Discard any filters with defects. Care must be taken to avoid contamination during the inspection.
- 5.1.10 Confirm the number of filter stages required by the site in the CASTNET Filter Pack Notebook (Figure 7). Exclude any filter stages that are not required.
- 5.1.11 Using clean forceps, carefully transfer two K_2CO_3 -impregnated cellulose filters into the filter support ring with grid, if required. Place the next support ring with grid over the filters, ensuring that it has mated properly with the stage below.
- 5.1.12 Using another pair of clean forceps, insert one nylon filter on the second support grid. Place the next support grid on top, ensuring that it has mated properly with the stage below.
- 5.1.13 Using another pair of clean forceps, insert one Teflon filter on the third support ring with grid. Ensure proper orientation of the Teflon filter - Teflon side (dull side) facing up, toward the ambient air (shiny surface should be facing down). An additional support ring for the Teflon filter is then added.
- 5.1.14 Place the white final stage of the filter assembly onto the base and tighten securely.
- 5.1.15 Remove the filter pack from the filter-packing stand and attach the black end cap.
- 5.1.16 Attach the filter ID label to the gray collar. Cover the label with tape to prevent damage due to rain. Place in a resealable plastic bag.
- 5.1.17 Record the required information in the CASTNET Filter Packing Notebook (see Figure 7).

Figure 7. CASTNET Filter Pack Notebook

WSP USA
Gainesville Lab

EPA BASE Sites CASTNET Filter Pack Preparation

Teflon	TAT Samples	Lot Number	CASTNET Samples
	2440011-01 → 04	20663540	LB1, 2508001-01 → 49.

Nylon	NAT Samples	Lot Number	CASTNET Samples
	2323026-41 → 42	211 Box 4326	LB1, 2508001-01 → 28
	2323026-43 → 44	211 Box 4327	LB2, 2508001-29 → 49.

Whatman	WAT Samples	Impreg. Date	Group	Logbook-Page	CASTNET Samples
	2435011-09 → 16, 18	11.24.2024	B	B-2004.1243	LB1, 2508001 →
					-23, -30, -47 only

In date 02.18.2025

LB: 25xxxx02 - 01, and 02			Week 08-2508001		
Lab ID	Site ID	✓	Lab ID	Site ID	✓
25##001-01	ABT147	✓	25##001-28	MCK231	✓
25##001-02	ARE128	✓	25##001-29	MKG113	✓
25##001-03	BEL116	✓	25##001-30	NIC001	✓
25##001-04	BFT142	✓	25##001-31	OXF122	✓
25##001-05	BVL130	✓	25##001-32	PAL190	✓
25##001-06	BWR139	✓	25##001-33	PAR107	✓
25##001-07	CAD150	✓	25##001-34	PED108	✓
25##001-08	CAT175	✓	25##001-35	PND165	✓
*25##001-09	CDR119	✓	25##001-36	PRK134	✓
25##001-10	CKT136	✓	25##001-37	QAK172	✓
25##001-11	CND125	✓	25##001-38	ROM206	✓
25##001-12	CNT169	✓	25##001-39	SAL133	✓
25##001-13	COW137	✓	25##001-40	SND152	✓
25##001-14	CTH110	✓	25##001-41	SPD111	✓
25##001-15	CVL151	✓	25##001-42	STK138	✓
*25##001-16	DCP114	✓	25##001-43	SUM156	✓
25##001-17	DUK008	✓	25##001-44	UVL124	✓
25##001-19	ESP127	✓	25##001-45	VIN140	✓
25##001-20	GAS153	✓	25##001-46	VPI120	✓
25##001-21	GTH161	✓	25##001-47	WFM105	✓
25##001-22	HOX148	✓	25##001-48	WSP144	✓
25##001-23	IRL141	✓	25##001-49	WST109	✓
25##001-24	KEF112	✓			
25##001-25	KNZ184	✓			
25##001-26	LRL117	✓	18 EGB181 -	see logbook	
25##001-27	MCK131	✓	21 GTH161 -	see logbook	

Notes: * Mothballed sites: CDR119, DCP114
Bolded sites need Whatman filters.

Packed By: Amr Date: 02.04.2025 Shipped via: fedex Date: 02.06.2025

Book# 2066

Page# 25

5.2 Preparation of Laboratory Blanks

5.2.1 Prepare two laboratory blanks weekly for each filter type. The laboratory blank LIMS Lab ID follows the same format as the filter pack field groups:

XXYY002 - 01, 02	002	=	Laboratory Blank
XX		=	Year (last two digits)
YY		=	Week number(1-52)
01		=	First Laboratory Blank
02		=	Second Laboratory Blank

5.2.2 Place one Teflon, one nylon, and two cellulose acceptance tested filters into the appropriate bottles labeled correctly for each filter type and the corresponding week number. Use filters from the same lots as were used in packing the filter packs for that week.

5.2.3 Record the date of preparation on the field log sheet. Record the required information in the CASTNET Filter Packing Notebook.

5.2.4 Store the bottles at 4 degrees Celsius (°C) until the samples for that week are ready for extraction.

5.3 Preparing the Shipping Tubes for Shipment

5.3.1 Each cardboard shipping tube must contain the PVC sleeve, filter pack, an SSRF, and a USPS prepaid return label. Foam end-pieces or bubble wrap are used to prevent damage to the filter pack and to the shipping tube. Attach the end-caps securely to both tubes to prevent the filter pack from falling out during shipment (see Figure 8).

Figure 8. Filter Shipping Tubes



- 5.3.2 Attach the shipping tube/FedEx Site ID label to the outside of the tube. This label identifies the destination of the tube to the shipping technician. FedEx is used to ship the tubes to the site operators.
- 5.3.3 Keep the filter packs, SSRF, and shipping/contents labels in a set order to ensure that the correct filter pack is matched up with the correct SSRF and that the PVC shipping tube is sent to the correct site according to the shipping/contents label.
- 5.3.4 The date the shipment is given to the shipping technician is recorded at the bottom of the CASTNET Filter Packing Notebook.

5.4 Update status of schedule samples in LIMS when shipped

- 5.4.1 Select Sample Control, select Custody
- 5.4.2 Highlight the first sample ID of the work order being shipped, hold the Shift Key and highlight the last one
- 5.4.3 Click the arrow pointing to the right moving samples to that section, right-click, Select-All.
- 5.4.4 Right-click, select Edit Internal Custody; pick the Custody Date shipped from the drop-down; from the drop-down change Disposition to Active (Out), pick from the drop-down the initials of shipper in Checked In/Out, click Apply.
- 5.4.5 Print Sample Custody (see Figure 9).

Figure 9. Sample Custody

Sample Custody							
By Ruby W Wyrosdick							
Printed 08/10/18 07:48							
Lab ID	Container	Last Owner	Department	Location	Home Location	Status	Disposition Custody Date
1834001-01 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-02 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-03 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-04 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-05 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-06 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-07 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-08 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-09 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-10 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-11 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-12 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-13 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-14 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-15 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-16 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-17 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-18 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-19 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-20 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-21 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-22 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-23 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-24 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-25 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-26 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-27 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-28 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-29 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-30 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-31 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-32 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-33 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-34 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-35 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-36 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-37 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-38 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-39 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-40 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-41 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-42 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-43 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-44 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-45 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-46 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-47 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48
1834001-48 A	Filter Pack	RWW	6064			Pending	Active (Out) 08/09/18 07:48

Page 1

6.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April

WSP USA Environment & Infrastructure Inc. (WSP) formerly known as Wood Environment & Infrastructure Solutions, Inc. 2022. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.5*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC.

7.0 ATTACHMENTS

Attachment A – Labels

Attachment B – Revisions Table

ATTACHMENT A
Examples of Labels

SSRF Chain of Custody Label

WEEK 36 2018

Filter Pack ID #: **1836001-01** Site: **ABT147**
Scheduled On Date: **09/04/2018**

SHIPMENT OPENED BY: DATE:

PACKED BY: HAC

Filter Pack ID Label

Filter pack

SITE: ABT147 Sampled: 09/04/18
1836001-01

Shipping Tube/FedEx Site ID Label

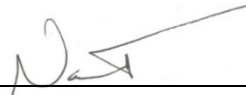
FEDEX-GOVT

LAB ID: 1836001-01 Sampled: 09/04/18
SITE: ABT147

ATTACHMENT B

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
8.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	6.0	Update references
	Attachment B	Addition of this table.
9.0	All	Update from Amec Foster Wheeler to Wood Environment & Infrastructure, Inc.
	4.0	Added “disposable nitrile” to gloves; added hair net and laboratory coat.
	Fig. 1	Added hair net & lab coat.
	5.1.1	Added “on the door to the filter packing room”.
	Fig. 3, 4, 7 & 9	Updated to recent copies.
	6.0	Added QAPP.
	Attachment A	Updated to recent copies.
10.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
11.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	The above revisions to this document do not impact the data generated by the procedure. <div style="text-align: right;">Verified by: </div>	
11.1	All	Update company name to WSP and apply Arial font formatting
12.0	All	Update company name to WSP USA Inc. Updated to accommodate filter packs with fewer than 3 stages.

Date: 3-6-2025

Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.25 15:49:33 -05'00'

Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 17:17:09 -05'00'

1.0	Purpose
2.0	Scope
3.0	Procedure
4.0	References
5.0	Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

PROCEDURE FOR SAMPLE INFORMATION CHANGES AND ADDITIONS

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for changing or adding sample information in the Laboratory Information Management System (LIMS) Element by Clinisys (formerly Promium).

2.0 SCOPE

This SOP applies to all samples received by the Gainesville Laboratory and is used whenever changes and/or additions need to be made to existing sample information stored in the LIMS.

3.0 PROCEDURE

- A request for changes and additions to sample information is initiated by an e-mail request sent to the Laboratory Operations Manager (LOM), copying the QA Manager and login technician.
- All requests must be printed, dated, and signed.
- The following items are required for each request: Project, lab identification (ID) number(s), date of request, requestor's name, and a clear description of the changes and/or additions to be made along with the reason for the request. Before changes are made, the LOM's signature is required. If the changes affect a sample already reported, the QA Manager also needs to sign.
- After the appropriate changes have been made, the request is signed and dated by the data technician.
- The request is then filed in the appropriate Project File.
- Communication of the change(s) is the responsibility of the person requesting the change(s).

4.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April

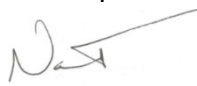
5.0 ATTACHMENTS

Attachment A – Revisions Table

ATTACHMENT A

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
9.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	4.0	Update references
	Attachment A	Addition of this table.
10.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
11.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	The above revisions to this document do not impact the data generated by the procedure. <div style="text-align: right;">Verified by: </div>	
11.1	All	Update company name to WSP and apply Arial font formatting
12.0	All	Update Promium company name to Clinisys Update company name to WSP USA Inc.

PROCEDURE FOR DATA ENTRY ERROR CORRECTION

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for correcting errors made during documentation of procedures used in sample chain-of-custody, sample records, standard and spike preparation, data transcription, data reduction, and data reporting.

2.0 SCOPE

This SOP applies to all changes on data or data entries performed at the Gainesville Laboratory including studies conducted under the Good Laboratory Practice (GLP) guidelines specified in 40 Code of Federal Regulations (CFR), Parts 160 and 792.

3.0 PROCEDURE

When an error is made or discovered in the documentation, the personnel making the correction shall strike a single line through the error so as not to obscure the original entry, make the correction, and initial and date the correction and include the appropriate code (see Attachment A).

4.0 REFERENCES

CFR 40, Part 160, FIFRA - Good Laboratory Practice Standards (7/01/90).

CFR 40, Part 792, TSCA - Good Laboratory Practice Standards (7/01/90).

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April

5.0 ATTACHMENTS

Attachment A – Data Entry Error Correction Codes.

Attachment B – Revisions Table

ATTACHMENT A

Data Entry Error Correction Codes



PROCEDURE FOR DATA ENTRY ERROR CORRECTION

PROCEDURE:

When an error is made or discovered in documentation, the personnel making the correction shall strike a single line through the error so as not to obscure the original entry, make the correction, initial and date the correction including one of the below appropriate codes.

DATA ENTRY ERROR CORRECTION CODES


<u>CODE</u>	<u>EXPLANATION</u>
WP	Entry made in wrong place
WI	Wrong information recorded
CE	Calculation error
SE	Spelling error
IW	Illegible writing error
FO	Data changed upon further observation
TE	Transcription error
FE	Further explanation provided
EE	Entry error

GLF3180-009 R3

ATTACHMENT B

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
7.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	4.0	Update references
	Attachment B	Addition of this table.
8.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
8.1	Attachment A	Update
9.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
		The above revisions to this document do not impact the data generated by the procedure. Verified by: 
9.1	All	Update company name to WSP and apply Arial font formatting
10.0	All	Update company name to WSP USA Inc.

TITLE: DEIONIZED WATER QUALITY

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie

Topie, Nathaniel (USNT719661)

Digitally signed by Topie, Nathaniel (USNT719661)
Date: 2025.02.25 15:52:49 -05'00'

Laboratory Operations Manager

Reviewed by: Marcus O. Stewart



Digitally signed by Stewart,
Marcus (USMS719399)

Date: 2025.02.24 17:22:37 -05'00'

Quality Assurance Manager

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Summary of Method
- 4.0 Materials
- 5.0 Safety
- 6.0 Procedure
- 7.0 References
- 8.0 Appendices
- 9.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

DEIONIZED WATER QUALITY

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide assurance that the WSP USA Inc. (WSP) laboratory deionized (DI) water system is regularly monitored, and the quality of water produced meets the required specifications.

2.0 SCOPE

This SOP applies to the DI water system located adjacent to the analytical laboratory building of the Gainesville WSP campus.

3.0 SUMMARY OF METHOD

The DI system is checked on weekdays (excluding holidays) to insure that the quality lights are on and the resistivity meets criteria.

4.0 MATERIALS

The laboratory DI system consists of anion, cation, mixed bed and carbon tanks; a meter to monitor the output water resistivity and a meter to display the volume of water used (see Figure 1).

Figure 1. DI Water System



5.0 SAFETY

No chemicals are used in this method; however, laboratory personnel should exercise caution when stepping up on the platform to take the daily readings.

6.0 PROCEDURE

6.1 Monitoring

6.1.1 Monitoring is done on a daily basis, excluding weekends and holidays, and recorded in the DI Water System Operation Log (see Attachment A).

Leave on at least one DI faucet inside the lab building to flow water through the system.

6.1.2 Inside the DI water shed, verify that all of the tank quality lights are green after 10 minutes (see Figure 2).

Figure 2. Tank Quality Lights



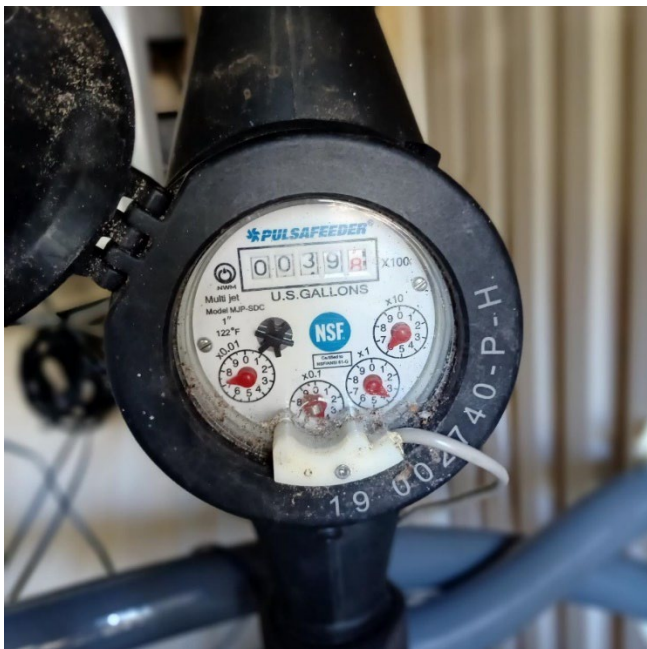
- 6.1.3 After approximately 30 seconds, record the resistivity (see Figure 5). The resistivity should be equal to or greater than 15 megohms per centimeter (Mohm/cm).

Figure 5. Resistivity Meter



- 6.1.4 Record the quantity of DI used (see Figure 6).

Figure 6. Water Meter



6.1.5 Turn the DI faucet off when back inside.

6.2 Quality Control

- 6.2.1 If one or more tank lights are red, but the resistivity is acceptable (≥ 15 Mohm/cm), the tanks need to be replaced but the water may still be used. The Laboratory Operations Manager (LOM) must be notified. The water system service company must be contacted and requested to have the tanks changed within the next 24 hours. The time the service company call was made must be marked in the DI Water System Operation Log. Once the tanks are changed by the water system service company, the LOM must be notified. The date and time that they were replaced must be noted in the DI Water System Operation Log.
- 6.2.2 If the tank lights are red and resistivity has dropped below the minimum specification (< 15 Mohm/cm), it indicates the tanks have expired. The DI water system must be shut down and the LOM must be notified immediately. The water system service company must be contacted and requested to have the tanks changed immediately. The time of the service company call must be marked in the DI Water System Operation Log. Once the tanks have been changed by the water system company, all DI faucets in the building must be purged for a minimum of 30 seconds. Once the water system has been purged and the resistivity is greater than 15 Mohm/cm, the LOM must be notified that the water system is within criteria and can now be used. The date and time that the DI water system is operational must be noted in the DI Water System Operation Log.

6.3 Corrective Action

When the resistivity falls below 15 Mohm/cm, the water system must be purged after the tanks are changed.

6.4 System Maintenance

The LOM must be notified immediately of any maintenance work to be done on the water system, whether planned or unplanned. The time the system was brought down, what work was done, and the time the system was brought back up must be recorded in the operating log. When any work is performed on the system that could adversely affect water quality, the system must be purged.

7.0 REFERENCES

WSP USA Environment & Infrastructure Inc. (WSP) formerly known as Wood Environment & Infrastructure Solutions, Inc. 2022. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.5*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC.

U.S. Environmental Protection Agency (EPA). 2007. *Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents*. EPA/600/B-07/001, April.

ISO/IEC. 1987. *Water for Analytical Laboratory Use — Specification and Test Methods*. ISO International Standard ISO/IEC 3696:1987

8.0 APPENDICES

Appendix 1 – Revisions Table


9.0 ATTACHMENTS

Attachment A – DI Water System Operation Log

Attachment B – ISO/IEC 3696:1987 Water Specifications

Appendix 1 – Revisions Table

Table – Revisions

Document Revision No.	Section	Revision
7.0	All	Change name from AMEC E&I to Amec Foster Wheeler
7.0	Cover	Katherine W. Barry replaces Garry L. Price as Laboratory Operations Manager
7.0	References	Addition of ISO/IEC 3696:1987 Water Specifications reference and an associated summary table as Attachment B
7.0	Appendix 1	Addition appendix 1 for inclusion of this table
8.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
9.0	All	Updated photos, removed old/inaccurate ones
	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	6.1	Edited to say turn faucet on instead of valve and check for green lights on tanks
	6.2	Changed monitoring light to “red”
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
	All	Update company name to WSP and apply Arial font formatting
10.0	All	Update company name to WSP USA Inc.

ATTACHMENT B
ISO/IEC 3696:1987 WATER SPECIFICATIONS

Grade	Minimum Conductance (Micro-Siemens per Centimeter)	Minimum Resistance (Mega-Ohms per Centimeter)
1	0.1	10
2	1	1
3	5	0.2

TITLE: ELEMENT® BATCH PREPARATION – DATA UPLOAD

Effective Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations Manager

Topie, Nathaniel
(USNT719661)

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Nathaniel (USNT719661)
Date: 2025.02.28 09:23:44 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager



Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.27 17:22:33
-05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Procedure
- 4.0 Troubleshooting and Corrective Actions
- 5.0 References
- 6.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

ELEMENT® BATCH PREPARATION

1.0 PURPOSE

The purpose of the SOP is to provide guidance for the preparation of electronic data batches in Element DataSystem® Laboratory Information Management System (LIMS) for all laboratory methods that require uploading instrument export files.

2.0 SCOPE

This SOP covers the automated upload data procedures for laboratory instrumentation, troubleshooting and error correction steps.

3.0 PROCEDURE

3.1 Prepare to upload.

Prepare an export file using the appropriate instrument software program (AutoAnalyzer Control and Evaluation (AACE) for the automated colorimeter, Chromeleon data system for the ion chromatographs, Syngistix for the inductively coupled plasma optical emission spectrometer, and AutoWeight for the microbalance). Do not include any samples requiring a dilution unless the diluted sample has been analyzed. If any required dilutions have been performed and analyzed, do not include any diluted values for samples in the automated upload file; all dilution values must be entered manually.

Prepare export files only after the raw data has been printed and evaluated for errors, including incorrect sample laboratory IDs. Be sure to check the entire file for correct spelling and sample identification and correct any errors found before proceeding.

3.1.1 Chromeleon

- A. On the Chromeleon console, select the **Data** section. Right click on the sequence to be printed. Select **Print**. Print the checked items only, click **OK** to print.
- B. At the bottom of the screen, open the Instrument Method. Left click on the Chromeleon icon and select **Quick Print**. Repeat this for the Processing Method.
- C. Open the **Logbook Form**. Go to the **Sequence Printout** tab and adjust the information to fit the logbook page. Note: changes are made the same as in an Excel spreadsheet.
- D. Highlight the samples for exporting. Do not include the calibration curve or shutdown method.
- E. Right click and select **Export**. The following screen (Figure 1) will open:

Figure 1. Chromeleon Data Export Screen - 1

The screenshot shows the 'Export...' dialog box in Chromeleon. The 'Report Template & Channel' section has 'Use report template' set to 'Anion Report' and 'With selected channel' set to 'CD'. The 'Destination Path' section has 'Parent Folder' set to 'C:\NC18 Export\TF12A18' and an empty 'Sub Folder' field. The 'Export Formats & Filenames' section lists several formats: 'Text format (Results) (*.txt)' (checked), 'Text format (Raw Data) (*.txt, *.csv)' (unchecked), 'Excel file format (*.xls)' (unchecked), 'PDF file format (*.pdf)' (checked), 'GAML file format (*.gaml)' (unchecked), 'AnDI/NetCDF file format (*.cdf)' (unchecked), 'Raw file format (*.raw)' (unchecked), 'Chromeleon data file format (*.cmbx)' (unchecked), and 'Allotrope data file format (*.adf)' (unchecked). The gear icon for the PDF format is highlighted. The 'External Program' section has 'Call external program' unchecked. The 'Notifications' section has 'Enable Notifications' unchecked. The 'OK' and 'Cancel' buttons are at the bottom.

- F. The **Text format (Results) (*.txt)** and **PDF file format (*.pdf)** boxes should be the only ones checked. Change the sequence ID in the **Parent Folder** section to match your sequence.
- G. Click on the tool button that is highlighted. Verify that **Integration** is the only item checked (Figure 2). Click **OK** to close. Do this for both *.txt and *.pdf formats.

Figure 2. Chromeleon Data Export Screen – 2

Export Parameters

Destination

File name formula {smp.number;04}

Select sheets to be exported

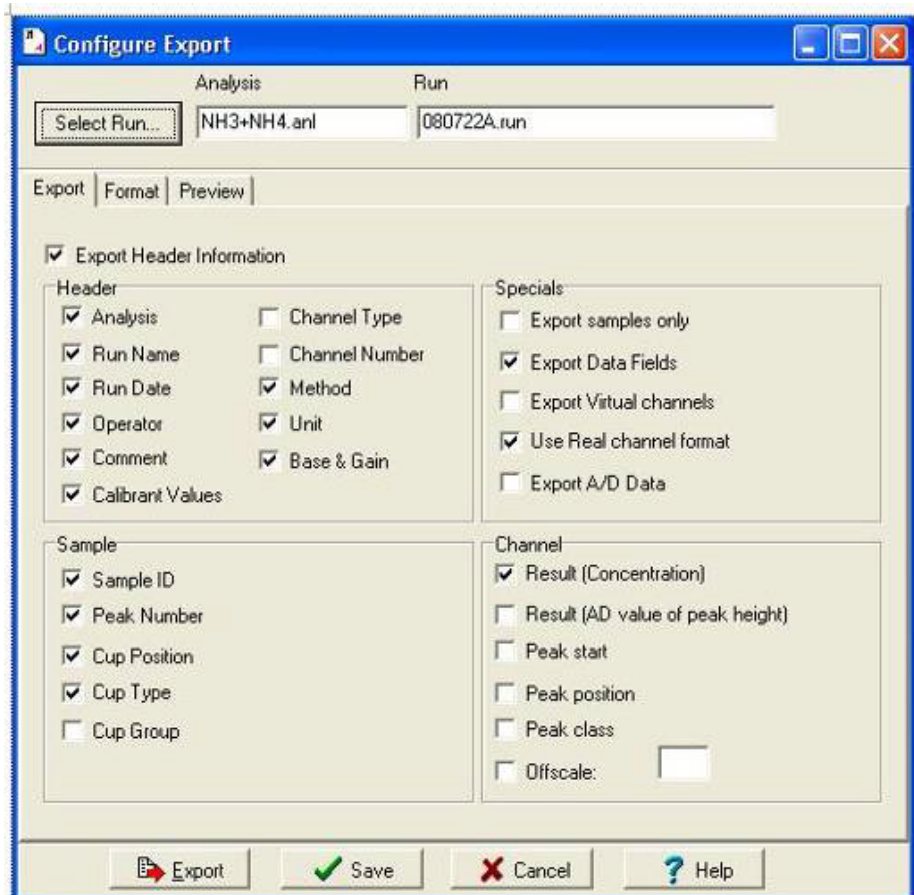
Sheet Name	Export	Condition
Integration	<input checked="" type="checkbox"/>	Each Injection
Calibration	<input type="checkbox"/>	
Peak Analysis	<input type="checkbox"/>	
Summary - INJ. vs ANL.	<input type="checkbox"/>	
Audit Trail	<input type="checkbox"/>	

OK Cancel

- H. Click **OK** to create the export files. Each sample will have a corresponding text and PDF file and will be created in a directory with the same name as the sequence file in item F (extension.seq) located in an export folder on the instrument computer.
- I. Transfer the entire export file to an Element®- enabled workstation via rewriteable compact disc or USB thumb-drive to process your Element® AutoBatch.

3.1.2 Bran+Luebbe AACE 6.03

Figure 3. Bran+Luebbe AACE 6.03 Export Screen



- From the main **AACE 6.03** screen on the instrument PC select **File** and then choose **Export to** from the drop-down list. Select **ASCII File** to open the **Select Run** screen.
 - On the **Select Run** screen, select the following data path: **C:\Program Files\Bran+Luebbe\Aace 6.03\Data\NH3+NH4**.
 - Select the appropriate **.run** file on the right side of the **Select Run** screen and click **OK** to open the **Configure Export** screen.\
- It should be noted that the following instructions are only required if the software has not been used for an export prior to this. An example would be a new software installation. If the previous analysis has been exported, the default settings may be used.*

- D. On the **Configure Export** screen, click the **Export** tab. The following information should be selected as indicated by a check mark next to each option (see Figure 3):

Export Header Design	Method	Export Data Fields
Analysis	Unit	Use Real Channel Format
Run Name	Base + Gain	Result
Run Date		
Operator		
Comment		
Calibrant Values		
Sample ID		
Peak Number		
Cup Position		
Cup Type		

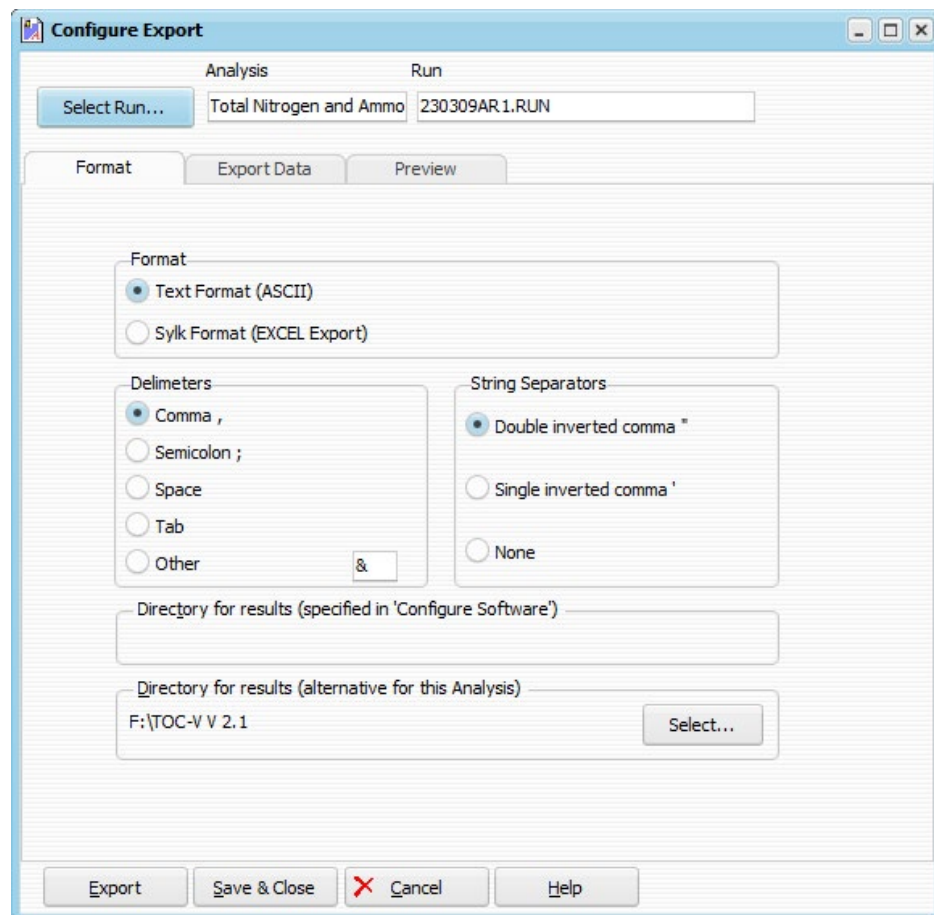
- E. On this same screen click the **Format** tab and select the following by clicking on the radio button next to each option:

- i. **Text Format (ASCII)**
- ii. **Comma**
- iii. **Double Inverted Comma**

- F. Insert a USB thumb drive into the computer.
- G. Click **Export** at the bottom of the **Configure Export** screen to create the export file (".txt" format). The **AACE Message** window will open to indicate that the file was successfully created; click **OK**. Click **Cancel** to exit the **Configure Export** screen.
- H. The file is automatically saved to the thumb drive directory (E:\) and can be transferred to an Element™-enabled workstation.
- I. The export file is archived at the following address: **P:\Lab\Projects\AA3** (file name which is always the year, the month, the day, and an alpha character for discrete instrument run of the day – see Figure 3 for example – **080722A.run**)

3.1.3 SEAL AACE 8.02 SP1

Figure 4. SEAL AACE 8.02 SP1 Export Screen



- J. From the main **AACE 8.02 SP1** screen on the instrument PC select **File** and then choose **Export to** from the drop-down list. Select **ASCII File** to open the **Select Run** screen.
- K. On the **Select Run** screen, select the following data path: **C:\Program Data\SEAL analytical\AACE 8.02 SP1\Data\Total Nitrogen and Ammonia**.
- L. Select the appropriate .run file on the right side of the **Select Run** screen and click **OK** to open the **Configure Export** screen (see Figure 4).
It should be noted that the following instructions are only required if the software has not been used for an export prior to this. An example would be a new software installation. If the previous analysis has been exported, the default settings may be used.

- M. On the **Configure Export** screen, click the **Export** tab. The following information should be selected as indicated by a check mark next to each option (see Figure 5):

Figure 5. SEAL AACE 8.02 SP1 Export Data Screen

The screenshot shows the 'Configure Export' window with the 'Export Data' tab active. The 'Analysis' section at the top shows 'Total Nitrogen and Ammo' and '230317AR1.RUN'. The 'Export Data' tab is selected, and the following options are checked:

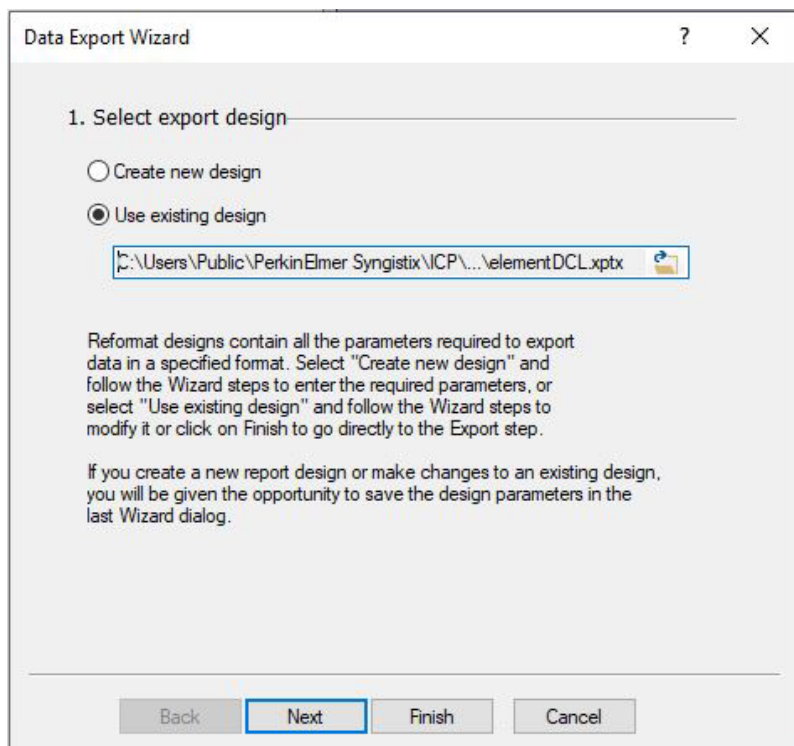
- Export Header Information:**
 - Analysis
 - Channel Type
 - Run Name
 - Channel Number
 - Run Date
 - Method
 - Operator
 - Unit
 - Comment
 - Base/Offset & Gain
 - Calibration Fit
 - Calibration Coeff.
- Sample:**
 - Sample ID
 - Peak Number
 - Cup Position
 - Cup Type
- Channel:**
 - Result (Concentration)

The 'Specials' section has all options unchecked. At the bottom are buttons for 'Export', 'Save & Close', 'Cancel', and 'Help'.

- N. On this same screen click the **Format** tab and select the following by clicking on the radio button next to each option (see Figure 4):
- Text Format (ASCII)**
 - Comma**
 - Double Inverted Comma**
- O. Insert a USB thumb drive into the computer. On this same screen (Format tab) select the **Directory for Results**. Confirm the thumb drive directory is selected.
- P. Click **Export** at the bottom of the **Configure Export** screen to create the export file (".txt" format). The **AACE Message** window will open to indicate that the file was successfully created; click **OK**. Click **Cancel** to exit the **Configure Export** screen.
- Q. The file will automatically save to the designated folder on the thumb drive and can be transferred to an Element™-enabled workstation.
- R. The export file is archived at the following address: **P:\Lab\Projects\AA500** (file name which is always the year, the month, the day, and an alpha character for discrete instrument run of the day – see Figure 4 for example – **230309AR1.run**)

3.1.4 Perkin Elmer Syngistics

Figure 6. Perkin Elmer Syngistics Export Screen - 1



- A. From the main Syngistix screen on the instrument PC click on **Utilities** in the upper left corner.
- B. Select **Data Manager** to open the screen. Choose the results file that contains the desired data by clicking on the filename.
- C. Select **Export** to open the **Data Export Wizard** (see Figure 6). Under Select Export Design choose **Use Existing Design** and select Browse.
- D. Choose **element.xpt** from the pop-up window and click **Open** to return to the **Select Export Design** window. Click **Next** to open the **Select Samples to Export** screen.
- E. To select or deselect sample data files, choose **Enable/Disable** on the **Select Samples to Export** screen to open the **Enable/Disable** window. A check mark in the Enable column indicates that a particular sample will be included in the export file. Click in the Enable column to add or remove the check marks.
- F. Click **OK** once all samples have been selected to return to the **Select Samples to Export** screen. Click on **Next** to open the **Select Analytes to Export** window.
- G. Ensure that the all analytes of analysis are on the right. Select by clicking **Add** on the **Select Analytes to Export** screen. When all analytes are selected, choose **Next** to open the **Select Export Options** screen.
- H. On the screen (see Figure 7), the settings should be as follows:
Name – Same as data set file name, Extension - .prn, Directory is set to E:\ or D:\.
Use a USB thumb drive for drive **E:** and a CDRW for drive **D:**.
Select **Next** to proceed.

It should be noted that the following instructions are only required if the software has not been used for an export prior. An example would be a new software installation. If the previous analysis has been exported, the default settings may be used.

Figure 7. Perkin Elmer Syngistics Export Screen - 2

The screenshot shows the 'Data Export Wizard' dialog box at step 4, 'Select export options'. The 'Exported file' section has 'Name' set to 'Same as data set' (selected with a radio button) and an empty text box. The 'Extension' is set to '.pm' in a dropdown menu. The 'Directory' section has 'Default export directory' (unselected) and 'E:\' (selected with a radio button) in a text box. The 'If file already exists' section has 'Append' (unselected) and 'Overwrite' (selected with a radio button). The 'Data delimited by' is set to '.' in a dropdown menu. There are checkboxes for 'Include descriptive header' (checked) and 'Quote strings' (unchecked). At the bottom, there are four buttons: 'Back', 'Next' (highlighted with a blue border), 'Finish', and 'Cancel'.

- I. On the **Select Sample Parameters** screen, choose **Sample ID** by highlighting and clicking on **Add** to move the selection to the right side of the screen. Choose **Next**.
- J. On the **Select Mean-Related Parameters** screen, select the following options by highlighting and clicking **Add** to move the selections to the right side of the screen:

Analyte Name	Date and Time
Concentration (Samp. Units)	Reported Conc. (Samp.Units)
Element Wavelength	Reported Concentration (Calib. Units)

Select **Next**.
- K. On the **Select Replicate-Related Parameters** screen, repeat item J for the following parameters:
Replicate Number, Date and Time, Concentration (Samp. Units), and Concentration (Calib Units).
Click **Next** to open the **Export Data Set** window.
- L. Select **Export Data** at the top of the **Export Data Set** window to create the export file on the thumb drive. After the file is written select **Finish**.
- M. Transfer the export file to an Element™-enabled workstation via thumb drive.
- N. The export file is archived at the following address:
P:\Lab\Projects\Avio220\Results\Element

3.1.5 AutoWeight V36 – See also Section 7.5.14 in GLM3180-002

Figure 8. AutoWeight V36 Export Screen

ExportData : Form

PM 2.5 Export File Generation

Analyst: Ruby W. Wyrosdick

Start Date: 7/28/2008

End Date: 07/28/2008

List Samples missing Initial wt: [Icon]

Update export file: [Icon]

Print form: [Icon]

Export data: [Icon]

Exit Form: [Icon]

Garry Export

Choose Data to Export

Save Changes Close Form Select All Export Data

Analyst	Units	Timestamp	Sample ID	Filter ID	Final weight mg	Initial weight mg	Net mg	Selected?
Ruby W. Wyrosdick	mg	7/28/2008 10:05:44 AM	DI08-13-	D08-00022	268.291	268.258	0.033	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:09:50 AM	DI08-13-	D08-00023	272.027	271.933	0.094	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:11:57 AM	DI08-13-	D08-00024	270.55	270.304	0.246	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:13:43 AM	DI08-13-	D08-00025	275.855	275.704	0.151	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:15:55 AM	DI08-13-	D08-00026	265.743	265.54	0.203	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:38:31 AM	FRM08-14-	F99-33346	144.424	144.191	0.233	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:40:33 AM	FRM08-14-	F99-33347	148.071	147.738	0.333	✓
Ruby W. Wyrosdick	mg	7/28/2008 10:42:06 AM	EDM08-14-	E08-33348	130.450	130.450	0.000	✓

Record: 1 of 21

- From the **Options** menu in **AutoWeight** , select **Export Data** (see Figure 8).
- Select a starting date and an ending date. Click the **Update Report File** button.
 - To edit the report, select **Review and Edit Data** from the Options form.
 - Select Initial/Final and Yesterday/Today. Press **Start**.
 - Edit the form. All fields except Analyst and Sample Weight are available for editing. **Save** after every change.
 - Close form.
- Print using the **Print Form** button.
- Click the **Export Data** button. Enter a filename at the prompt; do not enter a file extension. The file is automatically saved to the following address:
- G:\GNVCASTNET\ELEMENT\AutoWeight Export files**

3.2 Element® Login and Data Upload

3.2.1 Double click on the Element® icon on the pc desktop

3.2.2 Enter your analyst ID and password

3.2.3 **Data Tool** – Creating a Bench Sheet

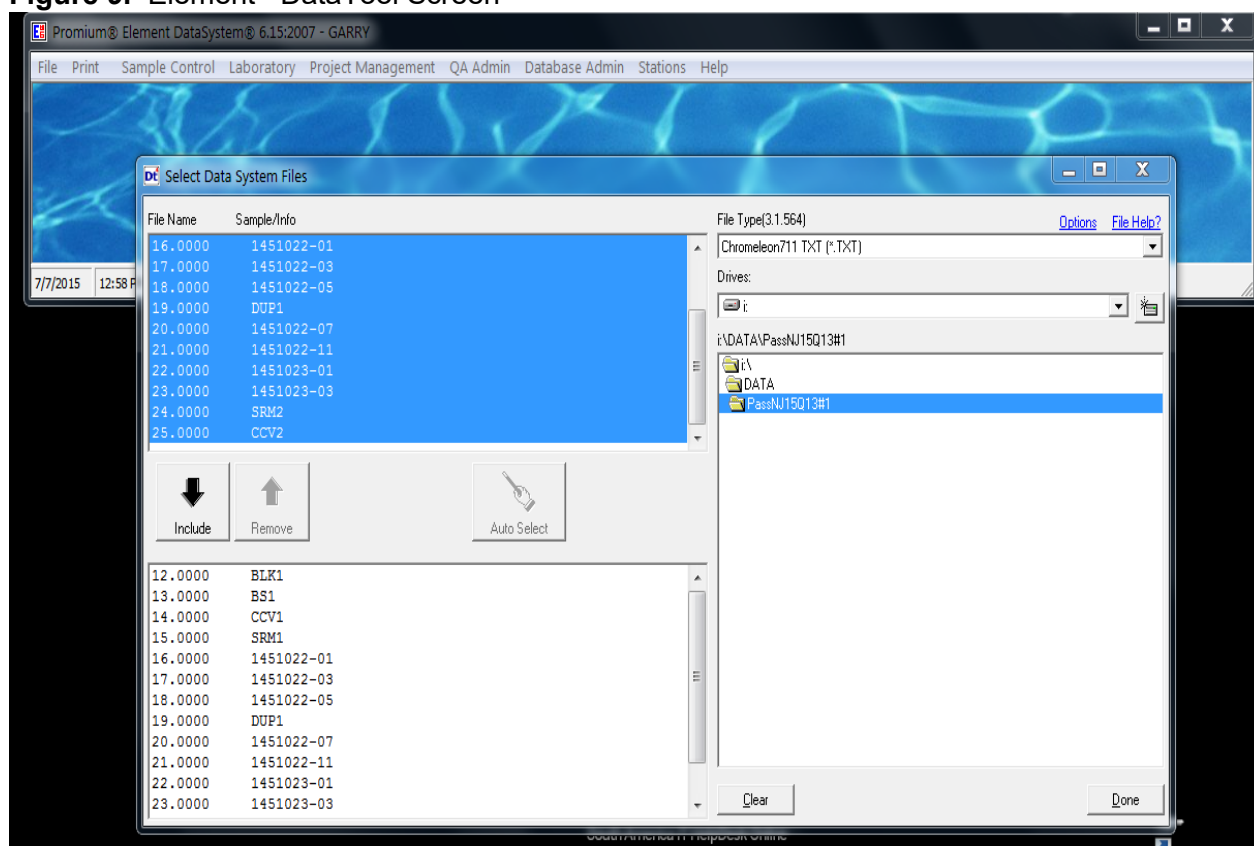
- A. From the **Laboratory** drop-down and open **Data Tool**.
- B. Clear any data visible on the left side of the **Data Tool – Main** screen by clicking on the **Clear** button for that side of the screen.
- C. Select the **Browse** button on the **right** side of the screen to open the **Select Data System Files** screen. Clear any data visible on the bottom left side of the screen by using the **Clear** button.
- D. From the drop-down list under **File Type** select as shown below:

Chromeleon711 (Chrom7.2)	Chromeleon711 (*.txt)
Bran+Luebbe AACE 6.03	Braun + Luebbe (*.txt)
SEAL AACE 8.02	Braun + Luebbe (*.txt)
Perkin Elmer Syngistics	PE WinLab-Final (*.prn)
AutoWeight v36	Excel Spreadsheet (*.xls)

Note: For Perkin Elmer Syngistics files, select Options next to File Type, and make sure Report Final is checked. Data Tool may need updated to the latest version for it to work.

- E. Select the appropriate drive and pathway.
- F. Choose the correct export file from those displayed in the bottom right section of the **Select Data System Files** screen by double-clicking on the filename. For Chromeleon 7.2, chose the appropriate directory. The samples in that file or directory should appear in the upper left section of the **Select Data System Files** screen.
- G. Highlight all samples to be uploaded. Do not include any calibration standards that may have inadvertently been exported with the sample data. Use the Include button to move the highlighted samples to the lower left section of the Select Data System Files screen. Verify that all desired samples have been included and any undesired samples excluded before proceeding. See an example of DataTool in Figure 9 on the following page.

Figure 9. Element® DataTool Screen



- H. Select **Done** to move the samples to the right side of the **Data Tool – Main** screen. If any samples appear on the left side of this screen select **Clear** at the top of the left side of the screen.
- I. Verify that the **CrossTable** displayed at the bottom of the screen corresponds to the correct instrument and/or analysis. Correct the **CrossTable** by selecting **File** followed by **Select Cross Table**. Verify that the data path is **C:\ELEMENT** before selecting the appropriate **CrossTable**.

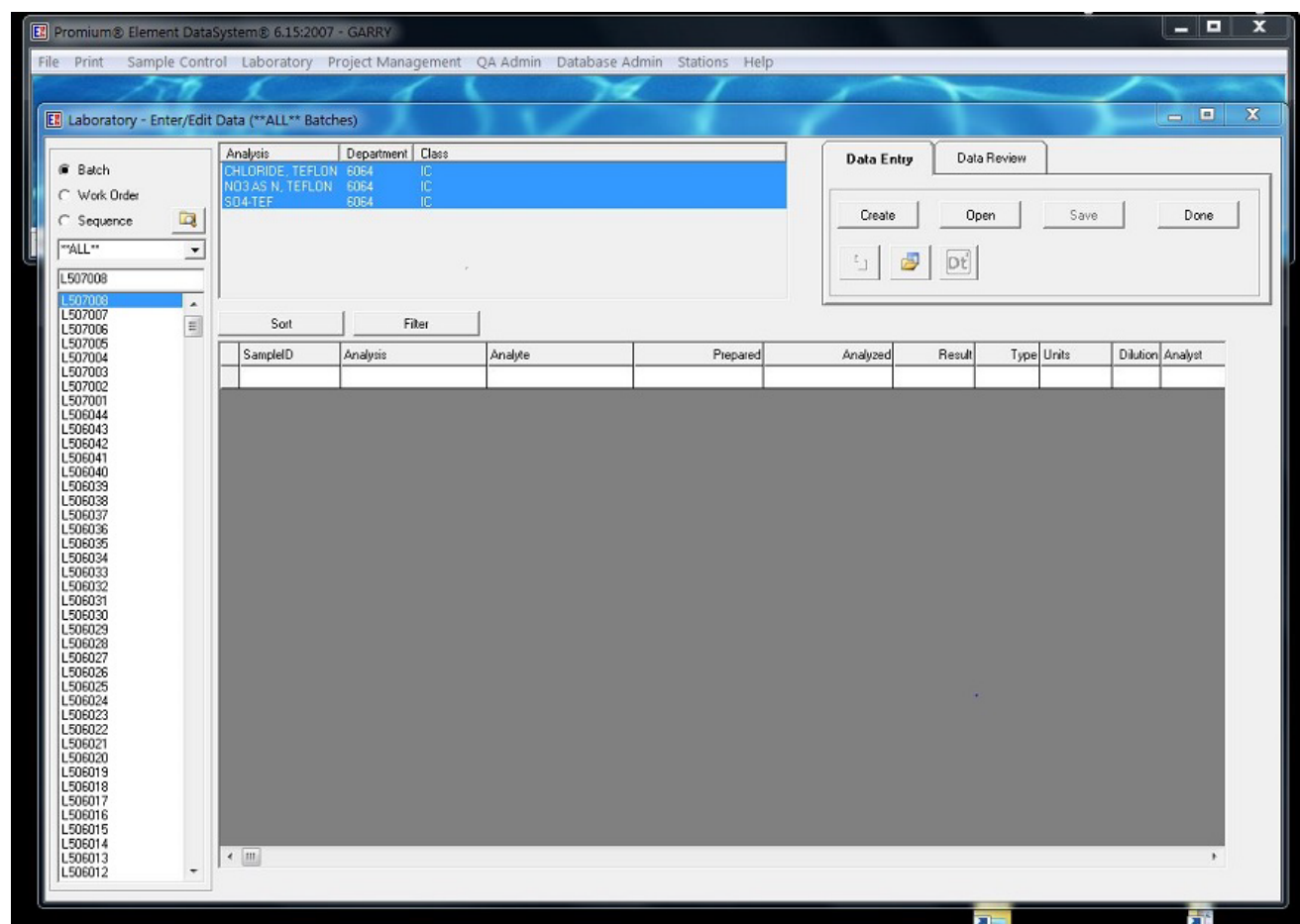
Note: A pop-up will open stating *“The selected filename does not match the expected name. Are you sure you want to use it?”* Choose **Yes**.

- J. Click **Merge Files** once the **CrossTable** is correct to bring up the **Data Transfer** screen. Select the **Instrument Data** tab to confirm that data has been entered. **Save** to the following pathway with a unique filename: **C:\ELEMENT\UserFiles**
- K. Click **Done** and close the **Data Tool – Main** screen by clicking on the [X] at the top right corner of the screen.

3.2.4 AutoBatch

3.2.4.1 Under **Laboratory**, select **Data Entry/Review** (Figure 10); under the **Data Entry** tab, choose the yellow folder button as shown here . Select the appropriate merged upload file saved from **Data Tool** and **Open**.

Figure 10. Data Entry/Review



3.2.4.2 Select the appropriate parameters from the **Batch Analysis** pop-up window by clicking in the box to the left of each parameter name.

Note: Only the parameters available for the samples included in the upload file will be available in the pop-up window.

Close this window by clicking on the [X] at the top right corner of the window to open the **Bench Sheet** (Figure 11). Record the batch number.

Figure 11. Bench Sheet

Client Sample	Cont...	Name	Analysis	Status	Prepared	By
1525010-01	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-01	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-02	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-02	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-03	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-03	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-04	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-04	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-05	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-05	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-06	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-06	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-07	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-07	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-08	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-08	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-09	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH
1525010-09	-	NAT15	S04-NYL	Analyzed	07/09/15 00:00	CMH
1525010-10	-	NAT15	N03 AS N, NYLON	Analyzed	07/09/15 00:00	CMH

QC Sample	Name	Prepared	By	Initial (filter)	Final (mL)	Source	Spike
L507020-BLK1	Blank	07/09/15 00:00	CMH	1	25		
L507020-BS1	LCS	07/09/15 00:00	CMH	1	25		5A29C
L507020-CCV1	Calibration Che...	07/10/15 00:00	CMH	1	25		5A19C
L507020-CCV2	Calibration Che...	07/10/15 00:00	CMH	1	25		5A19C
L507020-CCV3	Calibration Che...	07/10/15 00:00	CMH	1	25		5A19C
L507020-CCV4	Calibration Che...	07/10/15 00:00	CMH	1	25		5A19C
L507020-DUP1	Duplicate	07/10/15 00:00	CMH	1	25	1525010-08	
L507020-SRM1	Reference	07/10/15 00:00	CMH	1	25		5E04C
L507020-SRM2	Reference	07/10/15 00:00	CMH	1	25		5E04C

3.2.4.3 On the **Bench Sheet**, select the **Edit** button to enter Edit Mode.

- In the upper window (real samples), verify that all desired samples were included. If any samples are missing, it is likely that they were misnamed. Check the Laboratory ID against the label on the extract bottle and make any necessary corrections to the raw data and upload files before proceeding.
- Still in the upper window, highlight a sample, right click and choose **Select All** to highlight all samples. Right click again and select **Prepared** to correct the extraction date (if applicable). Repeat and select **Prepared By** to correct the extractor name if different than that of the analyst preparing the data batch.
- In the lower window (QC samples), repeat the steps in item B, correcting the **Prepared** date to the date of extraction for the method blank (**BLK1**) and any other extracted QC samples (such as **BS1**). Correct the **Prepared** date to the date of analysis for any non-extracted QC samples such as **CCV** and **SRM**.
- Highlight all **CCV**, right click and select **Spike 1 ID**. Select the appropriate Element® Standard assigned ID by double-clicking. Repeat right-click while all **CCV** are still highlighted and select **Spike 1 Type**. Right-click again and choose **Static** from the drop-down list. Repeat right-click again and select **Spike 1 Amount**. Set this value to **1**.

- E. Repeat item D for **SRM** samples.
- F. Repeat item D for **BS1** sample. Choose **Pre-Prep** under **Spike 1 Type** and either **1000** or **2000** (the later for 50 mL extracts only) for **Spike 1 Amount**.
- G. Highlight DUP1. Right click and select **Source**. Using the information from the run log, choose the correct Laboratory ID for the duplicated sample. Repeat for the remaining **DUP** samples in the batch.
- H. **Save** the changes and select **Done** to open the **Data Transfer** screen.

3.2.4.4 Any unmatched parameters appearing in red in the upper left corner of the **Data Transfer** screen must be added to the **CrossTable**.

- A. Double-click the first unmatched analyte in red to open the **CrossTable**.
- B. The **CSAnalyte** and **ELMAAnalyte** columns **must** match for every entry in the table; the **ELMAAnalysis** column should be **ignored**.
- C. To match, click in the unmatched **ELMAAnalyte** column and select the correct match from the drop-down list.
- D. The **CSAnalyte** column must be either matched to the **ELMAAnalyte** column or listed as ***Non-Target***.
- E. Verify that the upper range of the method is correct.
- F. **Save** and **Close**.

3.2.4.5 On the **Data Entry/Review** screen, select the **Analyst** column by clicking on the appropriate header tab. Right click and choose **Fill Cells**. Select the appropriate analyst initials from the drop-down list and click **Apply** and **Save**.

3.2.4.6 Click **OK** to close the **Data Post Results** pop-up window.

3.3 Review and Print Batch

3.3.1 From **Laboratory** in the Element® taskbar, select **Data Entry/Review**, highlight your batch number, and under the **Data Review** tab choose **Query**.

3.3.2 Review all data for correctness. Verify that all desired samples are listed. Samples for which the database detects an error or flag will be coded in red. The parameter in question will also be coded red. Investigate all red-coded samples for corrections.

Note: If no red-coded parameters are initially viewable, reveal all details for the samples by clicking on the grey square in the uppermost left corner of the data display to select all samples, right click, and choose "View Details." Scroll to the right until the red-coded parameter comes into view.

Note: All flags and errors must be addressed in the batch checklist.

3.3.3 After all necessary corrections have been made, select all by clicking on the grey square in the uppermost left corner of the data display. Right click and select **Update Status** from drop-down and select **Update to Analyzed**.

3.3.4 Select **Lock** to lock the data from further editing.

3.3.5 Print the batch report using the correct report format as indicated below.

IC and ICP – rev_WSP_R3.rpt

AA3 – rev_WSP_NH4.rpt

Mass analyses – rev_WSP_PM25.rpt / rev_WSP_PMHVol.rpt

3.4 Standard Update

3.4.1 Update the **Standards** table for QC used in analysis. This step only need be completed when new standard solutions or masses are being used.

3.4.1.1 Under **Laboratory** on the main Element® screen, select **Standards** to open the **Standards** table. On the left side of the table are the standard numbers assigned by Element®; on the right are the descriptions of each standard.

3.4.1.2 Choose the number for a previous standard of the type required and click **Copy** to create another entry of the same type. To create a standard from scratch click **Add** and specify the type as follows:

For stocks (purchased or laboratory prepared), purchased standards, and mass standards:

1 – Specify each analyte and its concentration.

For diluted standards:

2 – Combine and/or dilute existing standards.

3.4.1.3 **For copied standards**, update the entry to reflect the correct information for the standard.

A. For purchased stocks and standards:

- 1) The **Prepared Date** and the **Reference Date** should be changed to reflect the date the stock or standard was made. If this date is not available from the manufacturer's documentation, use the received date. For masses, use the certification date.
- 2) The **Expiration Date** should reflect the date specified by the Certificate of Analysis. If no expiration date is given, the solution expires one year from the date of receipt. For masses, the **Expiration Date** is one year from the date of certification.
- 3) Select the radio button next to **Purchased** and enter the Received date and **Opened date** in the appropriate fields.
- 4) Update **Prepared By** with ****Vendor**** and **Vendor** to the correct manufacturer source.
- 5) Update the lot number both in the **Vendor Lot** field and in the **Comment** field.

B. For laboratory prepared stocks:

- 1) The **Prepared Date** and the **Reference Date** should be changed to reflect the date the stock was made.
- 2) The **Expiration Date** is one year from the date the stock was prepared.
- 3) Select the **Prepared** radio button.
- 4) Update the **Vendor Lot** field and in the **Comment** field with the solution number. Include a specific reference to the logbook and page number in the Comment field.

Note: Each laboratory prepared standard should be documented in an appropriate logbook and assigned a unique solution number that references both the logbook and page number. For example, 1807011A references the first solution documented in section I of page 01 in logbook 1807. For logbooks designed to document only solution per page, the logbook number followed by the page number should be sufficient, eg. 1857-01.

C. For diluted standard solutions:

- 1) The **Prepared Date** should be changed to reflect the date the diluted standard was made.

- 2) The **Reference Date** should be changed to reflect the date the **stock** was made. If no prepared date was supplied with a purchased stock, use the receipt date.
- 3) The **Expiration Date** is assigned as follows:

ICP standards:	1 month from date of dilution.
Most other standards:	3 months from date of dilution.
High-level standards:	6 months from date of dilution.
- 4) Select the **Prepared** radio button.
- 5) Update the **Vendor Lot** field and in the **Comment** field with the **stock** lot number for standards diluted from purchased stocks or the **diluted standard** solution number for standards diluted from prepared stocks. Include a specific reference to the logbook and page number in the Comment field.
- 6) In the left-hand portion of the screen below the Comment field, right click on the displayed Element[®] standard number and select **Browse** to open the list of all Element[®] assigned standard ID numbers. Select the standard number of the stock solution used for the dilution.

Note: Only the information in the Comment field is visible when selecting the correct "Spike 1 ID" in the Bench Sheet. Any information necessary to identify the correct standard – such as lot number, expiration date, and/or preparation date – should be included in this field.

3.4.1.4 For newly created standards, update the entry to reflect the correct information for the standard.

- A. For purchased stocks and standards or standard masses (Type 1):
 - 1) Edit the dates as in Section 3.4.1.3 A.
 - 2) Select the **Vendor** from the drop-down list or enter an unlisted vendor by hand. Enter the **Vendor Lot** number.
 - 3) Select the radio button next to **Purchased** and enter the **Received date** and **Opened date** in the appropriate fields.
 - 4) Enter the **Volume** of the standard and the **Concentration Units**. Set the Concentration Units for masses to **NA**. The **Solvent Lot#** is also **NA** for masses.
 - 5) Select the analytes. Highlight the desired parameters in the left-hand portion of the screen below the **Comment** field and click the "→" button to move the selected analyte to form an analyte table on the right side of the screen.
 - 6) Enter the targets for each analyte in the column next to the parameter name. This column will be named based on the **Concentration Units**. Verify that the correct control limits have been entered.
 - 7) Select the radio button next to **Reference** under **Standard Type**. Choose **Other** for mass standards.
- B. For laboratory prepared stocks (Type 1):
 - 1) Edit the dates as in Section 3.4.1.3 B.
 - 2) Select the radio button next to **Prepared**.
 - 3) Update the **Vendor Lot** field and in the **Comment** field with the solution number. Include a specific reference to the logbook and page number in the **Comment** field.
 - 4) Follow Sections 3.1.3.4.1.4 – 3.1.3.4.1.7.

C. For diluted standard solutions (Type 2):

- 1) Edit the dates as in Section 3.4.1.3 C.
- 2) Select the radio button next to **Prepared**.
- 3) Update the **Vendor Lot** field and in the **Comment** field with the **stock** lot number for standards diluted from purchased stocks or the **diluted standard** solution number for standards diluted from prepared stocks. Include a specific reference to the logbook and page number in the **Comment** field.
- 4) In the left-hand portion of the screen below the **Comment** field, right click on the displayed Element® standard number and select **Browse** to open the list of all Element® assigned standard ID numbers. Select the standard number of the stock solution used for the dilution.
- 5) Select the radio button next to **Reference** under **Standard** Type.

3.4.1.5 **Save** the changes.

4.0 TROUBLESHOOTING AND CORRECTIVE ACTIONS

Most Element® errors occur because of misidentified samples. The Element® Laboratory IDs are purely numeric and can be **very** similar for some samples. Careful attention is required at every stage of analysis to ensure that each sample is correctly identified. It is strongly recommended that instrument schedules be prepared directly from the samples and not from another schedule or list as this creates an opportunity for errors to be introduced in manner that is extremely difficult to detect.

- 4.1 Before submitting the batch, verify that every sample included in the export file has been uploaded into Element®. If a sample field or QC is missing, check the instrument schedule or run log for obvious errors, such as alphabetical characters interchanged with numerals. If the schedule appears correct, check the export file for inadvertently excluded samples. If this is correct, verify the schedule against the sample bottle labels.
- 4.2 If the missing sample is a misidentified QC sample, follow the procedure in Section 4.3, but select the appropriate QC sample type instead of **Client Sample (Container)** as specified in Section 4.3.3. See Section 3.3.2.2 for a list of the selection choices for each QC sample type.

Note: Most often a sample will be misidentified as a sample for which the data has already been locked in Element®. In this case a pop-up window will appear during upload indicating that a sample already has data entered for the parameters included in the batch. The sample will not be uploaded into Element®. The specific sample affected is not named and must be identified by comparing the uploaded samples with the instrument run log.

- 4.3 If a misidentified sample is indicated, correct the export file and add it to the data batch.

4.3.1 Open the export file and make the appropriate correction, making sure to save the file. Alternatively, the export file can be recreated after the sample identification has been corrected.

Note: The raw data, both electronic (where possible) and the hard-copies must be corrected before the batch can be submitted.

4.3.2 Open the **Laboratory** tab and select **Data Entry/Review**. Select the correct batch number and **Query**. **Make sure all data are locked**. See Section 3.3.4. If data are left unlocked it could be overwritten and additional compounding errors introduced.

4.3.3 Open the **Bench Sheet** and select the appropriate batch. Enter **Edit Mode**. Highlight any sample that should **not** be in the batch and click **Remove**. Click **Add** to and select **Client Sample (Container)** to bring up a list of available samples. Double-click the appropriate sample and analysis to add it to the bench sheet. Close the window by clicking on the [X] in the upper right corner of the screen.

4.3.4 Highlight the added sample and right-click. Select **Prepared** and change the prepared date to match the rest of the samples in the batch. **Save** and **Done** to exit the **Bench Sheet**.

4.3.5 Open **Laboratory** tab and select **Data Entry/Review**; select the appropriate batch. Under the **Data Entry** tab, click **Create** and then **Export** as an Excel file. Assign the file a unique name that is different from the original export file for this batch but is related. Save to the following directory: **C:\ELEMENT\UserFiles**. Click **Cancel** and close the screen.

4.3.6 Open **Data Tool** through Element®. **Clear** the left side of the screen of samples. Click **Browse** on the **left side** of the **Data Tool – Main** window. Open the Excel file created in Section 4.3.5 so that the samples are listed in the left pan of the window.

4.3.7 Click **Browse** on the **right side** of the window. **Clear** any existing samples displayed on the **Select Data System Files** screen. Select the original export file so that the samples are displayed in the upper left portion of the screen. Highlight the desired sample and move it to the lower left portion of the screen using the **↓/Include** button. Click **Done** to return to the **Data Tool – Main** screen.

4.3.8 Click **Merge Files**. Click the Instrument tab on the **Data Transfer** screen to display the instrument data.

4.3.9 **Save** as an Excel file to the same destination as in Section 4.3.5 with a new related filename.

4.3.10 Open the **Laboratory** tab and select **Data Entry/Review** screen and select the correct batch. Click **Open** and select the file saved in Section 4.3.9. **Save** and **Query** to review. In cases where data have not been updated to *Reviewed* status, it is currently possible to overwrite data for batched samples *even if the data have been locked*. When this happens, the older sample will be deleted from its original batch. To correct this problem it is therefore also necessary to add the erased sample back into its original batch as well as correct the misidentified sample in the current batch.

4.3.11 If a misidentified sample has resulted in data from previous batches being erased, delete the offending sample from the most recent batch from the Bench Sheet.

4.3.12 Replace the deleted sample in its original batch following the steps outlined in Sections 4.3.2 – 4.3.10. Resubmit the batch including a Batch Update Request Form. No status change is required. See Attachment C.

4.3.13 Repeat the entirety of Section 4.3 for the most recent batch.

4.4 If a sample in the current batch is correctly identified but is excluded from the upload because a sample in a previous batch has been misidentified with the same Laboratory

ID, the data in the older batch must be corrected before the current sample can be uploaded properly.

4.4.1 Determine the original batch's number and submit a Batch Update Request Form to have the status changed back to "Analyzed" by the Laboratory Manager.

4.4.2 Using the archived data files, follow the steps in Section 4.3 for the original batch and resubmit the batch, including the Batch Update Request Form.

4.4.3 Re-upload the current batch.

4.4.4 Using the archived data files, follow the steps in Section 4.3 for the original batch and resubmit the batch, including the Batch Update Request Form.

4.4.5 Re-upload the current batch.

5.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April

6.0 ATTACHMENTS

Attachment A – General Batch Narrative Format.

Attachment B – Mass Analyses Batch Format.

Attachment C – Example Batch Update Request Form.

Attachment D – Revisions Table

ATTACHMENT A
General Batch Narrative Format

Batch Comments <Batch Number> <Analysis Date>

1. Comment 1.

2. Comment 2.

Analyst	_____	Date	_____
Reviewer	_____	Date	_____
	_____		_____

ATTACHMENT B
Mass Analyses Batch Format
(See also Attachment E of GLM3180-002 for PM_{2.5} analyses)

Batch: _____ Date: _____

Room Temp.: _____ Humidity: _____

Please note the following observations for filters in this batch:

Sample Name (Filter #) Code and description (repeat this information for all samples identified with a code).

Note: The following filters are field blanks:
Sample Name (Filter #),

Analyst Signature: _____ Date: _____

Reviewer Signatures: _____ Date: _____
_____ Date: _____
_____ Date: _____

ATTACHMENT C
Example Batch Update Request Form

Batch #: _____	By: _____	Date: _____
Request Justification:		
<div style="display: flex; justify-content: space-between;"> Status Changed By: _____ Date: _____ </div>		
<div style="display: flex; justify-content: space-between;"> Changes Made By: _____ Date: _____ </div>		
<div style="display: flex; justify-content: space-between;"> Updates Reviewed By: _____ Date: _____ </div>		
<div style="display: flex; justify-content: space-between;"> _____ Date: _____ </div>		
<div style="display: flex; justify-content: space-between;"> Status Changed By: _____ Date : _____ </div>		

ATTACHMENT D

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
4.0	Appendix 4 Attachment D	Addition of this table
	Figure 2	Updated Dionex Chromeleon 6.8 Data Export Screenshot
	3.1.1.5	Text changed to: G:\GNVCASTNET\ELEMENT\AutoWeight Export files
	3.2	(* .csv) changed to (*filename Dtool.xls)
	3.4.5.1	Lowercase amec changed to AMEC
	3.4.5.2	Lowercase amec changed to AMEC
	3.4.5.3	Lowercase amec changed to AMEC
	3.4.5.4	Lowercase amec changed to AMEC
5.0	Attachment D	Corrected reference in revisions table row 1.
	All	Chromeleon 6.8 references updated to 7.2 except where references are to external processor function names instead of the actual software.
	3.1.1.1	The section referencing PeakNet 5.1 was replaced by Chromeleon 7.2.
6.0	3.3	Manual Entry batches was removed and a separate SOP for manual entry Element® created
		Figures 6, 7, and 8 added
7.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	5.0	Update references
8.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
9.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	3.1	Added description of instrument software used to generate data upload files.

9.1	All	Update company name WSP USA Environment & Infrastructure, Inc. and apply Arial font formatting. Replace WinLab with Syngistix for ICP uploads.
10.0	All	Update company name to WSP USA Inc.
	3.1.1	Chromeleon 7.2 Data export description and figures revised to include PDF format.
	3.1.2	Changed the wording for use of a thumb drive for exporting data
	3.1.3	Added a section for the SEAL AA500
	3.1.4	Updated the section for the ICP software
	3.2	Amended Data Tool upload for new instruments
	3.2.3	Seal added to drop down list discussion.
	3.3.5	WSP replaces AMEC in report file naming convention.

PROCEDURE FOR GENERATION OF CONTROL CHARTS

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for generation of control charts for CASTNET and CASTNET-like projects.

2.0 SCOPE

This SOP applies to Laboratory Control Samples (LCS), Continuing Calibration Standards (CCV) and Standard Reference Materials (SRM) analyzed at the Gainesville Laboratory. The charts generated will be used as a tool to assist in detection of trends, bias or other problems at the bench and for estimating uncertainty.

3.0 PROCEDURE

3.1 Chart generation

Charts will be generated quarterly by the 15th of the month following the end of the previous quarter using data in the Laboratory Information Management System (LIMS). New charts will start where the previous set ended.

- 3.1.1 Log into Element and access "Control Charts" under QA Admin (see Figure 1).
- 3.1.2 Select the appropriate analyte from the list on the left side of the screen.
- 3.1.3 Set the dates to cover a three month range starting with the day after the end of the last set generated.
- 3.1.4 Select "All" for Data Points.
- 3.1.5 Query.
- 3.1.6 Right click on the graph and print.
- 3.1.7 LCS percent recovery (%R), SRM %R and CCV %R are printed for each analyte.
- 3.1.8 Annually, the same procedure will be used to export a minimum of 20 data points for the estimation of uncertainty. Uncertainty will be defined as two times the standard deviation (2σ) for each analyte (see Attachment E).

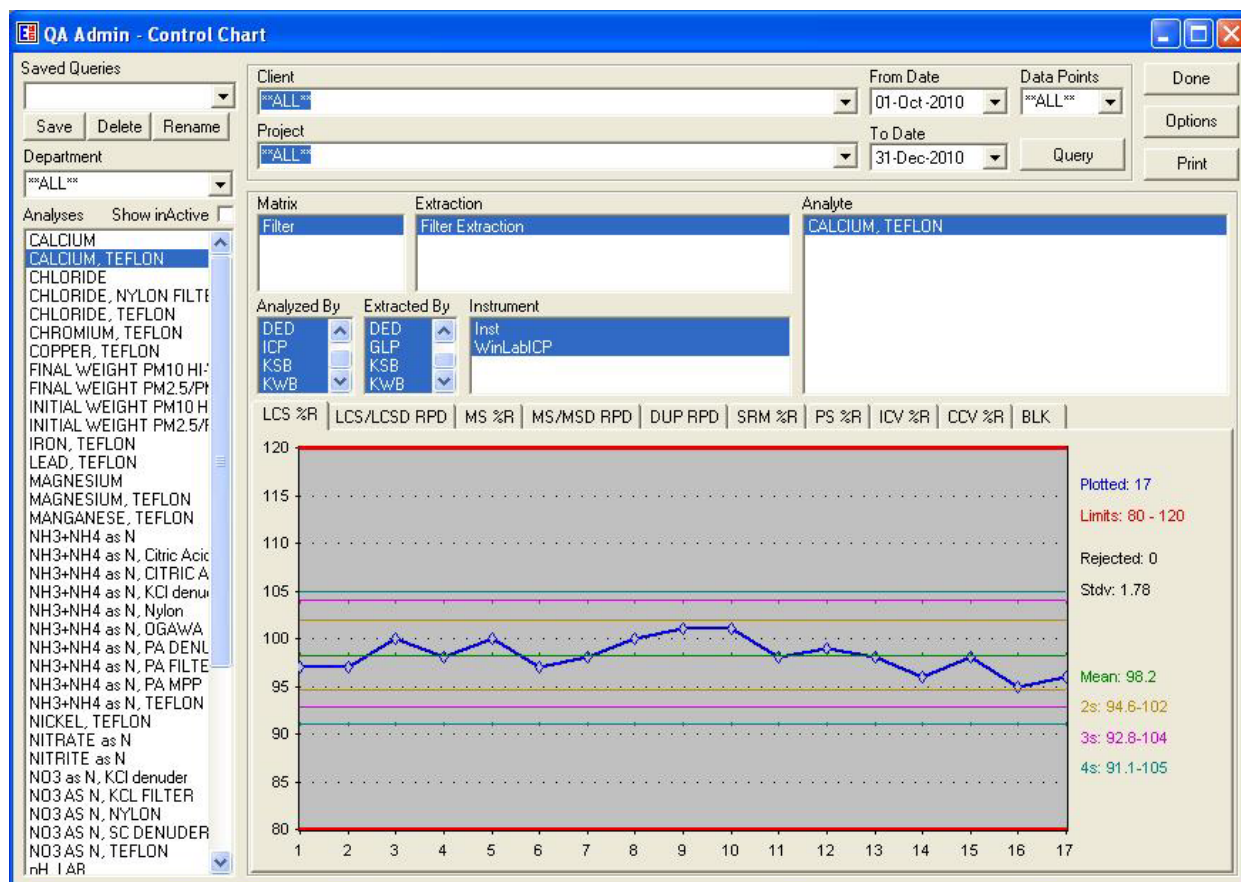
Note: Moving averages will not be calculated and limits will not be continually adjusted.

3.2 Analyst review

Copies of the charts will be maintained in each laboratory. The analyst will compare batch results with charts to check for situations including, but not limited to:

- Excursions beyond three standard deviations from the mean;
- Five or more consecutive points increasing or decreasing;
- Step function changes (see Attachments C & D for examples).

Figure 1. Control Chart Screen in Element



3.3 Corrective actions

Suspect results as defined in 3.2 will be reported to the Laboratory Operations Manager (LOM). Justification will be documented in the data batch comments as per the LOM's direction.

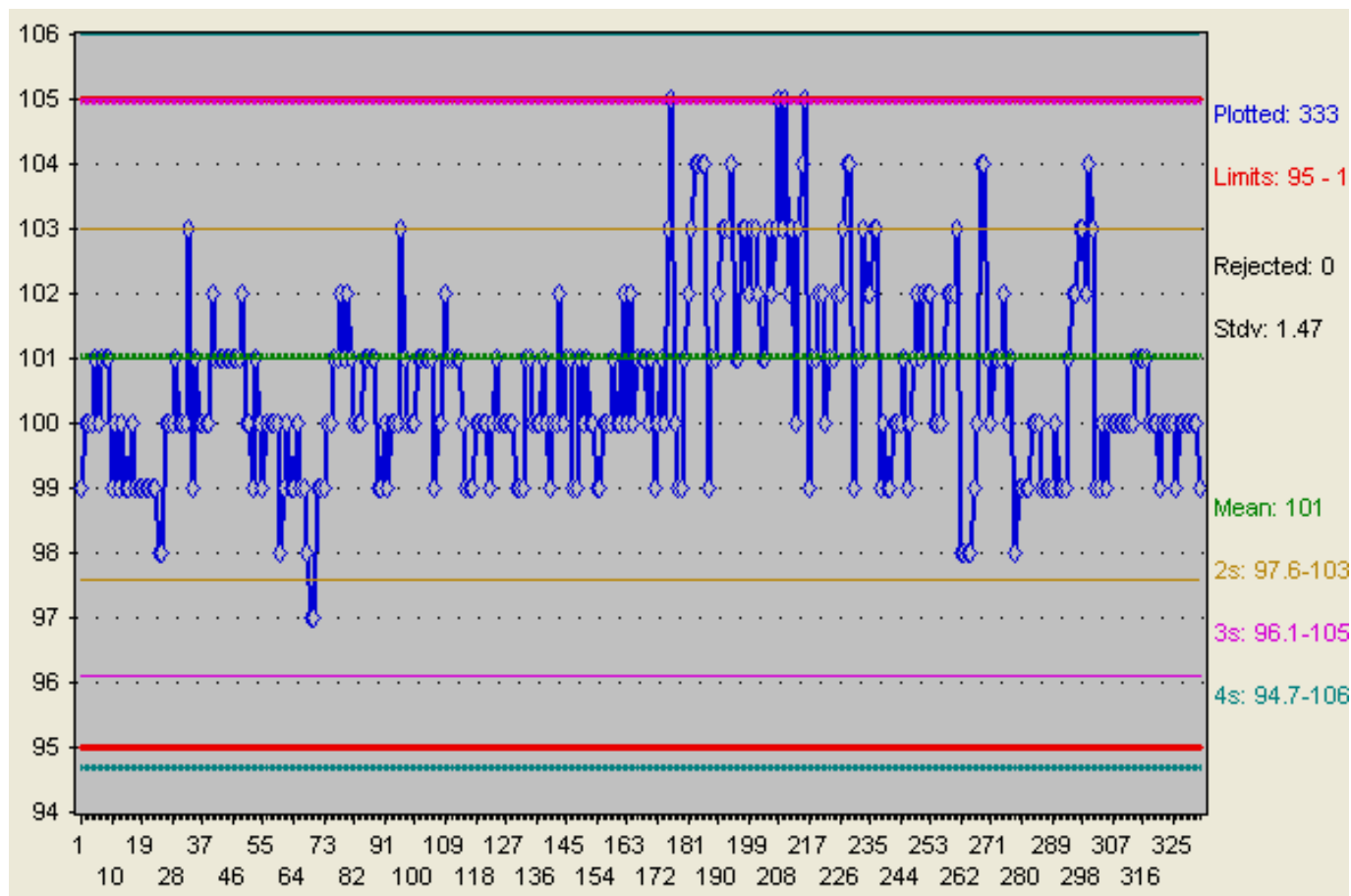
4.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April

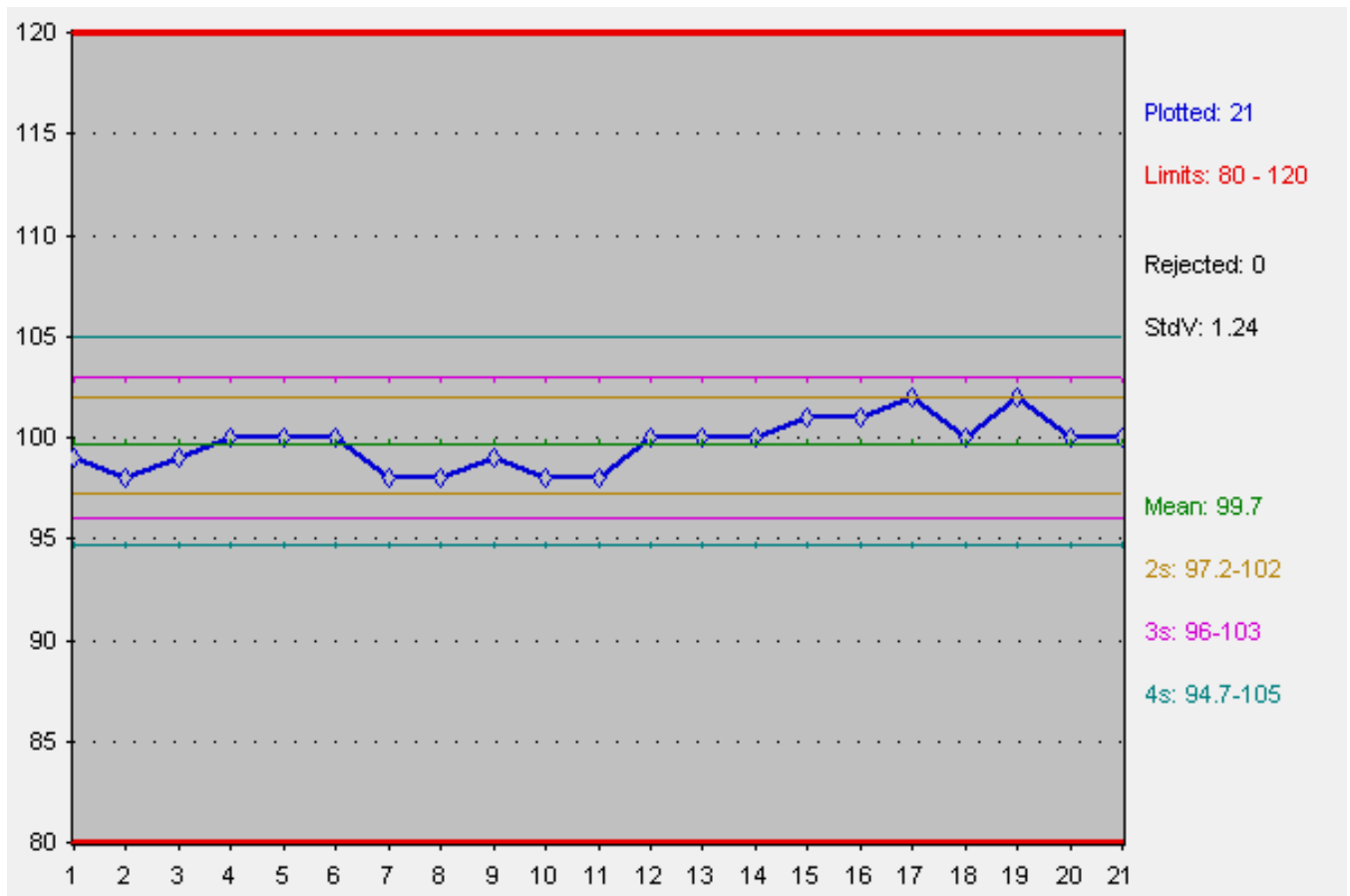
5.0 ATTACHMENTS

- Attachment A – SO₄ Cellulose CCV
- Attachment B – SO₄ Cellulose LCS
- Attachment C – SO₄ Cellulose SRM
- Attachment D – NO₃ as N Teflon SRM
- Attachment E - Uncertainty
- Attachment F – Revisions Table

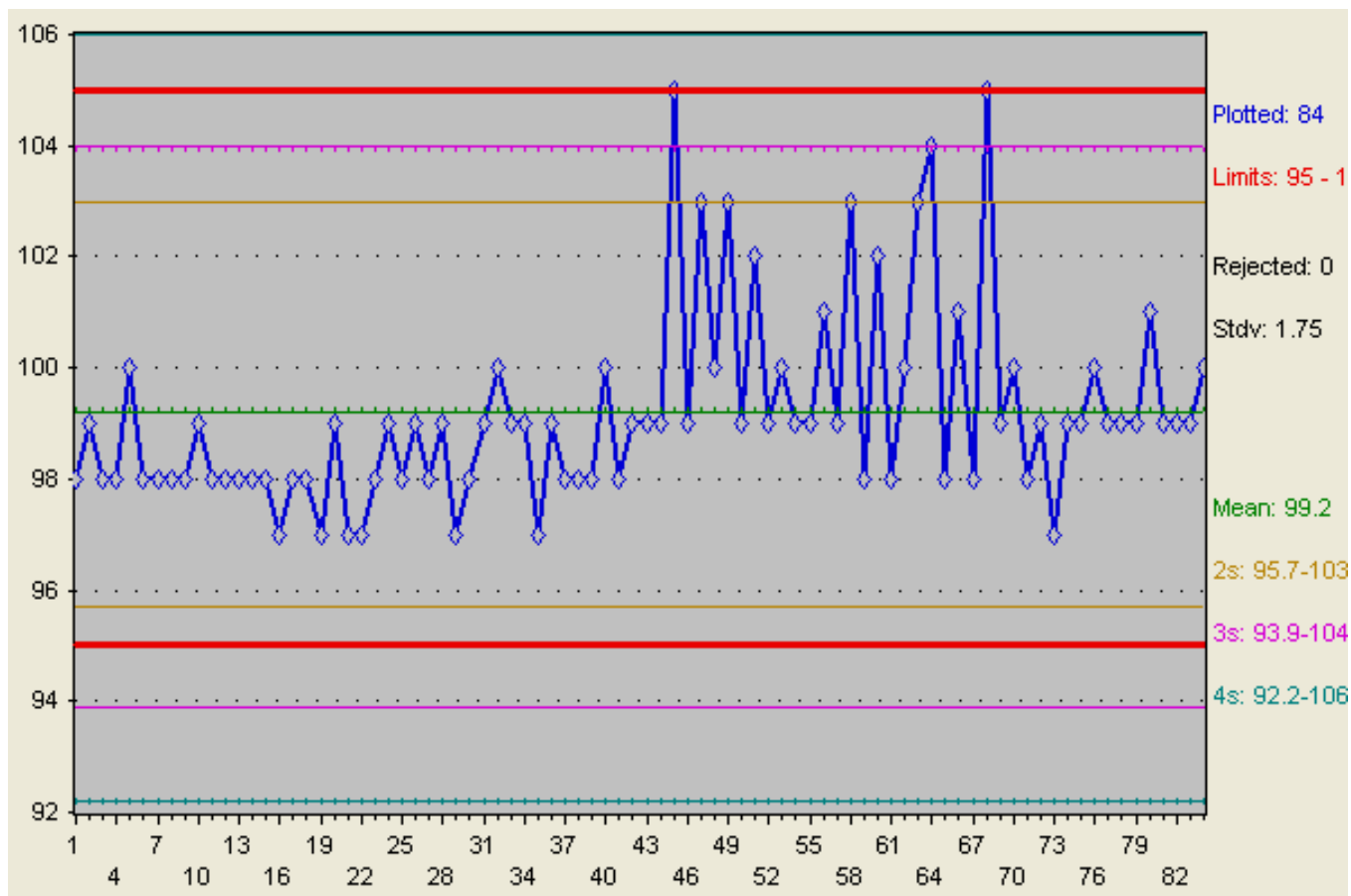
ATTACHMENT A **SO₄ Cellulose CCV**



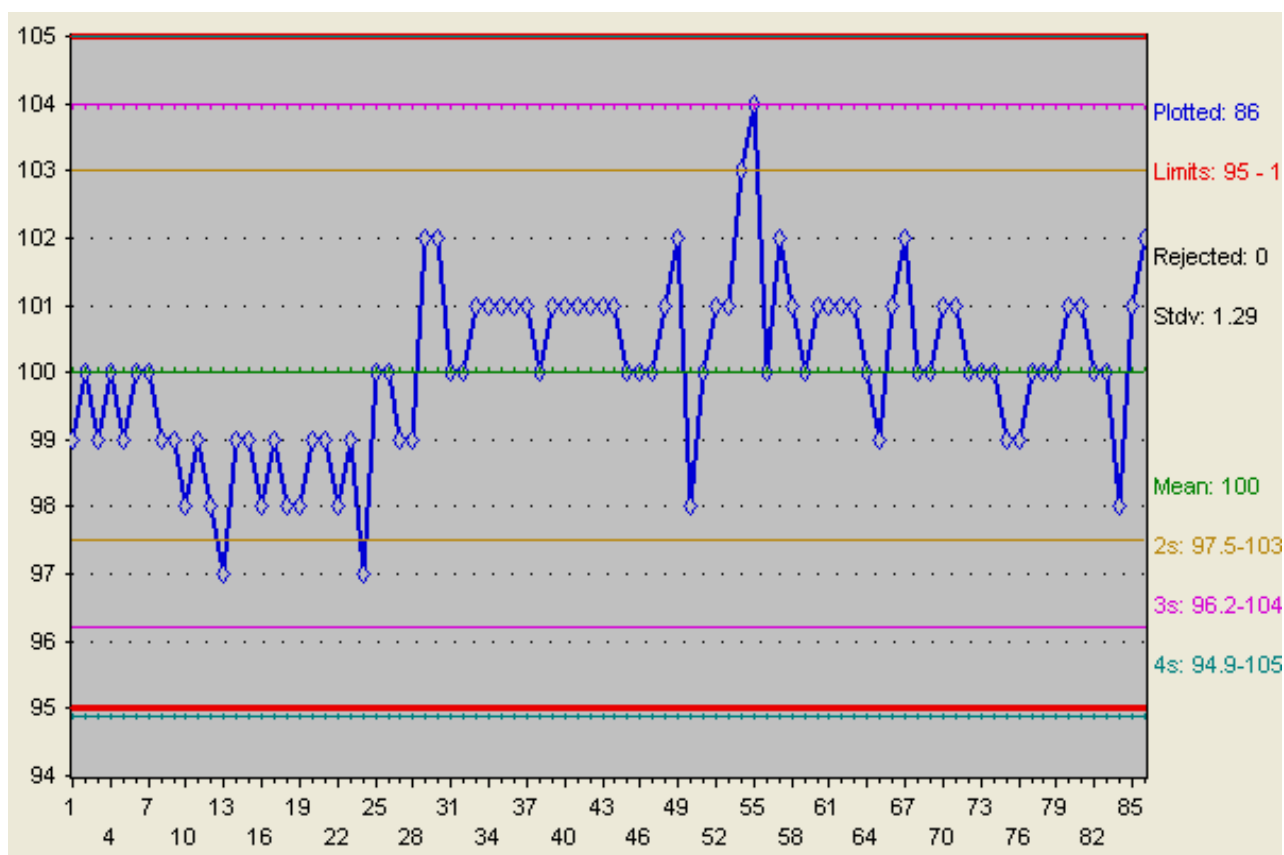
ATTACHMENT B
SO₄ Cellulose LCS



ATTACHMENT C
SO₄ Cellulose SRM



ATTACHMENT D **NO₃ as N Teflon SRM**



ATTACHMENT E

Uncertainty Values

LAB	Amec Foster Wheeler								
All Clients/Projects [10/1/2016 to 3/31/2017 11:59:59 PM]				6 months					
MATRICES	Filter		LIMIT1	80					
CHART	BS %R		LIMIT2	120					
	NH3+NH4 as N, TEFLON	CALCIUM, TEFLON	MAGNESIUM, TEFLON	POTASSIUM, TEFLON	SODIUM, TEFLON	CHLORIDE, TEFLON	NO3 AS N, TEFLON	SO4-TEF	
PLOTTED	32	32	32	32	32	32	32	32	
REJECTED	0	0	0	0	0	0	0	0	
LCL	92.6	91.1	95.1	92.6	93.3	91.7	92.1	96.5	
UCL	103.9	104.6	100.5	102.3	101.9	105.6	101.7	103.2	
MEAN	98.3	97.8	97.8	97.5	97.6	98.7	96.9	99.8	
STDDEV	1.88	2.25	0.90	1.63	1.43	2.32	1.61	1.11	
Uncertainty, %	3.76	4.50	1.79	3.26	2.86	4.64	3.22	2.22	
S2LCL	94.5	93.3	96.0	94.2	94.8	94.0	93.7	97.6	
S2UCL	102	102	99.6	101	100	103	100	102	
S3LCL	92.6	91.1	95.1	92.6	93.3	91.7	92.1	96.5	
S3UCL	104	105	100	102	102	106	102	103	
S4LCL	90.7	88.8	94.2	91	91.9	89.4	90.5	95.4	
S4UCL	106	107	101	104	103	108	103	104	
	NO3 AS N, NYLON	SO4-NYL		SO4-WHT					
PLOTTED	35	35		45					
REJECTED	0	0		0					
LCL	89.1	86.0		87.5					
UCL	103.5	104.8		108.9					
MEAN	96.3	95.4		98.2					
STDDEV	2.40	3.14		3.58					
Uncertainty, %	4.80	6.28		7.16					
S2LCL	91.5	89.2		91.0					
S2UCL	101	102		105					
S3LCL	89.1	86		87.5					
S3UCL	103	105		109					
S4LCL	86.7	82.9		83.9					
S4UCL	106	108		112					

ATTACHMENT F

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
1.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	4.0	Update references
	Attachment B	Addition of this table.
2.0	2.0	Added: "and estimation of uncertainty"
	3.1	Added: 3.1.8 Exporting data for estimation of uncertainty.
	Attachment E	Added: Uncertainty Values
	Attachment F	Revisions Table is now Attachment F
3.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
4.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	3.1.7	Added "percent recovery (%R)".
	Attachment B	Updated.
4.1	All	Update company name WSP USA Environment & Infrastructure, Inc. and apply Arial font formatting.
5.0	All	Update company name to WSP USA Inc.

TITLE: PROCEDURE FOR LABELING AND EXPIRATION OF STANDARDS

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
 Laboratory Operations Manager

Topie, Nathaniel (USNT719661)
Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.25 16:04:44 -05'00'

Reviewed by: Marcus O. Stewart
 QA Manager

 Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 17:28:01 -05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Procedure
- 4.0 References

Annual Review			
Reviewed by:	Title:	Date:	Signature:

PROCEDURE FOR LABELING AND EXPIRATION OF STANDARDS

1.0 Purpose

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for labeling and determining expiration dates for standards and reagents used in sample preparation and quantitative sample analysis.

2.0 Scope

This SOP is a general guideline for determining expiration dates for standards, all dilutions of standards, and reagents. This includes standards and reagents purchased or prepared for use on all projects at WSP.

3.0 Procedure

3.1 Vendor prepared standards and reagents

Standards and reagents purchased from vendors should have an expiration date on the label or certificate of analysis. If the vendor does not supply an expiration date for a reagent, the lab will use a date of five years from receipt.

All reagents received from vendors must have a Certificate of Analysis (see Attachment A). The date received and receiving analyst initials will be recorded on the original certificate. If applicable, the new standard will be entered in the Element DataSystem® (see GLO-3180-035 section 3.4) and assigned a unique Element ID. The Element ID is also recorded on the original certificate.

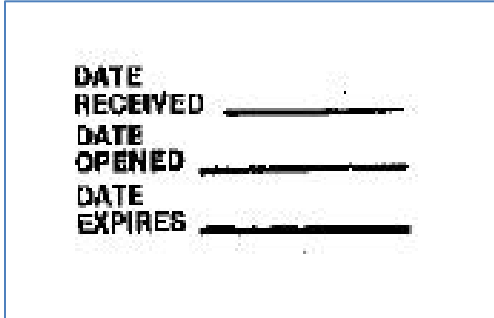
3.2 Lab prepared solutions

Inorganic analyte calibration and quality control solutions for Ion Chromatography (IC) and Inductively Coupled Argon Plasma-Optical Emission Spectrometry (ICP-OES) will have an expiration date one month after preparation. Stock conductivity solutions with a concentration of 0.05 molar (M), or greater, will have an expiration date of one year from preparation. Working conductivity solutions with a concentration less than 0.05 M will have an expiration date of six months from preparation. Concentrated eluents will have an expiration of one year from preparation. Extraction solutions and working eluents will have an expiration of one month from preparation.

3.3 Labeling

All vendor prepared standards and reagents and lab prepared solutions will be labeled with date received/prepared, date opened and expiration date. The analyst receiving/preparing and opening should also include their initials. See Figure 1 for an example of the label that can be affixed to the bottle.

Figure 1. Bottle Label



DATE
RECEIVED _____

DATE
OPENED _____

DATE
EXPIRES _____

4.0 References

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-0//001, EPA QA/G-6, US EPA, Washington, D.C. April.

5.0 Attachments


Attachment A – Certificate of Analysis

Attachment B – Revisions Table

ATTACHMENT A

Certificate of Analysis

Element ID: 7D24001




**HIGH-PURITY
STANDARDS**
www.highpuritystandards.com

P.O. Box 41727
Charleston, SC 29423
Phone (843) 767-7900
Fax (843) 767-7906


PH: 7D24002


Certificate of Analysis

Certified Reference Material*



ISO Guide 34:2009 (RMP) Accreditation
Certificate Number AR-1436





ISO/IEC 17025:2005 Accreditation
Certificate Number AT-1529

Product Description:

Name: Simulated Rainwater Level II
Part Number: SR-2
Lot Number: 1617223
Matrix: H₂O
Purity: 99+%

Certified Values:

Component	Certified Value (mg/L)	NIST SRM ID	NIST SRM Lot #
Chloride	1.06 ± 0.11	3182	060925
Fluoride	0.11 ± 0.01	*	
Nitrate as N	1.59 ± 0.08	3185	050517
Nitrate	7.04 ± 0.35		
Sulfate	9.92 ± 0.50	3181	080603
Sodium	0.40 ± 0.02	3152a	120715
Potassium	0.100 ± 0.004	3141a	140813
Calcium	0.049 ± 0.003	3109a	130213
Magnesium	0.049 ± 0.003	3131a	140110

Certified values are based on gravimetric and volumetric preparation, and verified against NIST SRM 3100 series when available via ion chromatography (IC) and/or inductively coupled plasma optical emission spectrometry (ICP-OES) using an internal laboratory-developed method. The uncertainty in the certified value is calculated for a 95% confidence interval and coverage factor *k* is about 2.
* Refer to Traceability Information, Section d

Packaging and Storage Conditions:
The standard is packaged in a pre-cleaned polyethylene bottle. To maintain the integrity of this product, the solution should be kept tightly capped and stored under normal laboratory conditions.

Expiration Information:
The expiry date is guaranteed to be valid for twelve months from the shipping date provided. For this reason, standards from the same lot may have different expiration dates.

Preparation Date: June 22, 2016
Shipped Date: April 19, 2017
Expiration Date: April 19, 2018
Certificate Issue Date: August 17, 2016

Moven Mututuvvari
Moven Mututuvvari PhD., Laboratory Manager

Original Rev. Date: June 21, 2016
Original Rev. No.: 1.0.0

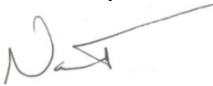
Lot No.: 1617223
Rev. No.: 1.1.0
Page 1 of 2

Rec.
04-21-17
DEL

ATTACHMENT B

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
1.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler Update “atomic emission” to “optical emission”
	4.0	Update references
	Attachment B	Addition of this table.
2.0	3.1	Added requirement for Certificate of Analysis
	3.2	Added expiration requirements for extraction solutions and eluents.
	Attachment A	Added Certificate of Analysis
	Attachment B	Revisions Table is now Attachment B
3.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
4.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	The above revisions to this document do not impact the data generated by the procedure. <div style="text-align: right;">Verified by: </div>	
4.1	All	Update company name to WSP and apply Arial font formatting
5.0	All	Update company name to WSP USA Inc.


TITLE: PROCEDURE FOR CALIBRATION OF PIPETTORS

Effective

Date: 3-6-2025

Prepared by: Nathaniel J. Topie
Laboratory Operations Manager

Topie, Nathaniel
(USNT719661)

 Digitally signed by Topie, Nathaniel
(USNT719661)
Date: 2025.02.25 16:05:27 -05'00'

Reviewed by: Marcus O. Stewart
QA Manager




 Digitally signed by Stewart,
Marcus (USMS719399)
Date: 2025.02.24 17:29:05 -05'00'

TABLE OF CONTENTS

- 1.0 Purpose
- 2.0 Scope
- 3.0 Materials
- 4.0 Procedure
- 5.0 References
- 6.0 Attachments

Annual Review			
Reviewed by:	Title:	Date:	Signature:

PROCEDURE FOR CALIBRATION OF PIPETTORS

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide consistent guidance to the WSP USA Inc. (WSP) laboratory personnel for calibrating pipettors.

2.0 SCOPE

This SOP is applicable to all pipettors which are used to prepare solutions used by the laboratory.

3.0 MATERIALS

- Pipettor, adjustable or fixed.
- Analytical balance capable of accurately weighing to the nearest 0.0001 gram (g)
- Weigh boat or disposable beaker.

4.0 PROCEDURE

- 4.1 Pipettors are received from the manufacturer calibrated and with compliant traceable certification.
- 4.2 Pipettor calibration must be verified each day of use.
- 4.3 Verification is performed as follows:
 - 4.3.1 Place a weigh boat or disposable cup on the analytical balance and tare the balance.
 - 4.3.2 Using the pipettor to be verified, draw the needed volume of deionized water.
 - 4.3.3 Release the deionized water into the tared weigh boat. Record the weight in the appropriate notebook for the balance (see Attachment A).
 - 4.3.4 Tare the weight again and repeat steps 4.3.2 and 4.3.3 two more times, recording the weight each time.
 - 4.3.5 Three consecutive weights must be within criteria for the pipettor to be considered verified.
- 4.4 The pipettor is acceptable if the verification shows that they can deliver within a +/- 1% accuracy. For example, a pipettor calibrated to one mL, must deliver a volume between 0.9900 and 1.0100 mL to be acceptable.
- 4.5 If the pipettor fails criteria and is adjustable, it should be adjusted and the procedure repeated until the three weights are within criteria.
- 4.6 If the pipettor is not adjustable and fails criteria or an adjustable pipettor that can not be properly calibrated, it must be removed from service.

5.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2007. Guidance for the Preparation of Standard Operating Procedures, (SOPs) for Quality-Related Documents. EPA/600/B-07/001, EPA QA/G-6, US EPA, Washington, D.C. April

6.0 ATTACHMENTS

Attachment A – Example Logbook Page

Attachment B – Revisions Table

ATTACHMENT A


Pipettor Calibration Logbook Page

Date	Initials	Pipette #1	Reading #1	Reading #2	Reading #3
03-05-21	DCL	B600134	1.0003g	1.0000g	0.9998g
03/05/21	JTA	R29596D	0.9997g	0.9995g	1.0001g
03/08/21	NJT	M42133E	1.0002g	1.0002g	0.9994g
03-09-21	DCL	B600134	1.0004g	1.0005g	1.0001g
03/11/21	JTA	R29596D	0.9999g	1.0002g	1.0001g
03-12-21	DCL	B600134	1.0002g	0.9997g	0.9996g
03-12-21	NJT	M42133E	1.0001g	0.9998g	0.9998g
03-17-21	JTA	R29596D	1.0004g	0.9997g	1.0001g
03-19-21	DCL	B600134	1.0003g	0.9998g	0.9996g
03-19-21	NJT	M42133E	0.9998g	1.0001g	0.9997g
03-20-21	JTA	R29596D	0.9996g	0.9997g	0.9997g
03-23-21	DCL	B600134	1.0001g	0.9996g	0.9998g
03-23-21	NJT	M42133E	1.0002g	1.0002g	0.9999g
03-24-21	JTA	R29596D	1.0001g	0.9998g	1.0004g
03-30-21	DCL	B600134	1.0004g	1.0001g	1.0000g
03-31-21	NJT	M42133E	0.9998g	0.9995g	0.9996g
04-06-21	DCL	B600134	1.0003g	1.0002g	0.9999g
04-06-21	NJT	M42133E	0.9999g	0.9996g	0.9998g
04-07-21	JTA	R29596D	1.0003g	1.0004g	1.0001g
04-08-21	DCL	R29607D	0.9998g	1.0004g	0.9999g
04-08-21	JTA	R296596D	0.9999g	1.0001g	1.0002g
04-08-21	NJT	M42133E	0.9998g	1.0000g	0.9995g
04-09-21	JTA	R29596D	1.0004g	1.0004g	1.0001g
04-13-21	DCL	R29607D	1.0005g	1.0001g	0.9997g
04-14-21	JTA	R296596D	0.9998g	0.9996g	1.0002g
04-15-21	NJT	M42133E	1.0002g	0.9998g	1.0004g
04-18-21	JTA	R29596D	0.9997g	0.9995g	0.9996g
04-20-21	DCL	R29607D	1.0003g	1.0005g	1.0002g
04-20-21	NJT	M42133E	1.0006g	1.0003g	1.0004g
04-22-21	DCL	R29607D	1.0000g	0.9996g	0.9998g
04-23-21	JTA	R29596D	1.0003g	1.0000g	1.0002g
04-23-21	NJT	M42133E	0.9998g	0.9995g	0.9995g
04-27-21	DCL	R29607D	1.0004g	1.0005g	1.0002g

ATTACHMENT B

Revisions Table

Table - Revisions

Document Revision No.	Section	Revision
2.0	Signature page	Remove Garry Price and add Kathy Barry as Laboratory Operations Manager
	All	Update company name to Amec Foster Wheeler
	5.0	Update references
	Attachment B	Addition of this table.
3.0	All	Update company name to Wood Environment & Infrastructure Solutions, Inc. and apply Wood font formatting
4.0	4.0	Added Section 4.1 describing calibration procedure. Changed “calibrated” wording to “verified.”
	Attachment A	Updated logbook image
5.0	Signature page	Updated Laboratory Manager to Nathaniel J. Topie. Removed Katherine W. Barry.
	4.1	Deleted wording suggesting annual calibration
	The above revisions to this document do not impact the data generated by the procedure. Verified by: 	
5.1	All	Update company name to WSP and apply Arial font formatting
6.0	All	Update company name to WSP USA Inc.