

BC



B1877

MV ✓

November 2, 2021

Mr. Brian Carley
EGLE
AQD - Jackson District
301 East Louis Glick Highway
Jackson, Michigan 49201

RECEIVED
MDEQ - JACKSON

NOV 09 2021

RE: October 13, 2021, Violation Notice – Sulfuric Acid Mist

AIR QUALITY DIVISION

Mr. Carley,

As stated in the violation notice, Guardian Industries performed a stack test on July 13, 2021, to determine compliance with emission limits for PM and H₂SO₄. The draft test report was received, and it was noted that the result from test runs 2 and 3 on the day of testing indicated higher than expected results for H₂SO₄. Guardian Industries submitted the test report in draft form and immediately began investigating the root cause of the high result.

The laboratory results for the reported test runs have uncharacteristic variability despite the stable operation of the source during testing. Test Run #1 test results were within expected ranges for H₂SO₄; however, Test Run #2 and #3 have the same analytical result but indicate levels nearly 15 times higher than Test Run #1 results. The delta between Run #1 and Test Runs #2 and #3 and elevated results suggests error within the testing process. The identical analytical result for Test Runs #2 and #3 is similarly concerning from a data reliability standpoint. Based on this information, Guardian does not believe that this is indicative of the operations during the time from initial testing to the subsequent testing performed on October 5, 2021.

Enclosed in this submittal is the final test report for the H₂SO₄ emissions testing performed on October 5, 2021. The results from this testing indicate H₂SO₄ emissions of 0.383 lbs per hour, following CTM-013.

Guardian affirms that the initial testing performed on July 13, 2021, is not representative of operation emissions and the testing on October 5, 2021, is representative of operation emissions.

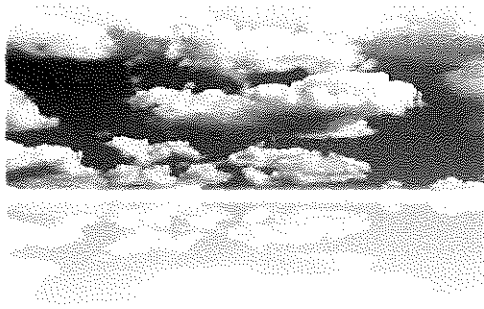
The final test report will be submitted following the required submittal process for source emissions testing.

Please contact Mr. Benjamin Kroeger at (734) 654-4252 or Benjamin.kroeger@guardian.com, if you have any questions or need further assistance.

Regards,

James Martin

cc: Ms. Jenine Camilleri



REPORT ON COMPLIANCE
TESTING

Carleton, Michigan
Stack (EU00079)

Guardian Industries, LLC
14600 Romine Road
Carleton, Michigan 48117
Client Reference No. G000243910

CleanAir Project No. 14485
A2LA ISO 17025 Certificate No. 4342.01
A2LA / STAC Certificate No. 4342.02
Revision 0, Final Report
October 28, 2021

COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Submittal:



October 28, 2021

Josh Childers, P.E., QSTI
Project Manager
State of Washington, Professional Engineer No. 20110720
jchilders@cleanair.com
(800) 632-1619 ext. 2072

Date

I hereby certify that the information contained within the final test report has been reviewed and, to the best of my ability, verified as accurate.

Independent Report Review



October 28, 2021

Jeff Reppert, QSTI
Project Manager
jreppert@cleanair.com
(800) 632-1619 ext. 2145

Date

CleanAir

Guardian Industries, LLC
Carleton, Michigan
Report on Compliance Testing

CleanAir Project No. 14485
Revision 0, Final Report
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REPORT REVISION HISTORY

Version	Revision	Date	Pages	Comments
Draft	D0a	10/26/2021	All	Draft version of original document.
Final	0	10/28/2021	All	Final version of original document.

PROJECT PERSONNEL

Name	Affiliation	Project Responsibility
Benjamin Kroeger, CPS, FSO	Guardian Industries, LLC	Client Contact
Josh Childers	CleanAir	Project Manager
Josh Lord	CleanAir	Project Field Leader / CleanAir IC Operator
Jeff Reppert	CleanAir	Independent Review of Report
Eric Doak	CleanAir	Field Engineer
Jon Kolling	CleanAir	Field Engineer
AJ Pallone	CleanAir	Field Scientist
Natassia Kupchick	CleanAir	Report Coordinator

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ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)	ft ² (square feet)	ml (milliliter(s))
acfm (actual cubic feet per minute)	ft ³ (cubic feet)	MMBtu (million British thermal units)
ACI (activated carbon injection)	ft/sec (feet per second)	MW (megawatt(s))
ADL (above detection limit)	FTIR (Fourier Transform Infrared Spectroscopy)	NCASI (National Council for Air and Stream Improvement)
AIG (ammonia injection grid)	FTRB (field train reagent blank)	ND (non-detect)
APC (air pollution control)	g (gram(s))	NDIR (non-dispersive infrared)
AQCS (air quality control system(s))	GC (gas chromatography)	NDO (natural draft opening)
ASME (American Society of Mechanical Engineers)	GFAAS (graphite furnace atomic absorption spectroscopy)	NESHAP (National Emission Standards for Hazardous Air Pollutants)
ASTM (American Society for Testing and Materials)	GFC (gas filter correlation)	ng (nanogram(s))
BDL (below detection limit)	gr/dscf (grains per dry standard cubic feet)	Nm ³ (Normal cubic meter)
Btu (British thermal units)	> (greater than)/ ≥ (greater than or equal to)	% (percent)
CAM (compliance assurance monitoring)	g/s (grams per second)	PEMS (predictive emissions monitoring systems)
CARB (California Air Resources Board)	H ₂ O (water)	PFGC (pneumatic focusing gas chromatography)
CCM (Controlled Condensation Method)	HAP(s) (hazardous air pollutant(s))	pg (picogram(s))
CE (capture efficiency)	HI (heat input)	PJFF (pulse jet fabric filter)
°C (degrees Celsius)	hr (hour(s))	ppb (parts per billion)
CEMS (continuous emissions monitoring system(s))	HR GC/MS (high-resolution gas chromatography and mass spectrometry)	PPE (personal protective equipment)
CFB (circulating fluidized bed)	HRVOC (highly reactive volatile organic compounds)	ppm (parts per million)
CFR (Code of Federal Regulations)	HSRG(s) (heat recovery steam generator(s))	ppm _{dv} (parts per million, dry volume)
cm (centimeter(s))	HVT (high velocity thermocouple)	ppm _{wv} (parts per million, wet volume)
COMS (continuous opacity monitoring system(s))	IC (ion chromatography)	PSD (particle size distribution)
CT (combustion turbine)	IC/PCR (ion chromatography with post column reactor)	psi (pound(s) per square inch)
CTI (Cooling Technology Institute)	ICP/MS (inductively coupled argon plasma mass spectrometry)	PTE (permanent total enclosure)
CTM (Conditional Test Method)	ID (induced draft)	PTFE (polytetrafluoroethylene)
CVAAS (cold vapor atomic absorption spectroscopy)	in. (inch(es))	QA/QC (quality assurance/quality control)
CVAFS (cold vapor atomic fluorescence spectrometry)	in. H ₂ O (inches water)	QI (qualified individual)
DI H ₂ O (de-ionized water)	in. Hg (inches mercury)	QSTI (qualified source testing individual)
%dv (percent, dry volume)	IPA (isopropyl alcohol)	QSTO (qualified source testing observer)
DLL (detection level limited)	ISE (ion-specific electrode)	RA (relative accuracy)
DE (destruction efficiency)	kg (kilogram(s))	RATA (relative accuracy test audit)
DCI (dry carbon injection)	kg/hr (kilogram(s) per hour)	RB (reagent blank)
DGM (dry gas meter)	< (less than)/ ≤ (less than or equal to)	RE (removal or reduction efficiency)
dscf (dry standard cubic feet)	L (liter(s))	RM (reference method)
dscfm (dry standard cubic feet per minute)	lb (pound(s))	scf (standard cubic feet)
dscm (dry standard cubic meter)	lb/hr (pound per hour)	scfm (standard cubic feet per minute)
ESP (electrostatic precipitator)	lb/MMBtu (pound per million British thermal units)	SCR (selective catalytic reduction)
FAMS (flue gas adsorbent mercury speciation)	lb/TBtu (pound per trillion British thermal units)	SDA (spray dryer absorber)
*F (degrees Fahrenheit)	lb/lb-mole (pound per pound mole)	SNCR (selective non-catalytic reduction)
FB (field blank)	LR GC/MS (low-resolution gas chromatography and mass spectrometry)	STD (standard)
FCC (fluidized catalytic cracking)	m (meter)	STMS (sorber trap monitoring system)
FCCU (fluidized catalytic cracking unit)	m ³ (cubic meter)	TBtu (trillion British thermal units)
FEGT (furnace exit gas temperatures)	MACT (maximum achievable control technology)	TEOM (Tapered Element Oscillating Microbalance)
FF (fabric filter)	MASS [®] (Multi-Point Automated Sampling System)	TEQ (toxic equivalency quotient)
FGD (flue gas desulfurization)	MATS (Mercury and Air Toxics Standards)	ton/hr (ton per hour)
FIA (flame ionization analyzer)	MDL (method detection limit)	ton/yr (ton per year)
FID (flame ionization detector)	μg (microgram(s))	TSS (third stage separator)
FPD (flame photometric detection)	min. (minute(s))	USEPA or EPA (United States Environmental Protection Agency)
FRB (field reagent blank)	mg (milligram(s))	UVA (ultraviolet absorption)
FSTM (flue gas sorbent total mercury)		WFGD (wet flue gas desulfurization)
ft (feet or foot)		%wv (percent, wet volume)

1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

Guardian Industries, LLC (Guardian) contracted Clean Air Engineering (CleanAir) to complete testing on the stack of the flat gas manufacturing Line #1 (EU00079) at the Guardian facility located in Carleton, Michigan. The objective of the test program was to complete compliance measurements for sulfuric acid mist emissions per the facility's (State Registration Number: B1877) Renewable Operating Permit (ROP) Number: MI-ROP-B1877-2021b.

A summary of the test program results is presented below. Section 2 (Results) provides a more detailed account of the test conditions and data analysis.

**Table 1-1:
Summary of Results**

Source	Sampling Method	Average Emission	Permit Limit¹
<u>EU(00079) Stack</u>			
H ₂ SO ₄ (lb/hr)	CTM-013	0.4	1.6

¹ Permit limits obtained from Michigan ROP Number: MI-ROP-B1877-2021b.

TEST PROGRAM DETAILS

PARAMETERS

The test program included the following measurements:

- sulfuric acid mist (H₂SO₄)
- flue gas composition (e.g., O₂, CO₂, H₂O)
- flue gas temperature and flow rate

SCHEDULE

Testing was performed on October 5, 2021. Table 1-2 outlines the on-site schedule followed during the test program.

**Table 1-2:
Test Schedule**

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	EU00079 Stack	CTM-013	H ₂ SO ₄	10/05/21	08:40	09:40
2	EU00079 Stack	CTM-013	H ₂ SO ₄	10/05/21	10:35	11:35
3	EU00079 Stack	CTM-013	H ₂ SO ₄	10/05/21	12:26	13:26
3	EU00079 Stack	USEPA Method 2	Velocity & Flow Rate	10/05/21	09:45	10:00
4	EU00079 Stack	USEPA Method 2	Velocity & Flow Rate	10/05/21	11:37	11:54
5	EU00079 Stack	USEPA Method 2	Velocity & Flow Rate	10/05/21	13:30	13:50

DISCUSSION

Project Synopsis

CleanAir conducted three valid 1-hour CTM-013 tests for the determination of sulfuric acid mist only. During each CTM-013 test, CleanAir conducted a complete velocity traverse. The CTM-013 train pulled a minimum of 21 scf and the impingers were gravimetrically measured before and after each test to determine moisture content from each test. The dry gas meter collected an integrated sample containing slipstream of dry gas into a bag for analysis in the CleanAir test trailer for oxygen and carbon dioxide.

At the conclusion of each test, samples were appropriately recovered and sent to the on-site laboratory trailer for analysis. CleanAir analyzed the samples on-site by both barium-thorin titration procedures and ion chromatography (IC) for sulfate (SO₄²⁻).

CleanAir performed a conditioning test run, Run 0, on Monday, October 4th as required by the methodology. The results are not included in the averages, but all data is contained within Appendix E of this test report.

EGLE required an audit sample for this test program. The audit sample results were reported from the barium-thorin titration procedure. Therefore, results in this report are reported based on the titration results as well.

Audit Sample Results

The ERA audit sample report can be found in Appendix J. CleanAir reported a value of 55.169 mg/dscm versus the ERA assigned value of 55.2 mg/dscm. The acceptable range was between 49.7 – 60.7 mg/dscm.

Modifications to Test Methodology

CTM-013 did not contain impingers of hydrogen peroxide as sulfur dioxide determination is not required for reporting analysis.

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

**Table 2-1:
 Stack (EU00079) – H₂SO₄**

Run No.	1	2	3	Average
Date (2021)	Oct 5	Oct 5	Oct 5	
Start Time (approx.)	08:40	10:35	12:26	
Stop Time (approx.)	09:40	11:35	13:26	
Process Conditions				
R _p Production rate - (tons produced/hr)	411	411	411	411
Gas Conditions				
O ₂ Oxygen (dry volume %)	11.1	10.8	10.4	10.8
CO ₂ Carbon dioxide (dry volume %)	7.9	8.5	8.9	8.4
T _s Stack temperature (°F)	589	589	586	588
B _w Actual water vapor in gas (% by volume)	14.60	13.23	14.66	14.16
Gas Flow Rate				
Q _a Volumetric flow rate, actual (acfm)	87,200	86,400	87,100	86,900
Q _s Volumetric flow rate, standard (scfm)	41,800	41,400	41,800	41,700
Q _{std} Volumetric flow rate, dry standard (dscfm)	36,400	35,400	36,200	36,000
Sampling Data				
V _{msid} Volume metered, standard (dscf)	21.99	21.94	21.92	21.95
Laboratory Data (Ion Chromatography)				
m _n Total H ₂ SO ₄ collected (mg)	1.9093	1.1935	2.1788	
Sulfuric Acid (H₂SO₄) Results (Ion Chromatography)				
C _{sd} H ₂ SO ₄ Concentration (ppmdv)	0.752	0.471	0.861	0.695
E _{lb/hr} H ₂ SO ₄ Rate (lb/hr)	0.418	0.255	0.477	0.383
Laboratory Data (Titration)				
m _n Total H ₂ SO ₄ collected (mg)	1.83888	1.34851	2.02276	
Sulfuric Acid (H₂SO₄) Results (Titration)				
C _{sd} H ₂ SO ₄ Concentration (ppmdv)	0.725	0.533	0.800	0.686
E _{lb/hr} H ₂ SO ₄ Rate (lb/hr)	0.402	0.288	0.442	0.377

End of Section

3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Guardian's flat glass manufacturing Line #1 consists of a raw material melting Furnace, glass forming and finishing, and glass cutting. Line #1 produces flat glass using the float method. Materials are weighed and mixed with water in the batch house before entering the natural gas-fired Furnace. Glass then enters the tin bath to be formed and drawn. Next, it enters a Lehr to reduce its temperature. The natural gas-fired Furnace portion of the emission unit is controlled by a Control Device consisting of a Dry Scrubber (DS), Particulate Filter (PF), and Selective Catalytic Reduction (SCR).

The emission unit includes a 4,000 cubic foot Dry Scrubber reagent storage silo equipped with a passive bin vent and a 20,000-gallon pressurized aqueous ammonia storage tank.

The testing reported in this document was performed at the Stack location (EU00079) and the glass product ID was Ultra Clear during the test period.

TEST LOCATION

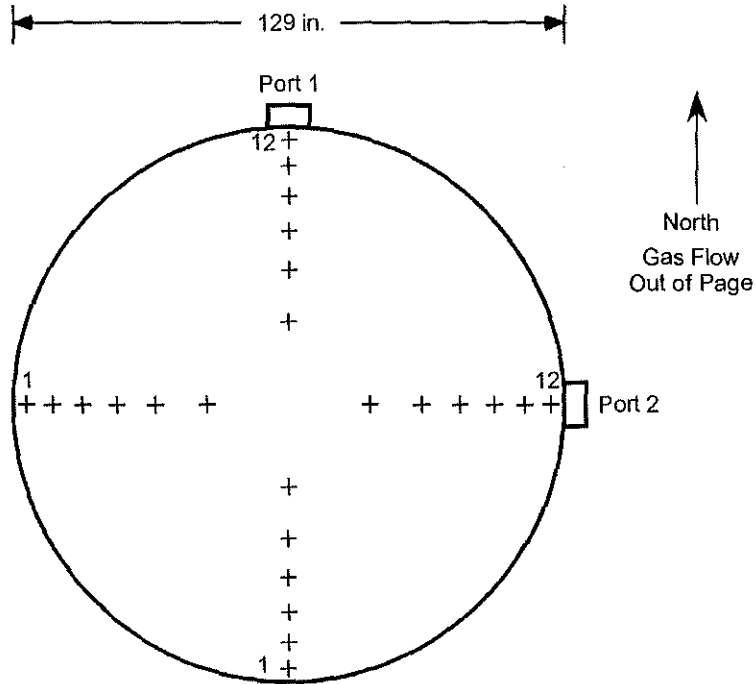
The sample point placement was determined by EPA Method 1 specifications. Table 3-1 presents the sampling information for the test location. The figure represents the layout of the test location.

**Table 3-1:
Sampling Information**

<u>Source</u>		<u>Run</u>	<u>Points per</u>	<u>Minutes</u>	<u>Total</u>	
<u>Constituent</u>	<u>Method</u>	<u>No.</u>	<u>Port</u>	<u>per Point</u>	<u>Minutes</u>	<u>Figure</u>
<u>Stack</u>						
Flow Rate	EPAM2	1-3	4	6	Varied	Varied 3-1
H ₂ SO ₄	CTM-013	1-3	1	1	60	60 NA ¹

¹ H₂SO₄ was sampled at the approximate center of the duct. Readings were taken every 5 minutes.

**Figure 3-1:
 Stack (EU00079) Sample Point Layout (EPA Method 1)**



Traverse Point	% of Stack Diameter	Port to Point Distance (Inches)
1	97.9	126.3
2	93.3	120.4
3	88.2	113.8
4	82.3	106.2
5	75.0	96.8
6	64.4	83.1
7	35.6	45.9
8	25.0	32.3
9	17.7	22.8
10	11.8	15.2
11	6.7	8.6
12	2.1	2.7

Duct diameters upstream from flow disturbance (A): 11.2
 Duct diameters downstream from flow disturbance (B): 7.0

Limit: 0.5
 Limit: 2.0

4. METHODOLOGY

PROCEDURES AND REGULATIONS

The test program sampling measurements followed procedures and regulations outlined by the USEPA and Michigan Department of Environment, Great Lakes, and Energy (EGLE). These methods appear in detail in Title 40 of the CFR and at <https://www.epa.gov/emc>.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

TITLE 40 CFR PART 60, APPENDIX A

- Method 1 "Sample and Velocity Traverses for Stationary Sources"
- Method 2 "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
- Method 3 "Gas Analysis for the Determination of Dry Molecular Weight"
- Method 3A "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
- Method 4 "Determination of Moisture Content in Stack Gases"

CTM-013 (MOD.) CONTROLLED CONDENSATION METHOD (CCM)

"Determination of Sulfur Oxides Including Sulfur Dioxide, Sulfur Trioxide and Sulfuric Acid Vapor and Mist from Stationary Sources Using a Controlled Condensation Sampling Apparatus"

METHODOLOGY DISCUSSION

VOLUMETRIC FLOW RATE – METHODS 1-4

EPA Methods 1, 2, 3 and 4 of 40 CFR 60, Appendix A, were followed to determine the average flue gas composition and volumetric flow rate. These methods determined several characteristics of the flue gas stream: velocity, moisture, flow rate, and the concentrations of oxygen (O₂) and carbon dioxide (CO₂).

SULFURIC ACID MIST – CTM-013

CleanAir followed EPA Conditional Test Method 013 (CTM-013). This method is applicable for the determination of sulfur trioxide (SO₃) and sulfuric acid vapor/mist (H₂SO₄) using a controlled condensation sampling system.

Key operating parameters include:

- Probe was maintained at a temperature of >350°F.
- Quartz fiber filter was maintained at a temperature of >500°F.
- H₂SO₄ condenser - Modified Graham condenser, filled with water and temperature maintained between 75 and 85°C (167 to 185°F).

A second filter referred to as the sulfuric acid mist (SAM) filter, was located at the condenser outlet for the collection of residual sulfuric acid aerosols not collected by the condenser. The condenser temperature was regulated by a water jacket and the SAM filter is regulated by a closed oven. Both the water jacket and oven were maintained between 167°F to 185°F. The condenser and SAM filter (glass frit) were maintained above the water dew point, which eliminates the problem of oxidation of dissolved SO₂.

The condenser collection media, including the coil condenser rinse and glass frit, were extracted with DI water.

End of Section

5. APPENDIX

Appendix A: Test Method Specifications

Appendix B: Sample Calculations

Appendix C: Parameters

Appendix D: QA/QC Data

Appendix E: Field Data

Appendix F: Field Data Printouts

Appendix G: Laboratory Data

Appendix H: Facility Operating Data

Appendix I: Chromatograms

Appendix J: Audit Sample Report

Appendix K: CleanAir Resumes and Certifications

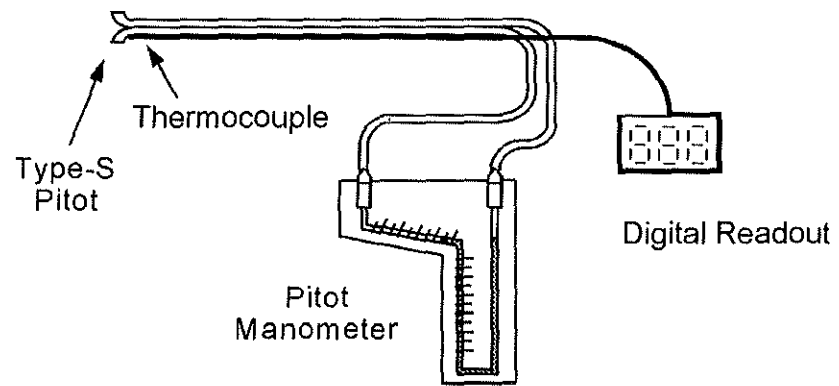
APPENDIX A: TEST METHOD SPECIFICATIONS

Specification Sheet for EPA Method 2

Source Location Name(s) Stack (EU00079)
 Pollutant(s) to be Determined None
 Other Parameters to be Determined from Train Flow Rate

	<u>Standard Method Specification</u>	<u>Actual Specification Used</u>
Pollutant Sampling Information		
Duration of Run	N/A	Varied
No. of Sample Traverse Points	N/A	12
Sample Time per Point	N/A	Varied
Sampling Rate	N/A	N/A
Sampling Probe		
Nozzle Material	N/A	N/A
Nozzle Design	N/A	N/A
Probe Liner Material	N/A	N/A
Effective Probe Length	Sufficient to Traverse Points	15 feet
Probe Temperature Set-Point	N/A	N/A
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	N/A	N/A
Meter Resolution	N/A	N/A
Meter Size	N/A	N/A
Meter Calibrated Against	N/A	N/A
Pump Type	N/A	N/A
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4°F	1.0°F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	N/A	N/A
Filter Holder Material	N/A	N/A
Filter Support Material	N/A	N/A
Cyclone Material	N/A	N/A
Filter Heater Set-Point	N/A	N/A
Filter Material	N/A	N/A
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

EPA Method 2 Sampling Train Configuration



Specification Sheet for EPA CTM-013

Source Location Name(s) Stack (EU00079)
 Pollutant(s) to be Determined Sulfuric Acid Mist (H₂SO₄)
 Other Parameters to be Determined from Train Gas Density, Moisture

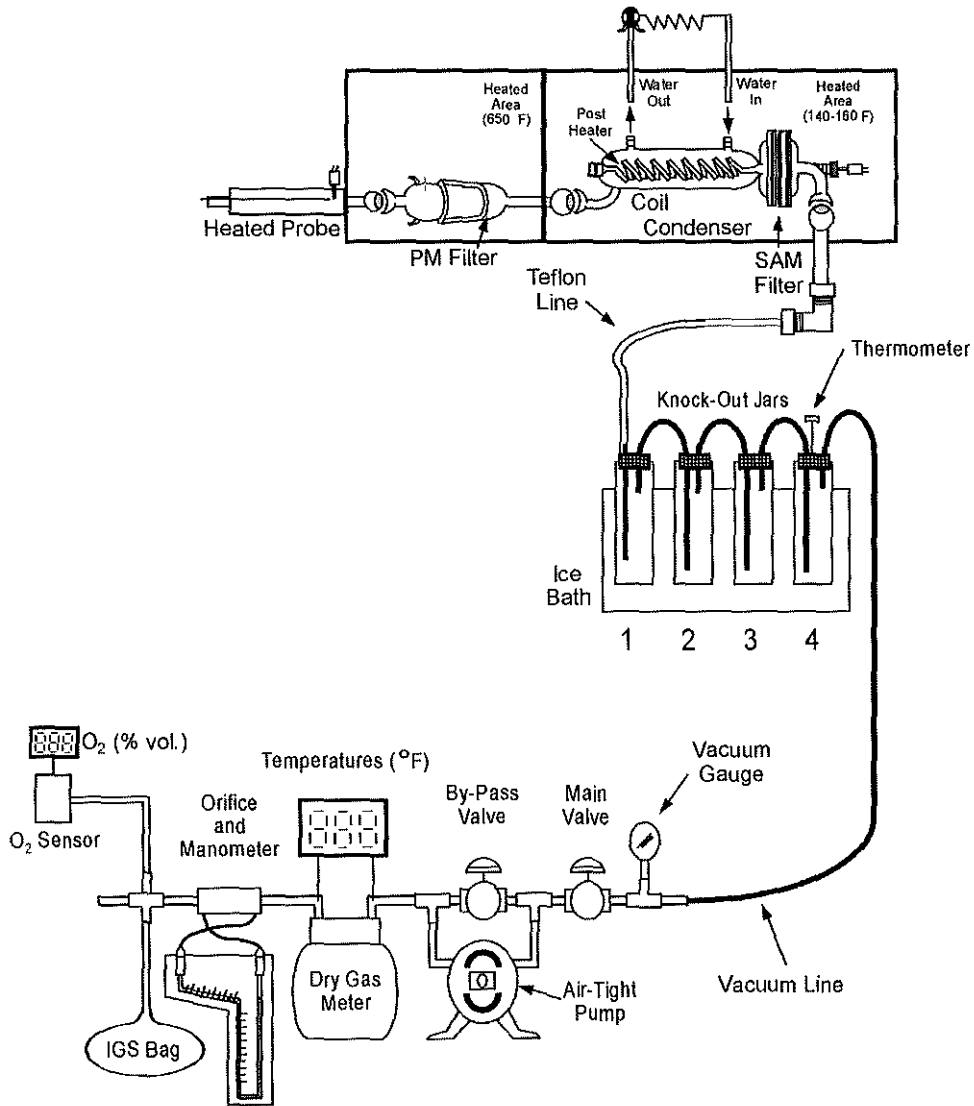
	<u>Standard Method Specification</u>	<u>Actual Specification Used</u>
Pollutant Sampling Information		
Duration of Run	60 minutes (minimum)	60 minutes
No. of Sample Traverse Points	1	1
Sample Time per Point	60 minutes (minimum)	60 minutes
Sampling Rate	Constant rate of at least 10.0 Lpm	Constant rate of at least 10.0 Lpm
Sampling Probe		
Nozzle Material	N/A	None
Nozzle Design	N/A	N/A
Probe Liner Material	Borosilicate Glass or Quartz	Quartz
Effective Probe Length	For dry stacks sufficient probe length to test 3.28ft from the stack wall. For WFGD Outlets use a minimum probe length of 10ft	6 ft., minimum
Probe Temperature Set-Point	>350°F	>350°F
Velocity Measuring Equipment		
Pitot Tube Design	N/A	None
Pitot Tube Coefficient	N/A	N/A
Pitot Tube Calibration by	N/A	N/A
Pitot Tube Attachment	N/A	N/A
Metering System Console		
Meter Type	Dry gas meter or controlled orifice	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	N/A	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	±5°F	1.0°F
ΔP Differential Pressure Gauge	N/A	N/A
ΔH Differential Pressure Gauge	N/A	Inclined Manometer
Barometer	Capable of measurement within 0.1 in. Hg	Digital Barometer calibrated w/Mercury Aneroid
Particulate (PM) Filter		
Filter Location	Exit of Probe	Exit of Probe
Connection to probe liner by	Direct glass-to-glass	Direct glass-to-glass
Filter Holder Material	Quartz	Quartz
Filter Support Material	Glass frit	Quartz
Cyclone Material	N/A	None
Filter Heater Set-Point	>500°F	>500°F
Filter Material	Sintered Glass Frit	Sintered Glass Frit
SO₃ Coil condenser		
Description	Coil Condenser with water jacket	Coil Condenser with water jacket
Location	After PM Filter	After PM filter
Connection to PM Filter by	Direct glass-to-glass	Ground Glass with Silicone O-Ring
Water Jacket	Temperature regulated water jacket surrounding coil condenser	Temperature regulated water jacket surrounding coil condenser
Operating Temperature	167 - 185°F	167 - 185°F

Specification Sheet for EPA CTM-013

Source Location Name(s) Stack (EU00079)
 Pollutant(s) to be Determined Sulfuric Acid Mist (H₂SO₄)
 Other Parameters to be Determined from Train Gas Density, Moisture

	<u>Standard Method Specification</u>	<u>Actual Specification Used</u>
Impinger Train Description		
Type of Glassware Connections	Flexible Rubber Tubing	Flexible Rubber Tubing
Number of Impingers	4	4
Impinger Stem Types		
Impinger 1	Modified Greenburg-Smith (Knockouts if no SO ₂ analysis)	Open Tip
Impinger 2	Greenburg-Smith (Knockouts if no SO ₂ analysis)	Open Tip
Impinger 3	Modified Greenburg-Smith (Knockouts if no SO ₂ analysis)	Open Tip
Impinger 4	Modified Greenburg-Smith (Knockouts if no SO ₂ analysis)	Open Tip
Impinger 5		
Impinger 6		
Impinger 7		
Gas Density Determination		
Sample Collection	N/A	Single Point Integrated
Sample Collection Medium	N/A	Vinyl Bag
Sample Analysis	N/A	CEM
Sample Recovery Information		
Probe Brush Material	N/A	N/A
Probe Rinse Reagent	N/A	N/A
Probe Rinse Wash Bottle Material	N/A	N/A
Probe Rinse Storage Container	N/A	N/A
PM Filter Recovered?	No	Yes
PM Filter Storage Container	N/A	Polyethylene
SO ₃ Condenser Contents Recovered?	Not required	Yes
SO ₃ Condenser Rinse Reagent	Deionized Water (DI H ₂ O)	DI Water
SO ₃ Condenser Wash Bottle	Polyethylene	Polyethylene
SO ₃ Condenser Storage Container	Polyethylene	Polyethylene
Impinger Contents Recovered?	Optional	No
Impinger Rinse Reagent	Deionized Water (DI H ₂ O)	N/A
Impinger Wash Bottle	Polyethylene	N/A
Impinger Storage Container	Polyethylene	N/A
Analytical Information		
Method 4 H ₂ O Determination by	Gravimetric	Concurrent M5/202 sample run
SO ₃ Condenser	Ion Chromatography or Titration for sulfate (optional)	IC for sulfate/Titration for sulfate
Impinger Analysis (SO ₂)	Ion Chromatography or Titration for sulfate (optional)	IC for sulfate/Titration for sulfate
PM Filter Analysis	PM Filter - Not recovered	Not analyzed

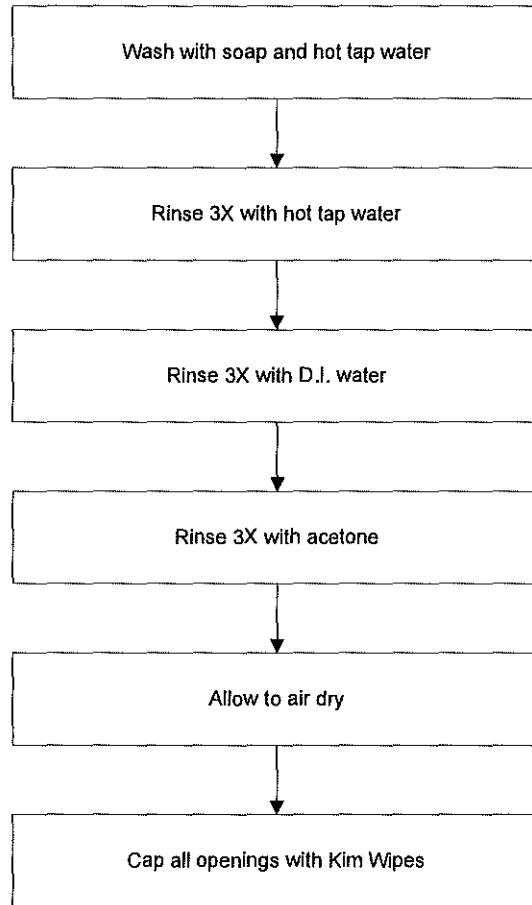
CTM-013 CCM Sampling Train Configuration



Impinger Contents

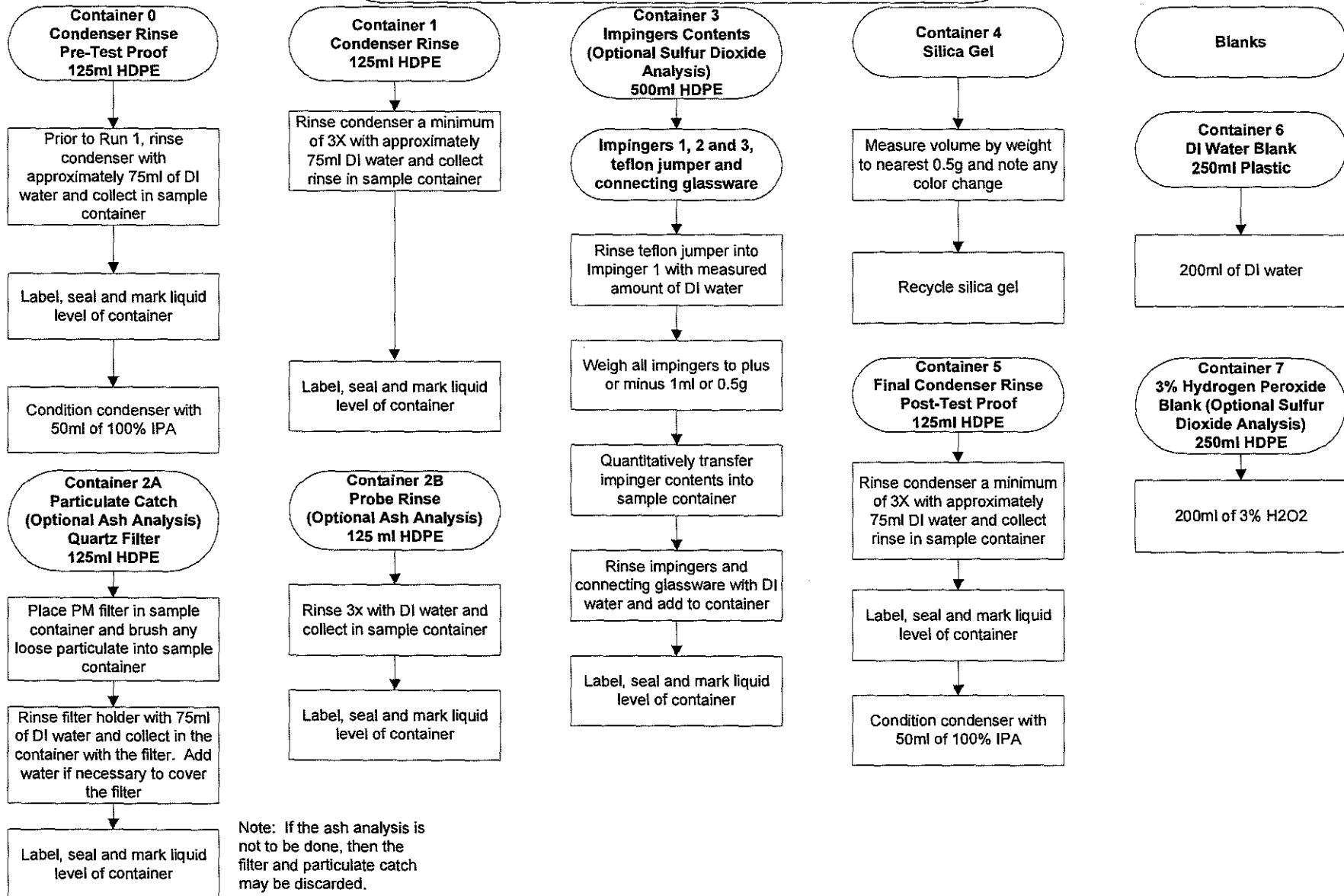
Impinger 1	DI Water
Impinger 2	DI Water
Impinger 3	Empty
Impinger 4	Silica Gel

CTM-013 CCM Glassware Preparation Procedures



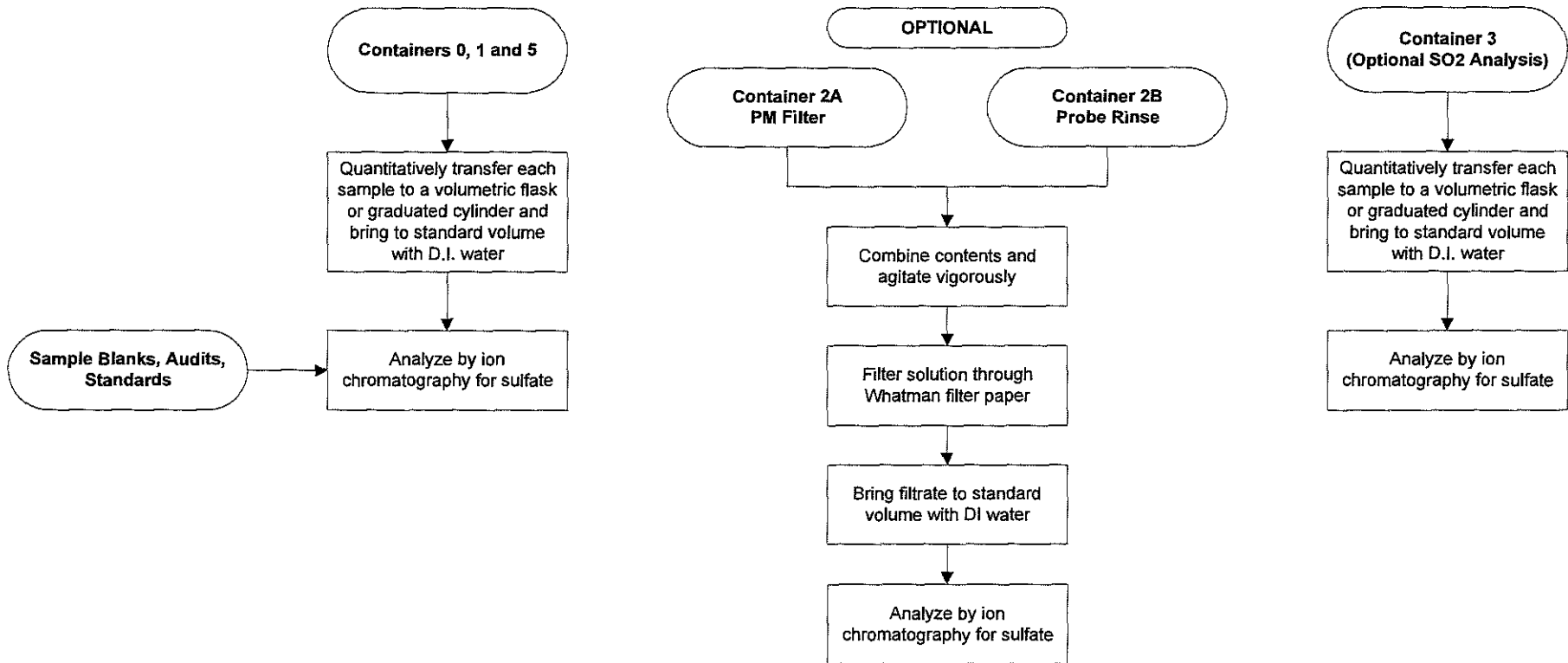
EPA CTM-013 Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)



EPA CTM-013 Analytical Flowchart

- Log each sample in shipment and verify against chain-of-custody sheet
- Note liquid levels in the sample containers and confirm on the chain-of-custody sheet condition



**Optional Titration Analysis: Refer to EPA Method 6 Analytical Flowchart*

APPENDIX B: SAMPLE CALCULATIONS

**CTM-013 (H2SO4)
 Sampling, Velocity and Moisture Sample Calculations**

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Volume of water collected (wscf)

$$V_{wstd} = (0.04706)(V_k)$$

Where:

V_k	= total volume of liquid collected in impingers and silica gel (ml)	=	70.4	ml
0.04706	= ideal gas conversion factor (ft ³ water vapor/ml or gm)	=	0.04706	ft ³ /ml
V_{wstd}	= volume of water vapor collected at standard conditions (ft ³)	=	3.31	ft ³

2. Volume of gas metered, standard conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m) \left(P_{bar} + \frac{\Delta H}{13.6} \right) (Y_d)}{(460 + T_m)}$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	29.40	in. Hg
T_m	= average dry gas meter temperature (°F)	=	74.25	°F
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	22.62	dcf
Y_d	= gas meter correction factor (dimensionless)	=	1.0004	
ΔH	= average pressure drop across meter box orifice (in. H ₂ O)	=	0.50	in. H ₂ O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	17.64	°R/in. Hg
13.6	= conversion factor (in. H ₂ O/in. Hg)	=	13.6	in. H ₂ O/in. Hg
460	= °F to °R conversion constant	=	460	
V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	21.994	dscf

3. Stack gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6} \right)$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	29.40	in. Hg
P_g	= sample gas static pressure (in. H ₂ O)	=	-0.85	in. H ₂ O
13.6	= conversion factor (in. H ₂ O/in. Hg)	=	13.6	in. H ₂ O/in. Hg
P_s	= absolute stack gas pressure (in. Hg)	=	29.34	in. Hg

4. Actual water vapor pressure at stack gas temperature less than 212°F (in. Hg)

$$P_v = \frac{e^{\left(\frac{18.3036 - \frac{3816.44}{\frac{5}{9}(T_s - 32) + 273.15 - 46.13}}{25.4} \right)}}{25.4}$$

Where:

T_s	= average stack gas temperature (°F)	=	588.50	°F
18.3036	= Antoine coefficient	=	18.3036	°K
3816.44	= Antoine coefficient	=	3816.44	°K
273.15	= temperature conversion factor	=	273.15	°K
46.13	= Antoine coefficient	=	46.13	°K
25.4	= conversion factor	=	25.4	mm Hg/in. Hg
5/9	= Fahrenheit to Celsius conversion factor	=	5/9	°C/°F
32	= temperature conversion (°F)	=	32	°F
P_v	= vapor pressure, actual (in. Hg)	=	29.34	in. Hg

5. Water vapor pressure at stack gas temperature greater than 212°F (in. Hg)

$$P_v = P_s$$

Where:

P_s	= absolute stack gas pressure (in. Hg)	=	29.34	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	29.34	in. Hg

6. Moisture measured in sample (% by volume)

$$B_{wa} = \frac{V_{wstd}}{(V_{mstd} + V_{wstd})}$$

Where:

V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	21.994	dscf
V_{wstd}	= volume of water collected at standard conditions (scf)	=	3.31	scf
B_{wa}	= proportion of water measured in the gas stream by volume	=	0.1309	
		=	13.09	%

7. Saturated moisture content (% by volume)

$$B_{ws} = \frac{P_v}{P_s}$$

Where:

P_s	= absolute stack gas pressure (in. Hg)	=	29.34	in. Hg
P_v	= water vapor pressure, actual (in. Hg)	=	29.34	in. Hg
B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions	=	100.00	%

8. Actual water vapor in gas (% by volume)

$$B_w = \text{MINIMUM} [B_{wo}, B_{ws}]$$

Where:

B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions	=	100.0000	
B_{wo}	= proportion of water measured in the gas stream by volume	=	0.1309	
B_w	= actual water vapor in gas	=	0.1309	
		=	13.09	%

9. Nitrogen (plus carbon monoxide) in gas stream (% by volume, dry)

$$N_2 + CO = 100 - CO_2 - O_2$$

Where:

CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	7.9	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	11.1	%
100	= conversion factor (%)	=	100	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	81.00	%

10. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d = (M_{CO_2}) \left(\frac{CO_2}{100} \right) + (M_{O_2}) \left(\frac{O_2}{100} \right) + (M_{N_2+CO}) \left(\frac{N_2+CO}{100} \right)$$

Where:

M_{CO_2}	= molecular weight of carbon dioxide (lb/lb·mole)	=	44.00	lb/lb·mole
M_{O_2}	= molecular weight of oxygen (lb/lb·mole)	=	32.00	lb/lb·mole
M_{N_2+CO}	= molecular weight of nitrogen and carbon monoxide (lb/lb·mole)	=	28.00	lb/lb·mole
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	7.9	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	11.1	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	81.0	%
100	= conversion factor (%)	=	100	%
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	29.71	lb/lb·mole

11. Molecular weight of stack gas (lb/lb·mole)

$$M_s = (M_d)(1 - B_w) + (M_{H_2O})(B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	13.0912	
M_d	= dry molecular weight of stack gas (lb/lb·mole)	=	29.71	lb/lb·mole
M_{H_2O}	= molecular weight of water (lb/lb·mole)	=	18.00	lb/lb·mole
M_s	= molecular weight of stack gas, wet basis (lb/lb·mole)	=	28.18	lb/lb·mole

12. Velocity of stack gas (ft/sec)

$$V_s = (K_p)(C_p)\left(\sqrt{\Delta P}\right)\left(\sqrt{\frac{(T_s + 460)}{(M_s)(P_s)}}\right)$$

Where:

K_p	= velocity pressure constant	=	85.49	
C_p	= pitot tube coefficient	=	0.84	
M_s	= wet molecular weight of sample gas, wet basis (lb/lb-mole)	=	28.18	lb/lb-mole
P_s	= absolute stack pressure (in. Hg)	=	29.34	in. Hg
T_s	= average stack gas temperature (°F)	=	588.50	°F
$\sqrt{\Delta P}$	= average square roots of velocity heads of sample gas (in. H ₂ O)	=	0.000	$\sqrt{\text{in. H}_2\text{O}}$
460	= °F to °R conversion constant	=	460	
V_s	= sample gas velocity (ft/sec)	=	16.01	ft/sec

13. Volumetric flow rate of stack gas at actual gas conditions (acfm)

$$Q_a = (60)(A_s)(V_s)$$

Where:

A_s	= cross sectional area of sampling location (ft ²)	=	90.76	ft ²
V_s	= stack gas velocity (ft/sec)	=	16.01	ft/sec
60	conversion factor (sec/min)	=	60	sec/min
Q_a	= volumetric flow rate at actual conditions (acfm)	=	87,175	acfm

14. Total flow of stack gas (scfm)

$$Q_s = (Q_a)\left(\frac{P_s}{29.92}\right)\left(\frac{68+460}{T_s+460}\right)$$

Where:

Q_a	= volumetric flow rate at actual conditions (acfm)	=	87,175	acfm
P_s	= absolute stack gas pressure (in. Hg)	=	29.34	in. Hg
29.92	= standard pressure (in. Hg)	=	29.92	in. Hg
T_s	= average stack gas temperature (°F)	=	588.5	°F
68	= standard temperature (°F)	=	68	°F
460	= °F to °R conversion constant	=	460	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=	43,045	scfm

15. Dry flow of stack gas (dscfm)

$$Q_{std} = (Q_s)(1 - B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	13.0912	
Q_s	= volumetric flow rate at standard conditions, wet basis (scfm)	=	43,045	scfm
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	37,409	dscfm

16. Dry flow of stack gas corrected to 7%O₂ (dscfm)

$$Q_{std7} = (Q_{std}) \left(\frac{20.9 - O_2}{20.9 - 7} \right)$$

Where:

Q _{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	37,409	dscfm
O ₂	= proportion of oxygen in the gas stream by volume (%)	=	11.1	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
7	= oxygen content of corrected gas (%)	=	7.0	%
Q _{std7}	= volumetric flow rate at STP and 7%O ₂ , dry basis (dscfm)	=	26,375	dscfm

17. Hourly time basis conversion of volumetric flow rate (Q_{std} example)

$$Q_{std-hr} = (Q_{std-min}) (60)$$

Where

Q _{std-min}	= volumetric flow rate, english units (ft ³ /min)	=	37,409	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Q _{std-hr}	= volumetric flow rate, hourly basis (dscf/hr)	=	2,244,570	dscf/hr

18. Metric Conversion of Gas Volumes (Q_{std} example)

$$Q_{std-metric} = (Q_{std-english}) \left(\frac{60}{35.31} \right)$$

Where:

Q _{std-english}	= volumetric flow rate, english units (ft ³ /min)	=	37,409	dscfm
35.31	= conversion factor (ft ³ /m ³)	=	35.31	ft ³ /m ³
60	= conversion factor (min/hr)	=	60	min/hr
Q _{std-metric}	= volumetric flow rate, metric units (m ³ /hr)	=	63,568	dry std m ³ /hr

19. Standard to Normal Conversion of Gas Volumes (Q_{std} example)

$$Q_{Normal} = (Q_{std-metric}) \left(\frac{32 + 460}{68 + 460} \right)$$

Where:

Q _{std-metric}	= volumetric flow rate, metric units (dry std m ³ /hr)	=	63,568	dry std m ³ /hr
32	= normal temperature (°F)	=	32	°F
68	= standard temperature (°F)	=	68	°F
460	= standard temperature in Rankine (68°F)	=	460	
Q _{Normal}	= volumetric flow rate, metric units (dry Nm ³ /hr)	=	59,233	dry Nm ³ /hr

20. Alternative Method 5 Post-Test Meter Calibration Factor

$$Y_{qa} = \frac{\Theta}{V_m} \sqrt{\frac{(0.0319)(T_m + 460)(28.96)}{(\Delta H_{\text{@}})(P_{\text{bar}} + \frac{\Delta H}{13.6})(M_d)}} (\sqrt{\Delta H})_{\text{avg}}$$

Where:

Θ	= total sampling time (min)	=	60	min
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	22.62	dcf
T_m	= average dry gas meter temperature (°F)	=	74.25	°F
$\Delta H_{\text{@}}$	= dry gas meter orifice coefficient	=	1.8754	
P_{bar}	= barometric pressure (in. Hg)	=	29.40	in. Hg
ΔH	= average pressure drop across meter box orifice (in. H ₂ O)	=	0.500	in. H ₂ O
M_d	= dry molecular weight of stack gas (lb/lb-mole)	=	29.71	lb/lb-mole
$\sqrt{\Delta H}_{\text{avg}}$	= average of square root of pressure drop across meter orifice	=	0.707	$\sqrt{\text{in. H}_2\text{O}}$
0.0319	= conversion constant	=	0.0319	
28.96	= molecular weight of ambient air (lb/lb-mole)	=	28.96	lb/lb-mole
13.6	= conversion factor (in. H ₂ O/in. Hg)	=	13.6	in. H ₂ O/in. Hg
460	= °F to °R conversion constant	=	460	
Y_{qa}	= alternative Method 5 post-test meter calibration factor	=	1.0289	

**CTM-013 (H2SO4)
 H2SO4 Analyte Calculations**

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Sulfate to H2SO4 conversion factor

$$K_a = \frac{MW_a}{n \times MW_{ion}}$$

Where:

MW _a	= molecular weight of H2SO4 (mg/mg-mole)	=	98.078	mg/mg-mole
MW _{ion}	= molecular weight of Sulfate ion (mg/mg-mole)	=	96.060	mg/mg-mole
n	= molar ratio of Sulfate to H2SO4	=	1.0	mole SO4--/mole H2S
K _a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	

2. Total H2SO4 collected (mg)

$$m_a = K_a \times \frac{(S_{i-1} V_1 + S_{i-2} V_2)}{1000}$$

Where:

K _a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
S _{i-1}	= Sulfate concentration of sample fraction 1 (mg/liter)	=	18.7200	mg/liter
V ₁	= liquid volume of sample fraction 1 (ml)	=	100.0	ml
S _{i-2}	= Sulfate concentration of sample fraction 2 (mg/liter)	=	0.0000	mg/liter
V ₂	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m _a	= total H2SO4 collected in sample (mg)	=	1.9113	mg

Note: Non-detects are treated as zero in summations.

DEFINITION

Fraction 1 = entire sample except last impinger containing applicable absorbing reagent.
 Fraction 2 = last impinger containing applicable absorbing reagent, analyzed separately to evaluate collection efficiency.
 If entire sample is analyzed as a single fraction, then data is included as Fraction 1 (Fraction 2 = 0).

3. Allowable blank subtraction (mg)

$$m_b = K_a \times B_f \times \frac{(V_1 + V_2)}{1000}$$

$$m_b = 0 \text{ if } B_f < MDL$$

Where:

K _a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
B _f	= Sulfate concentration of blank (mg/liter)	=	0.0200	mg/liter
V ₁	= liquid volume of sample fraction 1 (ml)	=	100.0	ml
V ₂	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m _b	= allowable blank subtraction (mg)	=	0.0020	mg

4. Total H2SO4 collected, corrected for blank (mg)

$$m_{nb} = m_a - m_b$$

Where:

m_a	= total H2SO4 collected in sample (mg)	=	1.9113	mg
m_b	= allowable blank subtraction (mg)	=	0.0020	mg
m_{nb}	= total H2SO4 collected, corrected for blank (mg)	=	1.9093	mg

5. Minimum detectable H2SO4 (mg)

$$m_{MDL} = K_a \times MDL \times \frac{(V_1 + V_2)}{1000}$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
MDL	= minimum detectable Sulfate concentration	=	0.018	mg/liter
V_1	= liquid volume of sample fraction 1 (ml)	=	100.0	ml
V_2	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
1000	= conversion factor (ml/liter)	=	1000	ml/liter
m_{MDL}	= minimum detectable H2SO4 (mg)	=	0.0018	mg

6. Total H2SO4 value used in emission calculations (mg)

$$m_n = \text{MAXIMUM} [m_{nb} \text{ or } < m_{MDL}]$$

Where:

m_{nb}	= total H2SO4 collected, corrected for blank (mg)	=	1.9093	mg
m_{MDL}	= minimum detectable H2SO4 (mg)	=	0.0018	mg
m_n	= total H2SO4 value used in emission calculations (mg)	=	1.9093	mg

7. Collection QC check (% mass collected in second fraction)

$$EFF = 100 \times \frac{K_a \times S_{i-2} \times \frac{V_2}{1000}}{m_a}$$

Where:

K_a	= conversion factor to convert mass SO4-- to mass H2SO4	=	1.021	
S_{i-2}	= Sulfate concentration of sample fraction 2 (mg/liter)	=	0.0000	mg/liter
V_2	= liquid volume of sample fraction 2 (ml)	=	0.0	ml
m_a	= total H2SO4 collected in sample (mg)	=	1.9113	mg
1000	= conversion factor (ml/liter)	=	1000	ml/liter
100	= conversion factor	=	100	%
EFF	= Collection QC check (% mass collected in second fraction)	=	0.00	%

**CTM-013 (H2SO4)
 H2SO4 Sample Calculations**

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. H2SO4 concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}} \right) \left(\frac{2.205 \times 10^{-3}}{1000} \right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	= 1.9093	mg
V_{mstd}	= volume metered, standard (dscf)	= 21.9943	dscf
2.205×10^{-3}	= conversion factor (lb/g)	= 2.205E-03	lb/g
1000	= conversion factor (mg/g)	= 1,000	mg/g
C_{sd}	= H2SO4 concentration (lb/dscf)	= 1.9141E-07	lb/dscf

2. H2SO4 concentration (ppmdv)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}} \right) \left(\frac{0.850}{1000} \right) \left(\frac{10^6}{MW} \right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	= 1.9093	mg
V_{mstd}	= volume metered, standard (dscf)	= 21.9943	dscf
MW	= molecular weight of H2SO4 (g/g-mole)	= 98.078	g/g-mole
0.850	= conversion factor (dscf/g-mole)	= 0.850	dscf/g-mole
1000	= conversion factor (mg/g)	= 1,000	mg/g
10^6	= conversion factor (ppm)	= 10^6	ppm
C_{sd}	= H2SO4 concentration (ppmdv)	= 0.7523	ppmdv

3. H2SO4 rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}} \right) \left(\frac{2.205 \times 10^{-3}}{1000} \right) (Q_{std})(60)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	= 1.9093	mg
V_{mstd}	= volume metered, standard (dscf)	= 21.9943	dscf
2.205×10^{-3}	= conversion factor (lb/g)	= 2.205E-03	lb/g
1000	= conversion factor (mg/g)	= 1,000	mg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	= 36,363	dscfm
60	= conversion factor (min/hr)	= 60	min/hr
$E_{lb/hr}$	= H2SO4 rate (lb/hr)	= 0.4176	lb/hr

**CTM-013 (H2SO4)
 H2SO4 Analyte Calculations**

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Average volume of titrant used for blanks

$$V_{tb,avg} = \frac{\sum_{i=1}^n (V_{tb})_i}{n}$$

Where:

$(V_{tb})_i$	= volume of titrant used with blank replicate "i" (ml)		
n	= number of replicates	=	1
V_{tb1}	= volume of titrant used with blank replicate #1 (ml)	=	0.050 ml
V_{tb2}	= volume of titrant used with blank replicate #2 (ml)	=	NA
V_{tb3}	= volume of titrant used with blank replicate #3 (ml)	=	NA
$V_{tb,avg}$	= average volume of titrant used for blanks (ml)	=	0.050 ml

2. Average volume of titrant used for samples in Run # 1

$$V_{t,avg} = \frac{\sum_{i=1}^n (V_t)_i}{n}$$

Where:

$(V_t)_i$	= volume of titrant used with replicate "i" (ml)		
n	= number of replicates	=	1
V_{t1}	= volume of titrant used with replicate #1 (ml)	=	0.800 ml
V_{t2}	= volume of titrant used with replicate #2 (ml)	=	NA
V_{t3}	= volume of titrant used with replicate #3 (ml)	=	NA
$V_{t,avg}$	= average volume of titrant used for samples (ml)	=	0.800 ml

3. Titration volume after blank subtraction

$$V_{net} = V_{t,avg} - V_{tb,avg}$$

Where:

$V_{t,avg}$	= average volume of titrant used for samples (ml)	=	0.800 ml
$V_{tb,avg}$	= average volume of titrant used for blanks (ml)	=	0.050 ml
V_{net}	= titration volume after blank subtraction (ml)	=	0.750 ml

4. Titrant Volume used in emission calculation

$$V_t = \text{MAXIMUM} [V_{net}, V_{MDL}]$$

Where:

V_{net}	= titration volume after blank subtraction (ml)	=	0.750	ml
V_{MDL}	= minimum measurable quantity of titrant	=	0.010	ml
V_t	= titrant volume used in emission calculation	=	0.750	ml

5. Total mass of Acid Mist collected

$$m_n = N \times V_t \times \frac{V_{soln}}{V_a} \times \frac{MW_i}{n_i}$$

Where:

N	= normality of titrant (mg-equivalent ion)	=	0.010000	mg-equiv ion
V_t	= titration volume after blank subtraction (ml)	=	0.750	ml
V_{soln}	= total volume of sample collected (ml)	=	100.0	ml
V_a	= volume of sample aliquot used in titration (ml)	=	20.0	ml
MW_i	= molecular weight of Acid Mist (mg/mg-mole)	=	98.0734	mg/mg-mole
n_i	= equivalents of SO4-- (ion) per mole of H2SO4 (compound)	=	2	mg-equiv/mg-mole
m_n	= mass of H2SO4 collected (mg)	=	1.8389	mg

**CTM-013 (H2SO4)
 H2SO4 Sample Calculations**

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. H2SO4 concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}} \right) \left(\frac{2.205 \times 10^{-3}}{1000} \right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	1.8389	mg
V_{mstd}	= volume metered, standard (dscf)	=	21.9943	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
C_{sd}	= H2SO4 concentration (lb/dscf)	=	1.8435E-07	lb/dscf

2. H2SO4 concentration (ppmdv)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}} \right) \left(\frac{0.850}{1000} \right) \left(\frac{10^6}{MW} \right)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	1.8389	mg
V_{mstd}	= volume metered, standard (dscf)	=	21.9943	dscf
MW	= molecular weight of H2SO4 (g/g-mole)	=	98.073	g/g-mole
0.850	= conversion factor (dscf/g-mole)	=	0.850	dscf/g-mole
1000	= conversion factor (mg/g)	=	1,000	mg/g
10^6	= conversion factor (ppm)	=	10^6	ppm
C_{sd}	= H2SO4 concentration (ppmdv)	=	0.7246	ppmdv

3. H2SO4 rate (lb/hr)

$$E_{lb/hr} = \left(\frac{m_n}{V_{mstd}} \right) \left(\frac{2.205 \times 10^{-3}}{1000} \right) (Q_{std})(60)$$

Where:

m_n	= total H2SO4 collected, corrected for applicable blank (mg)	=	1.8389	mg
V_{mstd}	= volume metered, standard (dscf)	=	21.9943	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
1000	= conversion factor (mg/g)	=	1,000	mg/g
Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	36,363	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
$E_{lb/hr}$	= H2SO4 rate (lb/hr)	=	0.4022	lb/hr

APPENDIX C: PARAMETERS

Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

USEPA Method 2 (Velocity & Flow Rate) Sampling, Velocity and Moisture Parameters

Run No.		3	4	5	Average
Date (2021)		Oct 5	Oct 5	Oct 5	
Start Time (approx.)		09:45	11:37	13:30	
Stop Time (approx.)		10:00	11:54	13:50	
Sampling Conditions					
C _p	Pitot tube coefficient	0.8400	0.8400	0.8400	
P _g	Static pressure (in. H ₂ O)	-0.8500	-0.8500	-0.8500	
A _s	Sample location area (ft ²)	90.7626	90.7626	90.7626	
P _{bar}	Barometric pressure (in. Hg)	28.40	28.40	28.40	28.4000
O ₂	Oxygen (dry volume %)	11.1000	10.8000	10.4000	10.7667
CO ₂	Carbon dioxide (dry volume %)	7.9000	8.5000	8.9000	8.4333
N ₂ +CO	Nitrogen plus carbon monoxide (dry volume %)	81.0000	80.7000	80.7000	80.8000
T _s	Stack temperature (°F)	581.9167	583.0417	582.8333	582.5972
Flow Results					
P _s	Stack gas pressure, absolute (in. Hg)	28.3375	28.3375	28.3375	28.3375
P _v	Vapor pressure, actual (in. Hg)	28.3375	28.3375	28.3375	28.3375
B _{wo}	Moisture measured in sample (% by volume)	14.5998	13.2331	14.6571	14.1633
B _{ws}	Saturated moisture content (% by volume)	100.0000	100.0000	100.0000	100.0000
B _w	Actual water vapor in gas (% by volume)	14.5998	13.2331	14.6571	14.1633
√ΔP	Velocity head (√in. H ₂ O)	0.1951	0.1930	0.1953	0.1945
M _d	MW of stack gas, dry (lb/lb-mole)	29.7080	29.7920	29.8400	29.7800
M _s	MW of stack gas, wet (lb/lb-mole)	27.9987	28.2316	28.1046	28.1116
V _s	Stack gas velocity ft/sec	16.0583	15.8283	16.0459	15.9775
Q _a	Volumetric flow rate, actual (acfm)	87,449	86,197	87,382	87,010
Q _s	Volumetric flow rate, standard (scfm)	41,972	41,326	41,903	41,734
Q _{std}	Volumetric flow rate, dry standard (dscfm)	35,844	35,857	35,761	35,821
Q _{std7}	Volumetric flow rate, dry std@7%O ₂ (dscfm)	25,271	26,055	27,014	26,113
Q _a	Volumetric flow rate, actual (acf/hr)	5,246,959	5,171,827	5,242,930	5,220,572
Q _s	Volumetric flow rate, standard (scf/hr)	2,518,307	2,479,569	2,514,161	2,504,012
Q _{std}	Volumetric flow rate, dry standard (dscf/hr)	2,150,639	2,151,445	2,145,659	2,149,248
Q _a	Volumetric flow rate, actual (m ³ /hr)	148,597	146,469	148,483	147,850
Q _s	Volumetric flow rate, standard (m ³ /hr)	71,320	70,223	71,203	70,915
Q _{std}	Volumetric flow rate, dry standard (dry m ³ /hr)	60,907	60,930	60,766	60,868
Q _{std7}	Volumetric flow rate, dry std@7%O ₂ (dry m ³ /hr)	42,942	44,273	45,903	44,373
Q _s	Volumetric flow rate, normal (Nm ³ /hr)	66,457	65,435	66,348	66,080
Q _{std}	Volumetric flow rate, dry normal (Nm ³ /hr)	56,755	56,776	56,623	56,718
Q _{std7}	Volumetric flow rate, dry normal @7%O ₂ (Nm ³ /hr)	40,014	41,254	42,773	41,347

Comments:

Average includes 3 runs.

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Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

CTM-013 (H2SO4) Sampling, Velocity and Moisture Parameters

Run No.	1	2	3	Average
Date (2021)	Oct 5	Oct 5	Oct 5	
Start Time (approx.)	08:40	10:35	12:26	
Stop Time (approx.)	09:40	11:35	13:26	
Sampling Conditions				
Y _d Dry gas meter correction factor	1.0004	1.0004	1.0004	
C _p Pitot tube coefficient	0.8400	0.8400	0.8400	
P _g Static pressure (in. H ₂ O)	-0.8500	-0.8500	-0.8500	
A _s Sample location area (ft ²)	90.7626	90.7626	90.7626	
P _{bar} Barometric pressure (in. Hg)	29.40	29.40	29.40	29.4000
O ₂ Oxygen (dry volume %)	11.1000	10.8000	10.4000	10.7667
CO ₂ Carbon dioxide (dry volume %)	7.9000	8.5000	8.9000	8.4333
N ₂ +CO Nitrogen plus carbon monoxide (dry volume %)	81.0000	80.7000	80.7000	80.8000
V _{lc} Total Liquid collected (ml)	79.90	71.10	80.00	
V _m Volume metered, meter conditions (ft ³)	22.6200	22.7900	22.7100	
T _m Dry gas meter temperature (°F)	74.2500	79.6250	78.1667	
T _s Stack temperature (°F)	588.5000	588.7500	586.0000	587.7500
ΔH Meter box orifice pressure drop (in. H ₂ O)	0.5000	0.5000	0.5000	
θ Total sampling time (min)	60.0	60.0	60.0	
Flow Results				
V _{wstd} Volume of water collected (ft ³)	3.7601	3.3460	3.7648	3.6236
V _{mstd} Volume metered, standard (dscf)	21.9943	21.9389	21.9211	21.9514
P _e Stack gas pressure, absolute (in. Hg)	29.3375	29.3375	29.3375	29.3375
P _v Vapor pressure, actual (in. Hg)	29.3375	29.3375	29.3375	29.3375
B _{w0} Moisture measured in sample (% by volume)	14.5998	13.2331	14.6571	14.1633
B _{ws} Saturated moisture content (% by volume)	100.0000	100.0000	100.0000	100.0000
B _w Actual water vapor in gas (% by volume)	14.5998	13.2331	14.6571	14.1633
√ΔP Velocity head (√in. H ₂ O)	0.0000	0.0000	0.0000	0.0000
M _d MW of stack gas, dry (lb/lb-mole)	29.7080	29.7920	29.8400	29.7800
M _s MW of stack gas, wet (lb/lb-mole)	27.9987	28.2316	28.1046	28.1116
V _s Stack gas velocity ft/sec	16.0583	15.8283	16.0459	15.9775
Q _a Volumetric flow rate, actual (acfm)	87,449	86,197	87,382	87,010
Q _s Volumetric flow rate, standard (scfm)	43,180	42,552	43,250	42,994
Q _{std} Volumetric flow rate, dry standard (dscfm)	36,876	36,921	36,911	36,902
Q _{std7} Volumetric flow rate, dry std@7%O ₂ (dscfm)	25,999	26,827	27,882	26,903
Q _a Volumetric flow rate, actual (acf/hr)	5,246,959	5,171,827	5,242,930	5,220,572
Q _s Volumetric flow rate, standard (scf/hr)	2,590,805	2,553,098	2,595,003	2,579,635
Q _{std} Volumetric flow rate, dry standard (dscf/hr)	2,212,552	2,215,244	2,214,652	2,214,149
Q _a Volumetric flow rate, actual (m ³ /hr)	148,597	146,469	148,483	147,850
Q _s Volumetric flow rate, standard (m ³ /hr)	73,373	72,305	73,492	73,057
Q _{std} Volumetric flow rate, dry standard (dry m ³ /hr)	62,661	62,737	62,720	62,706
Q _{std7} Volumetric flow rate, dry std@7%O ₂ (dry m ³ /hr)	44,178	45,586	47,379	45,714
Q _s Volumetric flow rate, normal (Nm ³ /hr)	68,370	67,375	68,481	68,076
Q _{std} Volumetric flow rate, dry normal (Nm ³ /hr)	58,388	58,459	58,444	58,431
Q _{std7} Volumetric flow rate, dry normal @7%O ₂ (Nm ³ /hr)	41,166	42,478	44,148	42,597

Comments:

Average includes 3 runs.
 Flow rate data obtained from separate Method 2 runs.

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Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

CTM-013 (H2SO4) Sulfate Laboratory Parameters

Run No.	Blank	1	2	3
Date (2021)		Oct 5	Oct 5	Oct 5
Start Time (approx.)		08:40	10:35	12:26
Stop Time (approx.)		09:40	11:35	13:26

DRAFT LAB DATA

MDL Min. detectable limit (mg SO4--/liter) 0.0180

H2SO4 as Total Sulfate

B_i Blank concentration (mg SO4--/liter) 0.0200

S _{i-1}	Fraction 1 concentration (mg SO4--/liter)	18.7200	11.7100	21.3600
v ₁	Fraction 1 sample volume (ml)	100.0	100.0	100.0
v ₂	Fraction 2 sample volume (ml)			
m _a	H2SO4 collected before blank subtraction (mg)	1.9113	1.1956	2.1809
m _b	Allowable blank subtraction (mg)	0.0020	0.0020	0.0020
m _{nb}	H2SO4 collected after blank subtraction (mg)	1.9093	1.1935	2.1788
m _{MDL}	Minimum detectable H2SO4 (mg)	0.0018	0.0018	0.0018
m _n	Total H2SO4 used in emission calculations (mg)	1.9093	1.1935	2.1788
EFF	Collection QC Check (% collected in Fraction 2)	0.00%	0.00%	0.00%

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Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

CTM-013 (H2SO4) H2SO4 Parameters

Run No.		1	2	3	Average
Date (2021)		Oct 5	Oct 5	Oct 5	
Start Time (approx.)		08:40	10:35	12:26	
Stop Time (approx.)		09:40	11:35	13:26	
Process Conditions					
R _p	Production rate - (tons produced/hour)	411	411	411	411
Gas Conditions					
O ₂	Oxygen (dry volume %)	11.1000	10.8000	10.4000	10.7667
CO ₂	Carbon dioxide (dry volume %)	7.9000	8.5000	8.9000	8.4333
T _s	Stack temperature (°F)	588.5000	588.7500	586.0000	587.7500
B _w	Actual water vapor in gas (% by volume)	14.5998	13.2331	14.6571	14.1633
Gas Flow Rate					
Q _a	Volumetric flow rate, actual (acfm)	87,175	86,450	87,123	86,916
Q _s	Volumetric flow rate, standard (scfm)	41,840	41,447	41,778	41,689
Q _{std}	Volumetric flow rate, dry standard (dscfm)	36,363	35,383	36,246	35,997
Sampling Data					
V _{mstd}	Volume metered, standard (dscf)	21.9943	21.9389	21.9211	21.9514
Laboratory Data					
m _n	Total H2SO4 collected (mg)	1.9093	1.1935	2.1788	1.7605
Sulfuric Acid (H2SO4) Results					
C _{sd}	H2SO4 Concentration (lb/dscf)	1.9141E-07	1.1996E-07	2.1916E-07	1.7684E-07
C _{sd7}	H2SO4 Concentration @7% O2 (lb/dscf)	2.7149E-07	1.6509E-07	2.9013E-07	2.4224E-07
C _{sd12}	H2SO4 Concentration @12% CO2 (lb/dscf)	2.9075E-07	1.6935E-07	2.9550E-07	2.5187E-07
C _{sd}	H2SO4 Concentration (ppmdv)	0.7523	0.4715	0.8614	0.6951
C _{sd7}	H2SO4 Concentration @7% O2 (ppmdv)	1.0671	0.6489	1.1403	0.9521
C _{sd12}	H2SO4 Concentration @12% CO2 (ppmdv)	1.1428	0.6656	1.1614	0.9899
C _w	H2SO4 Concentration (ppmwv)	0.6425	0.4091	0.7351	0.5956
C _{sd}	H2SO4 Concentration (mg/dscm)	3.0652	1.9210	3.5096	2.8319
C _{sd7}	H2SO4 Concentration @7% O2 (mg/dscm)	4.3475	2.6437	4.6460	3.8791
C _{sd12}	H2SO4 Concentration @12% CO2 (mg/dscm)	4.6560	2.7120	4.7320	4.0333
C _{sd}	H2SO4 Concentration (mg/Nm3 dry)	3.2895	2.0615	3.7664	3.0391
C _{sd7}	H2SO4 Concentration @7% O2 (mg/Nm3 dry)	4.6657	2.8372	4.9860	4.1629
C _{sd12}	H2SO4 Concentration @12% CO2 (mg/Nm3 dry)	4.9966	2.9104	5.0783	4.3284
E _{lb/hr}	H2SO4 Rate (lb/hr)	0.4176	0.2547	0.4766	0.3830

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Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

CTM-013 (H2SO4) Sulfate Laboratory Parameters

Run No.	Blank	1	2	3
Date (2021)		Oct 5	Oct 5	Oct 5
Start Time (approx.)		08:40	10:35	12:26
Stop Time (approx.)		09:40	11:35	13:26

DRAFT LAB DATA

H2SO4 as Total Sulfate

V _{tb1}	Volume of Titrant for blank replicate #1	0.050
V _{tb2}	Volume of Titrant for blank replicate #2	
V _{tb3}	Volume of Titrant for blank replicate #3	
V _{tbavg}	Average Volume of Titrant for blank	0.050

N	Normality of Titrant (mg-equiv ion)	0.0100	0.0100	0.0100
V _a	Aliquot volume of sample used in titration (ml)	20.0	20.0	20.0
V _{soln}	Total volume of sample (ml)	100.0	100.0	100.0
V _{t1}	Volume of Titrant used on replicate #1 (ml)	0.800	0.600	0.875
V _{t2}	Volume of Titrant used on replicate #2 (ml)			
V _{t3}	Volume of Titrant used on replicate #3 (ml)			
V _{tavg}	Average Volume of Titrant used (ml)	0.800	0.600	0.875
V _{net}	Titrant volume after blank subtraction (ml)	0.750	0.550	0.825
V _{MDL}	Minimum detectable titrant volume (ml)	0.010	0.010	0.010
V _t	Titrant volume used in emission calculation (ml)	0.750	0.550	0.825
m _n	Total mass of Acid Mist collected (mg)	1.8389	1.3485	2.0228

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Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

**CTM-013 (H2SO4)
 H2SO4 Parameters**

Run No.		1	2	3	Average
Date (2021)		Oct 5	Oct 5	Oct 5	
Start Time (approx.)		08:40	10:35	12:26	
Stop Time (approx.)		09:40	11:35	13:26	
Process Conditions					
R _p	Production rate - (tons produced/hour)	411	411	411	411
Gas Conditions					
O ₂	Oxygen (dry volume %)	11.1000	10.8000	10.4000	10.7667
CO ₂	Carbon dioxide (dry volume %)	7.9000	8.5000	8.9000	8.4333
T _s	Stack temperature (°F)	588.5000	588.7500	586.0000	587.7500
B _w	Actual water vapor in gas (% by volume)	14.5998	13.2331	14.6571	14.1633
Gas Flow Rate					
Q _a	Volumetric flow rate, actual (acfm)	87,175	86,450	87,123	86,916
Q _s	Volumetric flow rate, standard (scfm)	41,840	41,447	41,778	41,689
Q _{std}	Volumetric flow rate, dry standard (dscfm)	36,363	35,383	36,246	35,997
Sampling Data					
V _{mstd}	Volume metered, standard (dscf)	21.9943	21.9389	21.9211	21.9514
Laboratory Data					
m _n	Total H2SO4 collected (mg)	1.8389	1.3485	2.0228	1.7367
Acid Mist (H2SO4) Results					
C _{sd}	H2SO4 Concentration (lb/dscf)	1.8435E-07	1.3553E-07	2.0347E-07	1.7445E-07
C _{sd7}	H2SO4 Concentration @7% O2 (lb/dscf)	2.6148E-07	1.8653E-07	2.6935E-07	2.3912E-07
C _{sd12}	H2SO4 Concentration @12% CO2 (lb/dscf)	2.8003E-07	1.9134E-07	2.7434E-07	2.4857E-07
C _a	H2SO4 Concentration (lb/acf)	7.6898E-08	5.5473E-08	8.4648E-08	7.2340E-08
C _{sd}	H2SO4 Concentration (ppmdv)	0.7246	0.5327	0.7997	0.6857
C _{sd7}	H2SO4 Concentration @7% O2 (ppmdv)	1.0278	0.7332	1.0587	0.9399
C _{sd12}	H2SO4 Concentration @12% CO2 (ppmdv)	1.1007	0.7521	1.0783	0.9770
C _w	H2SO4 Concentration (ppmwv)	0.6188	0.4622	0.6825	0.5879
C _{sd}	H2SO4 Concentration (mg/dscm)	2.9522	2.1704	3.2582	2.7936
C _{sd7}	H2SO4 Concentration @7% O2 (mg/dscm)	4.1872	2.9870	4.3133	3.8292
C _{sd12}	H2SO4 Concentration @12% CO2 (mg/dscm)	4.4843	3.0641	4.3931	3.9805
C _a	H2SO4 Concentration (mg/m3 (actual,wet))	1.2314	0.8883	1.3555	1.1584
C _{sd}	H2SO4 Concentration (mg/Nm3 dry)	3.1682	2.3292	3.4966	2.9980
C _{sd7}	H2SO4 Concentration @7% O2 (mg/Nm3 dry)	4.4936	3.2055	4.6289	4.1093
C _{sd12}	H2SO4 Concentration @12% CO2 (mg/Nm3 dry)	4.8124	3.2883	4.7146	4.2717
E _{lb/hr}	H2SO4 Rate (lb/hr)	0.4022	0.2877	0.4425	0.3775

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APPENDIX D: QA/QC DATA

Guardian Industries, LLC
 Clean Air Project No: 14485
 EU00079 Stack

**CTM-013 (H2SO4)
 QA/QC Results**

Run No.	1	2	3
Date (2021)	Oct 5	Oct 5	Oct 5
Start Time (approx.)	08:40	10:35	12:26
Stop Time (approx.)	09:40	11:35	13:26
Total Duration of Test Run (min.)	60	60	60
Net Sampling Time (min.)	60	60	60

Sampling System Calibration Summary

	Probe ID No:	68-CC-9-4	68-CC-9-4	68-CC-9-4
C _p	Pitot Coefficient:	0.8400	0.8400	0.8400
	Meter Box ID. No:	68-4	68-4	68-4
.Y _d	Meter Box Yd - Field Sheet	1.0004	1.0004	1.0004
	Meter Box Yd - Database	1.0004	1.0004	1.0004
	Meter Box ΔH@ - Field Sheet	1.8754	1.8754	1.8754
	Meter Box ΔH@ - Database	1.8754	1.8754	1.8754

QA/QC

	<u>Final Leak Check</u>			
	(a) 4% of Sampling Rate (cfm)	0.0151	0.0152	0.0151
	(b) Allowable Rate from Method (cfm)	0.0200	0.0200	0.0200
	Allowable Limit - minimum of a and b (cfm)	0.0151	0.0152	0.0151
	Actual Final Leak Rate (cfm)	0.0010	0.0010	0.0010
	<u>Sample Volume</u>			
	Minimum Volume Required (dscf)	21.00	21.00	21.00
V _{mstd}	Actual Sample Volume (dscf)	21.994	21.939	21.921

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Certificate of Calibration

Calibrated For: Clean Air Engineering
Performance Division
7936 Conner Road
Powell, TN 37849

Test Result: PASS

Calibration Date: 05 January 2021

*Due Date: 05 January 2022

UUT Description: Omega CL23A
Thermocouple Calibrator
Serial Number: T-276617
Asset Number: C51091

Temperature: 23.0 °C
Humidity: 45 %RH
Data Type: AS-FOUND

Calibrated By: Corey Mullen
Procedure Used: Omega CL-23: CAL VER

Notes:

This instrument was calibrated using laboratory standards that are traceable to the National Institute of Standards and Technology (NIST), nationally recognized standards or natural physical constants, or are derived using self-calibrating ratio techniques. The CleanAir calibration program complies with the requirements of ANSI/NC SL Z540.1-1994.

Measurement uncertainties are calculated in accordance with the methods described in NIST TN1297, using a coverage factor k=2, resulting in a measurement confidence level of approximately 95%. The collective uncertainty of the standard utilized in this procedure does not exceed 25% of the unit under test (UUT) accuracy specification (TUR<4:1) unless otherwise specified in the test data or notes.

**A calibration due date determined by the customer, manufacturers specifications, or instrument history; is provided for reference only and does not imply continued conformance to specification.*

This document shall not be reproduced except in full, without written approval of CleanAir Engineering.

Corey Mullen

Calibration Performed By

Jacob Ortman

Calibration Reviewed By

Standards Used

<u>Asset #</u>	<u>Description</u>	<u>Cal Date</u>	<u>Due Date</u>
110253	Fluke 5520A Multifunction Calibrator	5/18/2020	5/18/2021

CleanAir Engineering
Performance Division
7936 Conner Road
Powell, TN 37849

865-938-7555
www.cleanair.com

Report of Cal Ver - Cleanair
Certificate #: C51091-010521AF
Asset Number: C51091
Date Printed: 01/05/2021

Test Results

<u>Test Description</u>	<u>System Actual</u>	<u>UUT Value</u>	<u>Tolerance</u>	<u>Deviation</u>	<u>Condition</u>	<u>Exp Uncert</u>	<u>TUR</u>
INPUT RANGE CALIBRATION							
Thermocouple Input K							
-130.00 °C	-130.000	-130.10	0.800	-0.100 °C	Pass	2.559e-001 °C	2.42
0.00 °C	0.000	-0.10	0.800	-0.100 °C	Pass	1.242e-001 °C	
100.00 °C	100.000	99.90	0.900	-0.100 °C	Pass	1.242e-001 °C	
300.00 °C	300.000	299.90	0.900	-0.100 °C	Pass	2.016e-001 °C	3.46
800.00 °C	800.000	800.30	0.900	0.300 °C	Pass	2.016e-001 °C	3.46
1000.00 °C	1000.000	1000.30	0.900	0.300 °C	Pass	2.016e-001 °C	3.46
1200.00 °C	1200.000	1200.70	0.900	0.700 °C	Pass	3.101e-001 °C	2.25
1300.00 °C	1300.000	1300.70	0.900	0.700 °C	Pass	3.101e-001 °C	2.25
OUTPUT RANGE CALIBRATION							
Thermocouple output type K							
-130.00 °C	-129.800	-130.00	0.800	-0.200 °C	Pass	2.559e-001 °C	2.42
0.00 °C	0.120	0.00	0.800	-0.120 °C	Pass	1.242e-001 °C	
100.00 °C	100.120	100.00	0.900	-0.120 °C	Pass	1.242e-001 °C	
300.00 °C	300.160	300.00	0.900	-0.160 °C	Pass	2.016e-001 °C	3.46
800.00 °C	800.180	800.00	0.900	-0.180 °C	Pass	2.016e-001 °C	3.46
1000.00 °C	1000.280	1000.00	0.900	-0.280 °C	Pass	2.016e-001 °C	3.46
1200.00 °C	1200.280	1200.00	0.900	-0.280 °C	Pass	3.101e-001 °C	2.25
1300.00 °C	1300.320	1300.00	0.900	-0.320 °C	Pass	3.101e-001 °C	2.25

***** End of Certificate *****

CleanAir Engineering
 Performance Division
 7936 Conner Road
 Powell, TN 37849

865-938-7555
 www.cleanair.com

Report of Cal Ver - Cleanair
 Certificate #: C51091-010521AF
 Asset Number: C51091
 Date Printed: 01/05/2021

CRITICAL ORIFICE K' CALIBRATION

Critical Orifice I.D.: <u>63-F</u>	Dry Gas Meter I.D.: <u>68-8</u>
Calibration Date: <u>1/6/2021</u>	DGM Yd <u>1.0066</u>
Calibrated By: <u>Bill Dimitroff</u>	DGM Full Cal. Date: <u>10/21/2020</u>

Parameter	Units	Run 1	Run 2	Run 3
Initial DGM meter reading	ft ³	549.00	552.78	556.54
Final DGM meter reading	ft ³	552.78	556.54	560.32
Net Meter Volume (Vm)	ft ³	3.78	3.76	3.78
Average Inlet/Outlet Temperatures				
Initial	°F	71.0	72.5	72.5
Final	°F	72.5	72.5	72.5
Avg. Temperature (t _m)	°F	71.8	72.5	72.5
Time (θ) 5 minute minimum	minutes	5.00	5.00	5.00
Orifice manometer reading (ΔH)	in. H ₂ O	1.85	1.85	1.85
Barometric pressure, P _{bar}	in. Hg	29.11	29.11	29.11
Ambient temperature (t _{amb})	°F	68	68	68
Pump vacuum	in. Hg	17.0	17.0	17.0
K' - Critical orifice coefficient value		0.583	0.579	0.582
K' value deviation from average (%diff)	≤0.5%	0.271	0.400	0.129
Average K' value		0.5814		

$$K' = \frac{K_1 V_m Y_d (P_{bar} + \Delta H / 13.6) \sqrt{T_{amb}}}{P_{bar} T_m \theta}$$

$$T_m = (t_m + 460)$$

$$T_{amb} = (t_{amb} + 460)$$

$$K_1 = 17.64^\circ R / \text{in. Hg}$$

All test runs must be of the same time length.

Allow meter to warm up for 15 minutes with orifice before calibration.



Geometric Probe Calibration

Probe Type: Other

I.D. Number: 68-CC-9-4

Project Number: _____

Thermocouple Calibration

Reference Type: Thermocouple Reference I.D. No: TT-68-002 Pyrometer I.D. No: 68-P6 Units: °F

Point No.	Target Temp.	Reference Temp.	Indicated Temp.	Temp. Difference	Specification*
1	Ambient	70	68	1.8	±2 °F

* Based on ALT 011

Geometric Pitot Calibration

Is pitot assembly in good repair? Yes No If no, explain:

"S" Pitot

Dimensions	Dimensions	Specifications	Within Spec?
$\alpha 1 =$	$\alpha 2 =$	$\leq 10^\circ$	
$\beta 1 =$	$\beta 2 =$	$\leq 5^\circ$	
$\gamma =$	$\theta =$	None	
A =		None	
Dt = 0.250		$0.1875" \leq Dt \leq 0.375"$	Yes

Calculations	Specifications	Within Spec?
$A/2 = P_a = P_b =$	None	
$P_a/Dt = P_b/Dt =$	$1.05 < P/Dt < 1.5$	
$z = A \sin \gamma =$	$\leq 0.125"$	
$w = A \sin \theta =$	$\leq 0.03125"$	

Pitot Cp =

Standard Pitot

Measurement	Specification	Calculation	Within Spec?
Tube O.D.	None		
Static Hole I.D.	within 10% of (0.1*O.D.)		
Tip to Static	$\geq 6 \times O.D.$		
Static to Bend	$\geq 8 \times O.D.$		

Pitot Cp =

Calibrated by: Bill Dimitroff

Date: 1/11/2021

Geometric Probe Calibration

Probe Type: S-Type Pitot

I.D. Number: TP-168-3

Project Number: _____

Thermocouple Calibration

Reference Type: Thermocouple Reference I.D. No: TT-68-002 Pyrometer I.D. No: 68-P6 Units: °F

Point No.	Target Temp.	Reference Temp.	Indicated Temp.	Temp. Difference	Specification*
1	Ambient	68	69	-1.3	±2 °F

* Based on ALT 011

Geometric Pitot Calibration

Is pitot assembly in good repair? Yes No If no, explain:

"S" Pitot

Dimensions		Dimensions		Specifications	Within Spec?
$\alpha 1 =$	1	$\alpha 2 =$	1	$\leq 10^\circ$	Yes
$\beta 1 =$	0	$\beta 2 =$	1	$\leq 5^\circ$	Yes
$\gamma =$	0	$\theta =$	1	None	N/A
A =	0.687			None	N/A
Dt =	0.250			$0.1875" \leq Dt \leq 0.375"$	Yes

	Calculations	Specifications	Within Spec?
A/2=Pa=Pb=	0.344 inches	None	N/A
Pa/Dt=Pb/Dt=	1.374 inches	$1.05 < P/Dt < 1.5$	Yes
$z = A \sin \gamma =$	0.000 inches	$\leq 0.125"$	Yes
$w = A \sin \theta =$	0.012 inches	$\leq 0.03125"$	Yes

Pitot Cp= 0.84 according to 40 CFR 60 section 10.1

Standard Pitot

	Measurement	Specification	Calculation	Within Spec?
Tube O.D.		None		
Static Hole I.D.		within 10% of (0.1*O.D.)		
Tip to Static		$\geq 6 \times O.D.$		
Static to Bend		$\geq 8 \times O.D.$		

Pitot Cp=

Calibrated by: Bill Dimitroff

Date: 1/11/2021

Meter Box Full Test Calibration

Meter Box No: 68-4

Date of Calibration: 10/09/20

Meter Box Y_d : 1.0004

Calibration Conducted by: Bill Dimitroff

Meter Box $\Delta H@$: 1.8754

Barometer ID: 68-1

Barometric Pressure: 29.11

				Standard Meter Gas Volume (ft ³)			Meter Box Gas Volume (ft ³)			Std. Meter Temperature (°F)			Meter Box Temperature (°F)			Time (min.)	Calibration Results	
Q	ΔH	ΔP	Y_{ds}	Initial	Final	V_{ds} Net	Initial	Final	V_d Net	T_{is} In	T_{os} Out	T_{ds} Avg.	T_i In	T_o Out	T_d Avg.	Θ	Y_d	$\Delta H@$
0.380	0.50	-0.20	1.0000	91.000	102.000	11.000	21.810	32.940	11.130	69.0	69.0	69.00	80.0	74.5	77.25	28.13	1.0020	1.8765
0.379	0.50	-0.20	1.0000	102.000	114.000	12.000	32.940	45.090	12.150	69.0	69.0	69.00	80.0	75.0	77.50	30.72	1.0018	1.8779
0.660	1.50	-0.40	1.0000	20.000	30.000	10.000	51.170	61.320	10.150	69.0	69.0	69.00	83.5	76.0	79.75	14.70	1.0004	1.8545
0.661	1.50	-0.40	1.0000	30.000	55.000	25.000	61.320	86.720	25.400	69.0	69.0	69.00	84.5	76.0	80.25	36.73	1.0004	1.8528
0.923	3.00	-0.60	1.0000	67.000	80.000	13.000	98.920	112.170	13.250	69.0	69.0	69.00	88.0	77.5	82.75	13.67	0.9975	1.8926
0.921	3.00	-0.60	1.0000	80.000	103.000	23.000	112.170	135.560	23.390	69.0	69.0	69.00	88.0	78.0	83.00	24.23	1.0002	1.8983
Averages																	1.00039	1.87541

Nomenclature	Equations
<p>P_b Barometric Pressure (in. Hg)</p> <p>Q Flow Rate (cfm)</p> <p>ΔH Orifice Pressure differential (in. H₂O)</p> <p>ΔP Inlet Pressure Differential (in. H₂O)</p> <p>V_d Gas Meter Volume - Dry (ft³)</p> <p>V_{ds} Standard Meter Volume - Dry (ft³)</p> <p>T_d Average Meter Box Temperature (°F)</p> <p>T_o Outlet Meter Box Temperature (°F)</p> <p>T_{ds} Average Standard Meter Temperature (°F)</p> <p>Y_d Meter Correction Factor (unitless), $Y_i \leq Y_{avg} \pm 0.02$</p> <p>$Y_{ds}$ Standard Meter Correction Factor (unitless)</p> <p>$\Delta H@$ Orifice Pressure Differential giving 0.75 cfm of air at 68°F and 29.92 in. Hg (in. H₂O)</p> <p>$\Delta H@_i \leq \Delta H@_{avg} \pm 0.2$</p> <p>$\Theta$ Duration of Run (minutes)</p>	$Y_d = (Y_{ds}) \left[\frac{V_{ds}}{V_d} \right] \left[\frac{T_d + 460}{T_{ds} + 460} \right] \left[\frac{P_b + \Delta P / 13.6}{P_b + \Delta H / 13.6} \right]$ $\Delta H@ = \frac{(0.0319)(\Delta H)}{P_b(T_o + 460)} \left[\frac{(T_{ds} + 460)\Theta}{(V_{ds})(Y_{ds})} \right]^2$ $Q = \frac{17.64(V_{ds})(P_b)}{(T_{ds} + 460)(\Theta)}$

Standard (in.Hg)	Gauge (in.Hg)
5.0	5.0
10.0	10.0
15.0	15.0
20.0	20.0
25.0	25.0



Meter Box - Pyrometer Calibration Sheet

Meter Box No: 68-4

Office: Office

Calibrated by: Bill Dimitroff

Client: NA

Date: 10/9/20

Job No: NA

Temperature Scale Used: Fahrenheit

Type of Calibration: Full-Test

Calibration Reference Settings (°F)	Pyrometer Reading for each Channel (°F)						
	1 Stack	2 Probe	3 Filter	4 Imp Out	5 Aux	6 DGM In	7 DGM Out
50	50	50	50	50	50	50	50
100	100	100	100	100	100	100	100
150	150	150	150	150	150	150	150
200	200	200	200				
250	250	251	250				
300	300	301	300				
350	350	351	350				
400	400	401	400				
450	450	451	450				
500	500	501	500				
550	550	551	550				
600	600	601	600				

Tolerance = ±2°F difference from reference setting.

Calibration Reference Information

Reference Used: <u>Digimite C51091</u>	Serial No: <u>C51091</u>
Calibrated By: <u>Clean Air Knoxville</u>	Date Calibrated: <u>1/7/2020</u>
Calibration Report No: <u>51091-01072020A</u>	

Meter Box Critical Orifice Post-Test Calibration Data

Project No. 14485 Meter No. 68-4 Orifice 63-F
 Location Office Meter Yd 1.0040 Orifice K' 0.5814
 Test Date 10/06/21 Meter ΔH@ 1.8754 Orifice Cal. Date 01/06/21
 Operator Bill Dimitroff Full Test Cal. Date 10/09/20

Leak Checks

Negative Pressure Pass
No movement of manometer in one-minute
 Positive Pressure Pass
No movement of manometer in one-minute

Barom. Press. (P_b) 29.21 in. Hg

Important: All leak checks must pass in order for calibration to be valid.

Run	Elapsed Time (minutes)	Meter Volume (dcf)	Meter Temperature		Ambient Temp. - T _{amb} (°F)	Orifice ΔH (in. W.C.)	Vacuum (in. Hg)	Net Run Time - θ (minutes)	Net Meter Volume for Run - V _m (dcf)	Avg Meter Temp. for Run - T _m (°F)	DGM Calibration Factor - Y _i	Percent Variation - ΔY _i
			Inlet (°F)	Outlet (°F)								
	0.0	810.00	75	75								
1	7.0	815.33	75	75	71	1.85	19	7.0	5.33	75.0	1.0003	0.1%
2	14.0	820.67	75	74	71	1.85	19	7.0	5.34	74.8	0.9980	-0.1%
3	21.0	826.00	75	74	71	1.85	19	7.0	5.33	74.5	0.9994	0.0%
											Average Y _i	0.9992
											Cal. Error	-0.5%

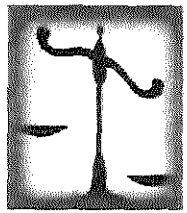
Calculations and Specifications

$$Y_i = \frac{K' \times P_h \times (T_m + 460) \times \theta}{17.64 \times V_m \times (P_b + \frac{\Delta H}{13.6}) \times \sqrt{T_{amb} + 460}}$$

$$\Delta Y_i = \frac{Y_i - \bar{Y}_i}{\bar{Y}_i} \times 100 \quad \text{Spec. : } \Delta Y_i \leq \pm 2\%$$

$$\text{Cal. Error} = \frac{\bar{Y}_i - Y_d}{Y_d} \times 100 \quad \text{Spec. : } \text{Cal. Error} \leq \pm 5\%$$





Total SP LLC

Laboratory & Pharmacy Balances & Scales
Service, Sales, Calibration & Repair

22 Crest Drive Monongahela PA 15063-1081

Phone (724) 825-6872 or email: totalsp22@gmail.com

CALIBRATION REPORT

DATE OF SERVICE: August 2, 2021

NEXT CALIBRATION DUE DATE: August 31, 2022

CLEAN AIR ENGINEERING, INC.
ATTN: JUSTIN GIEL
110 TECHNOLOGY DRIVE
PITTSBURGH PA 15275-1004

Procedures:

- A.) Toploading balances > one kilogram capacity use procedure A5A.
- B.) Toploading balances <= one kilogram capacity use procedure A4A.
- C.) Analytical balances use calibration procedure A1A.
- D.) Micro balances use procedure A2A.

Nr.	Manuf.	Model	Serial Nr.	Asset #	Location	Cal. Weight/ Procedure	Readability ±mg	Pre-Service Reading	Post-Service Reading	Repeatability ±mg	Condition or Not / Serviced
1	A&D	EK4100i	P1840030	68-4	FIELD	4 kg / A	100	NOT SERVICED – IN FIELD			SC EXT
2	A&D	EK4100i	P1840031	68-5	FIELD	4 kg / A	100	100.0 / 500.0 / 1000.0 2000.0 / 3999.9	100.0 / 500.0 / 1000.0 2000.0 / 4000.0	100	GOOD SC EXT

Notes: Condition "good" means that the unit meets Total SP's and manufacturer's tolerances for repeatability and readability in the environment found unless otherwise noted. "INT" means internal weight is used for calibration. "EXT" means external weight is used for calibration. "SC" means unit is self-calibrating, and "SET" means unit is calibrated by means of manually setting the calibration potentiometer. Balance calibrations and balance internal weights, if any, are checked against technician's test weights of TOTAL SP LLC. Test weights are calibrated annually against the primary standards of TOTAL SP LLC Set No. 4000011832, which have been certified by Henry Troemner, LLC, through Certificate No. 01142715 dated 14-JULY 2020 and expires 14-JULY 2021. This Certification is directly traceable to the National Standards of the National Institute of Standards and Technology through NIST Test No. 822-275872-11. Traceability documents are on file in the offices of TOTAL SP LLC and are available upon request. Calibrations comply with ANSI-NCSL Z 540-1-1994, MIL-STD-45662A and ISO 10012-1 specifications regarding calibration service and procedures.


Marian E Brna, Pres.

August 3, 2021
Date

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◇ Thank you for choosing Total SP LLC, a woman owned company ◇
◇ NIST Traceable Weights Certification ◇ Antistatic Products & Accessories ◇



Total SP LLC

Lab & Pharmacy Balances & Scales Sales, Service, Calibration & Repair
 Member American Society for Quality (ASQ)
 22 Crest Drive Monongahela PA 15063-1081
 Phone (724) 825-6872 or email: totalsp22@gmail.com
 EIN 47-2835493

Certification:

No: 21080301
 Date: August 3, 2021

CLEAN AIR ENGINEERING.
 ATTN: JUSTIN GIEL
 110 TECHNOLOGY DR
 PITTSBURGH PA 15275-1004

Certification Date: August 3, 2021

Next Certification Due: August 30, 2022



CERTIFICATION REPORT

S/N:	Nominal value:	As Found Apparent Mass vs 8.0 g/cm ³	As Left Apparent Mass vs 8.0 g/cm ³	Class 1 ± mg.	Uncertainty, ± mg.
05-J06467-1	1000 g	1000.000	1000.000	2.5	5

Assumed Densities:

When Stainless:	1-100 g	7.84 g/cm ³
When tantalum:	50 mg-500 mg	16.6 g/cm ³
When aluminum:	10-50 mg	2.7 g/cm ³
Temperature	23.8	°C
rh	43	%

Conditions:

Masses in bold italics are out of NIST Class 1 tolerances and were restored to NIST Class 1.

This certifies that the weights designated in this report have been compared with the primary standards of TotalSP, LLC. Troemner Box No. 4000011832, which have been certified by Henry Troemner, LLC, through Certificate No. 01213051 dated 28-JUL-2021 and expires 28-JUL-2022. This Certification is directly traceable to the National Standards of the National Institute of Standards and Technology through NIST Test No. 684/289871-17. Complete traceability documents are on file in the offices of TotalSP, LLC and are available for inspection upon request.

CHEMRY Service, JNC, for TotalSP, LLC.

Samuel M. Prepelka
 Samuel M. Prepelka, President

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◊ NIST TRACEABLE WEIGHTS CERTIFICATION ◊ ANTISTATIC PRODUCTS ◊ MEMBER, AMERICAN SOCIETY FOR QUALITY

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Part Number:	X02NI99C15A08T3	Reference Number:	48-402101138-1
Cylinder Number:	CC13945	Cylinder Volume:	144.4 CF
Laboratory:	124 - Los Angeles (SAP) - CA	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 04, 2021	Valve Outlet:	660
Lot Number:	48-402101138-1		

Expiration Date: May 04, 2029

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
NITRIC OXIDE	285.0 PPM	285.4 PPM	+/- 2%
NITROGEN	Balance		
Total oxides of nitrogen		285.6 PPM	For Reference Only



Signature on file
Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Customer:	CLEAN AIR ENGINEERING	Reference Number:	32-401158144-1
Part Number:	E03NI70E15A9DM2	Cylinder Volume:	152.0 CF
Cylinder Number:	CC316220	Cylinder Pressure:	2015 PSIG
Laboratory:	112 - Troy-32 (SAP) - MI	Valve Outlet:	590
PGVP Number:	B62018	Certification Date:	Mar 26, 2018
Gas Code:	CO2,O2,BALN		

Expiration Date: Mar 26, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	10.36 %	G1	+/- 1% NIST Traceable	03/26/2018
OXYGEN	20.00 %	19.52 %	G1	+/- 1% NIST Traceable	03/26/2018
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	08010629	K016293	13.94 % CARBON DIOXIDE/NITROGEN	+/-0.6%	Jan 30, 2024
NTRM	090614-26	CC273759	22.53 % OXYGEN/NITROGEN	+/-0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
O2 FS, SIEMENS OXYMAT 6 E/N 182	Paramagnetic	Mar 01, 2018

Triad Data Available Upon Request



Signature on file
Approved for Release

APPENDIX E: FIELD DATA

Instrumental O₂ / CO₂ Data

TEST LOCATION: LINE #1 STACK

PAGE 1 OF 1

Client	GUARDIAN INDUSTRIES	Project Number	14485	$F_o = \frac{20.9 - \%O_2}{\%CO_2}$
Plant	CARLETON, NJ	Unit	LINE #1	
Asset No.	68A	Fuel Type	NAT. GAS	Leak Check Passed <input checked="" type="checkbox"/>

Gas	Cylinder ID No.	Gas Concentration (%dv)	Expiration Date
Zero	HIS 365	0.0% / 0.0%	
O ₂ / CO ₂	CC13945	9.772% / 4.934%	3/26/26
O ₂ / CO ₂	CC316226	19.57% / 10.36%	3/26/26

Pre-Test Calibration Response

Calibration	Percent O ₂ Response	Percent CO ₂ Response
Zero	0.0	0.0
High	19.5	10.4
Low	9.8	4.9

Field Data

Run Number	Method Number	Percent O ₂	Percent CO ₂	F _o	Analyst	Analysis	
						Date	Time
0	CTM-013	10.4	8.8	1.19	E. DOAK	10/4/21	17:22
1	CTM-013	11.1	7.9	1.24	E. DOAK	10/5/21	10:25
2	CTM-013	10.8	8.5	1.19	E. DOAK	10/5/21	12:18
3	CTM-013	10.4	8.9	1.18	E. DOAK	10/5/21	14:03

Post-Test Calibration Response

Calibration	Percent O ₂ Response	Percent CO ₂ Response
Zero	0.0	0.0
High	19.5	10.4
Low	9.8	5.0

Calculate F_o to verify results.

Acceptable ranges for F_o:

Coal: Anthracite and Lignite	1.016-1.130	Gas: Natural	1.600-1.836
Bituminous	1.083-1.230	Propane	1.434-1.586
Subbituminous (PRB)	1.056-1.175	Butane	1.405-1.553
Oil: Distillate	1.260-1.413	Wood	1.000-1.120
Residual	1.210-1.370	Municipal Solid Waste	0.968-1.230

QA/QC ED
Date 10/5/21



Impinger Weight Sheet

Client <u>Guardian</u>	Unit Name / Location <u>Stack 79</u>
Plant <u>Cableton, MI</u>	Job No. <u>14485</u> Method <u>CTM013</u>

Balance Calibration Check			
Balance ID	<u>68-5</u>	Reference Weight Mass	<u>1000.0 g</u>
Reference Weight ID	<u>95-J06467-1</u>	Reference Weight Reading	<u>1000.1 g</u>

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. <u>0</u>	Filter Type <u>N/A</u>	<u>N/A</u>	Sample Box No. <u>87-R5</u>
Date <u>10/4/21</u>	Lot No. <u>N/A</u>	<u>N/A</u>	pH <u>N/A</u>
Analyst <u>J Lord</u>	Filter No. <u>N/A</u>	<u>N/A</u>	Rinse <u>N/A</u>

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	<u>100 mL DI</u>	<u>612.0</u>	<u>558.8</u>	<u>53.2</u>	QA/QC <u>JL</u> Date <u>10/4/21</u>
Impinger 2	<u>100 mL DI</u>	<u>647.5</u>	<u>640.2</u>	<u>7.3</u>	
Impinger 3	<u>None</u>	<u>439.9</u>	<u>436.7</u>	<u>3.2</u>	
Impinger 4	<u>Silica Gel</u>	<u>740.2</u>	<u>733.5</u>	<u>6.7</u>	
Impinger 5					Total Weight (gm)
Impinger 6					<u>63.7</u>
Impinger 7					<u>70.4</u>

Run No. <u>1</u>	Filter Type <u>N/A</u>	<u>N/A</u>	Sample Box No. <u>68-S</u>
Date <u>10/5/21</u>	Lot No. <u>N/A</u>	<u>N/A</u>	pH <u>N/A</u>
Analyst <u>J Lord</u>	Filter No. <u>N/A</u>	<u>N/A</u>	Rinse <u>N/A</u>

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	<u>100 mL DI</u>	<u>619.5</u>	<u>552.8</u>	<u>66.7</u>	QA/QC <u>JL</u> Date <u>10/5/21</u>
Impinger 2	<u>100 mL DI</u>	<u>570.8</u>	<u>565.0</u>	<u>5.8</u>	
Impinger 3	<u>None</u>	<u>447.4</u>	<u>445.9</u>	<u>1.5</u>	
Impinger 4	<u>Silica Gel</u>	<u>745.8</u>	<u>739.9</u>	<u>5.9</u>	
Impinger 5					Total Weight (gm)
Impinger 6					<u>74.0</u>
Impinger 7					<u>79.9</u>

Run No. <u>Run 2</u>	Filter Type <u>N/A</u>	<u>N/A</u>	Sample Box No. <u>87-R5</u>
Date <u>10/5/21</u>	Lot No. <u>N/A</u>	<u>N/A</u>	pH <u>N/A</u>
Analyst <u>J Lord</u>	Filter No. <u>N/A</u>	<u>N/A</u>	Rinse <u>N/A</u>

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	<u>DI</u>	<u>672.4</u>	<u>612.0</u>	<u>60.4</u>	QA/QC <u>JL</u> Date <u>10/5/21</u>
Impinger 2	<u>DI</u>	<u>650.9</u>	<u>647.5</u>	<u>3.4</u>	
Impinger 3	<u>None</u>	<u>441.9</u>	<u>439.7</u>	<u>2.0</u>	
Impinger 4	<u>Silica Gel</u>	<u>745.5</u>	<u>740.2</u>	<u>5.3</u>	
Impinger 5					Total Weight (gm)
Impinger 6					<u>65.8</u>
Impinger 7					<u>71.1</u>

QA/QC _____
Date _____



Impinger Weight Sheet

Line 1

Client Guardian	Unit Name / Location Stack 79
Plant Carleton, MI	Job No. 14485 Method CTM-013

Balance Calibration Check			
Balance ID	68-5	Reference Weight Mass	1000.0g
Reference Weight ID	05-206462-1	Reference Weight Reading	1000.1g

Check must be performed once per day. Reference Weight Mass must agree with Reference Weight Reading to within ±0.5 g.

Run No. 3	Filter Type N/A	N/A	Sample Box No. N/A 685
Date 10/5/21	Lot No. N/A	N/A	pH N/A
Analyst J Lord	Filter No. N/A	N/A	Rinse N/A

BR
10/5/21

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1	DI	684.4	619.5	64.9	
Impinger 2	DI	576.6	570.8	5.8	QA/QC AV Date 10/5/21
Impinger 3	None	449.6	447.4	2.2	
Impinger 4	Silica Gel	752.9	745.8	7.1	
Impinger 5					Total Weight (gm)
Impinger 6					72.9
Impinger 7					80.0

Run No.	Filter Type	Sample Box No.
Date	Lot No.	pH
Analyst	Filter No.	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1					
Impinger 2					QA/QC Date
Impinger 3					
Impinger 4					
Impinger 5					Total Weight (gm)
Impinger 6					
Impinger 7					

Run No.	Filter Type	Sample Box No.
Date	Lot No.	pH
Analyst	Filter No.	Rinse

	Contents	Gross Weight (gm)	Tare Weight (gm)	Net Weight Gain (gm)	
Impinger 1					
Impinger 2					QA/QC Date
Impinger 3					
Impinger 4					
Impinger 5					Total Weight (gm)
Impinger 6					
Impinger 7					

QA/QC _____
Date _____



TEST LOCATION: Stack

Sulfuric Acid Mist Testing

METHOD: CTM-013 Mod. PAGE 1 OF 1

UNIT: EU00079

RUN: X

FIELD DATA SHEET

Client: <u>Bradison</u>	Project No: <u>14485</u>
Plant: <u>Calleton, Am</u>	Date: <u>10/4/01</u>
Meter Operator: <u>J. Kollig</u>	
Probe Operator: <u>AT Barkae</u>	

Meter Box No: <u>60-4</u>	Sample Box No: <u>LL-100</u>
Meter Yr: <u>1.0004</u>	Meter ΔH: <u>1.8754</u>
K Factor: <u>0.84</u>	Pitot C: <u>0.84</u>
Leak Rate Before: <u>0.001</u> (pm) [Lpm] @ <u>15</u> (in. Hg)	
Leak Rate After: <u>0.001</u> (pm) [Lpm] @ <u>15</u> (in. Hg)	
Pitot Leak Check Before: <input type="checkbox"/>	After: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>

Cross-Section of Test Location

Duct Dimensions (in): 139

Static Pres (in. Hg): <u>-0.85</u>	Pitot Len (in): <u>46</u>	Gas Flow (In) (Out): <u>(In) (Out)</u>	First point above way: <u>(In) (Out)</u>
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Amb Temp (CF): <u>86</u>	Bar Press: <u>29.10</u> (in. Hg) [mbar]
Probe ID No: <u>68-11-9-4</u>	
Liner Material: <u>glass</u>	

Filter No: _____	_____	_____
Sample No: _____	_____	_____
Nozzle Diameter: _____	Nozzle ID: _____	
Post Test AET-011 Check: Good <input checked="" type="checkbox"/> NA <input type="checkbox"/>		

Start Time: <u>15:49</u>	Stop Time: <u>16:49</u>
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Traverse Point Number	Min/pt Elapsed Time	Velocity Head ΔP (in. H ₂ O)	Orifice Setting ΔH (in. H ₂ O)	Gas Sample Volume		Stack Temp (CF)	Probe ΔP (CF)	PM Filter ΔP (CF)	SO ₂ Probe ΔP (CF)	SAM Filter Temp (CF)	SAM Oven Temp (CF)	DCM Inlet Temp (CF)	DCM Outlet Temp (CF)	Pump Vacuum (in. Hg)	Oxygen Indicator approx (%vdv)	Impinger Outlet Temp (CF)	
				(In) Vol	(ft ³) [L]												
1	5		0.41	690	100	591	480	550	175	170	175	97	96	3.0	10.1	58	
2	5			693	107	591	401	550	175	172	175	97	96	3.0	10.0	58	
3	5			693	70	591	401	550	175	172	176	96	96	3.0	10.1	58	
4	5			693	70	591	400	550	176	174	180	95	94	3.0	10.5	54	
5	5			693	71	591	400	550	176	175	180	96	96	3.0	9.9	53	
6	5			698	84	591	401	550	176	175	180	97	96	3.0	9.9	54	
7	5		0.45	700	67	591	400	550	175	178	185	98	96	3.0	9.0	52	
8	5		0.45	702	46	591	400	550	176	181	190	100	97	3.0	9.8	56	
9	5		0.45	704	32	594	401	550	176	180	188	100	98	3.0	9.8	57	
10	5		0.45	706	18	593	401	550	177	180	190	100	100	3.0	9.9	58	
11	5		0.45	708	05	592	401	550	177	179	189	100	100	3.0	9.8	59	
12	60		0.45	709	850	592	400	549	175	178	189	100	100	3.0	9.8	60	
Total				5.1600		7106.00											
Average				0.4300		592.166											

Sum of square roots

Circle correct bracketed units on data sheet.

3.85
48



TEST LOCATION: Stack

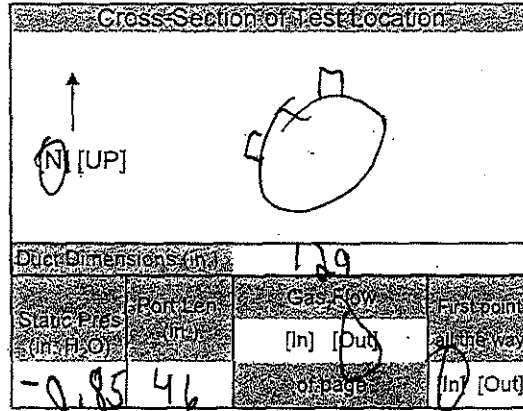
Sulfuric Acid Mist Testing

METHOD: CTM-013 Mod. PAGE 1 OF 1

UNIT: EM00079 RUN: 1

FIELD DATA SHEET

Client: <u>Qualtron</u>	Project No: <u>141105</u>
Plant: <u>Calchem</u>	Date: <u>10/5/11</u>
Meter Operator: <u>J. Kollin</u>	
Probe Operator: <u>AJ Nollman</u>	



Amb Temp (°F) <u>57</u>	Bar Press <u>29.40</u>	(in. Hg) (mbar)
Probe ID No: <u>68-11-9-4</u>		
liner Material: <u>219SS</u>		

Meter Box No: <u>60-4</u>	Sample Box No: <u>4A1</u>
Meter Yr: <u>1-004</u>	Meter Aff: <u>6-8254</u>
K Factor: <u>5.8654</u>	Pilot C: <u>5.8654</u>
Leak Rate Before: <u>0.001</u> (ftm) [Lpm] @ <u>15</u> (in. Hg)	
Leak Rate After: <u>0.001</u> (ftm) [Lpm] @ <u>15</u> (in. Hg)	
Pilot Leak Check Before: <input checked="" type="checkbox"/>	After: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>

Filter No: <u>---</u>		
Trimble No: <u>---</u>		
Nozzle Diameter: <u>---</u>	Nozzle ID: <u>---</u>	
Post-Test (ALI-01) Check: Good <input checked="" type="checkbox"/> NA <input type="checkbox"/>		

Start Time: <u>08:40</u>	Stop Time: <u>09:40</u>
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Traverse Point Number	Min/pt Elapsed Time	Velocity Head ΔP (in. H ₂ O)	Orifice Setting ΔH (in. H ₂ O)	Gas Sample Volume V _s		Stack Temp T _s (°F)	Probe Temp T _p (°F)	PM Filter Temp T _f (°F)	SE Cond	SAM Site Temp (°F)	SAM Oven Temp (°F)	DCM Inlet Temp (°F)	DCM Outlet Temp (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator approx (% O ₂)	Impinger Outlet Temp (°F)
				Init Vol. (L)	Final Vol. (L)											
			0.5	715.260			350	557	175							
2	5			717.17		589	400	549	176	177	185	71	71	3.0	9.9	66
	10			719.05		588	401	550	175	176	188	71	71	3.0	10.0	63
	15			720.94		588	401	550	176	176	183	73	72	3.0	9.9	60
	20			722.81		588	400	550	175	175	185	73	72	3.0	9.8	59
	25			724.68		589	400	551	176	176	184	75	73	3.0	9.9	57
	30			726.56		588	400	551	177	176	184	76	73	3.0	9.9	56
	35			728.45		588	400	549	177	176	183	78	73	3.0	9.9	56
	40			730.34		589	401	549	176	175	184	78	73	3.0	9.8	56
	45			732.22		589	400	550	175	175	183	78	73	3.0	9.9	56
	50			734.10		589	400	551	174	175	184	79	73	3.0	9.9	57
	55			736.00		588	400	550	173	176	185	79	73	3.0	9.9	57
	60			737.880		589	399	550	173	175	185	79	74	3.0	9.9	58
Total			6.000	22.6200		2061.000						711.000	871.000			
Average			0.5000	22.6200		588.500						74.2500				

Sum of square roots.

Circle correct bracketed units on data sheet.



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QA/QC JK
Date 10/5/11

TEST LOCATION: Stack

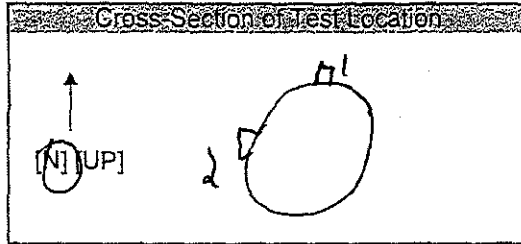
Sulfuric Acid Mist Testing

METHOD: CTM-013 Mod. PAGE 1 OF 1

UNIT: EU00079 RUN: 2

FIELD DATA SHEET

Client	<u>Granich</u>	Project No.	<u>14485</u>
Plant	<u>LaPorta, MI</u>	Date	<u>10/5/11</u>
Meter Operator	<u>J. Kollig</u>		
Probe Operator	<u>A. J. Palone</u>		



Amb. Temp. (°F)	<u>77</u>	Bar. Press.	<u>29.40</u>	(In. Hg) (mbar)
Probe ID No.	<u>68-16-9-4</u>			
Filter Material	<u>6155</u>			

Meter Box No.	<u>68-4</u>	Sample Box No.	<u>CC R1</u>
Meter Yr.	<u>10004</u>	Meter S/N	<u>L-8754</u>
K Factor		Pilot C	<u>0.84</u>
Leak Rate Before	<u>0.001</u> (cfm) [Lpm]	@	<u>15</u> (in. Hg)
Leak Rate After	<u>0.001</u> (cfm) [Lpm]	@	<u>15</u> (in. Hg)
Pilot Leak Check Before	<input checked="" type="checkbox"/>	After: Good	<input checked="" type="checkbox"/> Bad <input type="checkbox"/>

Direct Dimensions (in.)	<u>120</u>		
Static Pres (in. H ₂ O)	<u>0.85</u>	Flow (in. [In] [Out])	<u>46</u> of page <u>(N) [Out]</u>

Filter No.	<u>---</u>		
Filter No.	<u>---</u>		
Nozzle Diameter	<u>---</u>	Nozzle ID	<u>---</u>
Post-Test ALI-011 Check	Good <input checked="" type="checkbox"/>	NA	<input type="checkbox"/>

Start Time	<u>10:35</u>	Stop Time	<u>11:35</u>
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Traverse Point Number	Min/pt Elapsed Time	Velocity Head ΔP (in. H ₂ O)	Orifice Setting ΔH (in. H ₂ O)	Gas Sample Volume		Stack Temp (°F)	Probe Temp (°F)			SO ₂ Cond. (%)	SAM Filter Temp (°F)	SAM Oven Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator approx (%O ₂)	Impinger Outlet Temp (°F)
				Int. Vol. (mL)	(mL)		350	500	175								
2-1	5		0.5	743.85		589	400	550	176	172	180	77	76	3.0	10.0	64	
	5			745.76		589	401	551	174	173	185	79	76	3.0	9.9	62	
	5			747.66		589	401	550	175	174	187	80	77	3.0	9.9	60	
	5			749.56		589	401	551	176	175	188	81	77	3.0	9.9	57	
	5			751.45		589	401	551	175	176	189	81	77	3.0	9.9	57	
	5			753.34		589	401	551	175	176	189	81	77	3.0	9.9	57	
	5			755.24		589	400	551	176	177	191	84	78	3.0	9.8	55	
	5			757.15		589	399	550	175	176	191	84	78	3.0	9.8	55	
	5			759.07		589	400	550	174	175	191	85	78	3.0	9.9	56	
	5			760.96		589	400	550	173	174	191	85	78	3.0	9.9	56	
	5			762.86		589	401	549	174	176	195	84	78	3.0	9.8	57	
	5			764.75		589	401	551	175	177	196	84	78	3.0	9.9	58	
	5			766.64		589	402	550	175	176	196	84	78	3.0	9.9	59	
Total				6000		589											
Average				790		589.75											

Sum of square roots.

Circle correct bracketed units on data sheet.



QA/QC JK
Date 10/5/11

TEST LOCATION: Stack

Sulfuric Acid Mist Testing

METHOD: CTM-013 Mod. PAGE 1 OF 1

UNIT: EU00079 RUN: 3

FIELD DATA SHEET

Client: <u>Guardian</u>	Project No: <u>14485</u>
Plant: <u>Collector, Inc</u>	Date: <u>10/5/11</u>
Meter Operator: <u>J. Kalling</u>	
Probe Operator: <u>AT Pullone</u>	

Meter Box No: <u>68-4</u>	Sample Box No: <u>1103</u>
Meter Yr: <u>1.0004</u>	Meter Aff: <u>1.8754</u>
K Factor: <u>—</u>	Pitot C: <u>8.84</u>
Leak Rate Before: <u>0.000</u> (cfm) [Lpm] @ <u>15</u> (in. Hg)	
Leak Rate After: <u>0.000</u> (cfm) [Lpm] @ <u>15</u> (in. Hg)	
Pitot Leak Check Before: <input checked="" type="checkbox"/> After: <input checked="" type="checkbox"/> Good <input type="checkbox"/> Bad <input type="checkbox"/>	

Cross-Section of Test Location

Duct Dimensions (in): 149

Static Pies (in. H ₂ O): <u>-0.85</u>	Pitot Len (in): <u>46</u>	Gas Flow (in) [Out]: <u>(In) [Out]</u>	First point all the way (In) [Out]: <u>(In) [Out]</u>
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Amb. Temp (°F): <u>78</u>	Bar. Press: <u>29.40</u> (in. Hg) [mbar]
Probe I.D. No: <u>68-4-9-4</u>	
Probe Material: <u>Glass</u>	

Filter No: <u>—</u>		
Inj. No: <u>—</u>		
Nozzle Diameter: <u>—</u>	Nozzle I.D.: <u>—</u>	
Post-Test ALF-013 Check: <input checked="" type="checkbox"/> Good <input type="checkbox"/> NA <input type="checkbox"/>		

Start Time: <u>11:26</u>	Stop Time: <u>13:26</u>
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Traverse Point Number	Min/pl Elapsed Time	Velocity Head AP (in. H ₂ O)	Orifice Setting AP (in. H ₂ O)	Gas Sample Volume		Stack Temp (°F)	Probe I.D. (in)	Pitot Filter Set Points	SO ₂ Gal. (L)	SAM Filter Temp (°F)	SAM Oven Temp (°F)	DGM Inlet Temp (°F)	DGM Outlet Temp (°F)	Pump Vacuum (in. Hg)	Oxygen Indicator approx (% O ₂)	Impinger Outlet Temp (°F)
				Init. Vol. (ft ³)	[L]											
				771.500				350	500	175						
2-1	5		0.5	773.39		587	400	551	173	174	186	77	74	3.0	9.9	65
	10			775.28		586	401	551	174	175	189	77	75	3.0	9.8	63
	15			777.17		585	401	551	174	175	191	78	75	3.0	9.8	61
	20			779.05		586	400	551	175	175	191	79	75	3.0	9.7	60
	25			780.94		586	399	551	176	177	194	80	75	3.0	9.8	59
	30			782.83		586	400	550	175	176	195	80	75	3.0	9.8	57
	35			784.72		586	402	551	174	175	196	81	76	3.0	9.8	56
	40			786.62		586	402	550	175	175	195	81	76	3.0	9.8	55
	45			788.52		586	400	550	176	175	194	82	75	3.0	9.9	58
	50			790.42		586	400	550	175	176	195	83	78	3.0	9.9	58
	55			792.31		586	399	550	175	176	196	83	78	3.0	9.9	59
	60			794.21		586	399	550	174	175	195	83	78	3.0	9.8	60
	Total			6.000								164.000	911.000			
	Average			0.5000		586.000						78.1667				

Sum of square roots.

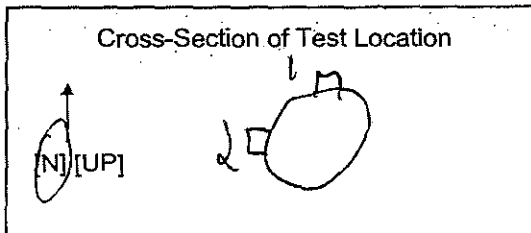
Circle correct bracketed units on data sheet.



TEST LOCATION: Stack
 UNIT: EU00079

VELOCITY DETERMINATION FIELD DATA SHEET

Client <u>Granite</u>	Project No. <u>14485</u>
Plant <u>Collection</u>	Date <u>10/4/01</u>
Meter Operator <u>Skilling</u>	
Probe Operator <u>AT Falgout</u>	
Source of Moisture and Molecular Weight Data	



Amb. Temp. (°F) <u>71</u>	P _{bar} <u>22.10</u>	(in. Hg) [mbar]
Pitot Cp <u>0.84</u>	Probe I.D. No. <u>TA-168-3</u>	
Duct Diameters from Disturbance		
Downstream <u>7.00</u>	Upstream <u>11.46</u>	
First point all the way (In) [Out]	Port Len. (in.)	
Gas Flow (In) [Out] of page		
Duct Dimensions (in.) <u>12.9</u>		

Run	ALT-011 Ck. <input checked="" type="checkbox"/> or NA <input type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input type="checkbox"/>	Run <u>Cyclonic</u>	ALT-011 Ck. <input type="checkbox"/> or NA <input type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input type="checkbox"/>
Start Time <u>14:05</u>	Stop Time <u>14:15</u>	Start Time	Stop Time	Start Time	Stop Time	Start Time	Stop Time
Static Press. (in. H ₂ O) <u>-0.85</u>		Static Press. (in. H ₂ O)		Static Press. (in. H ₂ O)		Static Press. (in. H ₂ O)	
Post-Test Leak Check: Pass <input checked="" type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input type="checkbox"/> Fail <input type="checkbox"/>	
Post-Test Pitot Check: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input type="checkbox"/> Bad <input type="checkbox"/>	

Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Angle ΔP	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Angle ΔP	Notes
1-1	584	0.04		2-1	584	0.03		1-1	0	0			2-1	0	0		
1-1	584	0.04		2-2	583	0.03		2	0	0			1-2	0	0		
1-2	585	0.04		2-3	584	0.03		3	0	0			3	0	0		
1-3	585	0.04		2-4	585	0.03		4	0	0			4	0	0		
1-4	585	0.05		2-5	584	0.04		5	0	0			5	0	0		
1-5	585	0.05		2-6	584	0.04		6	0	0			6	0	0		
1-6	585	0.05		2-7	583	0.04		7	0	0			7	0	0		
1-7	585	0.05		2-8	583	0.04		8	0	0			8	0	0		
1-8	586	0.05		2-9	583	0.03		9	0	0			9	0	0		
1-9	580	0.05		2-10	581	0.03		10	0	0			10	0	0		
1-10	578	0.04		2-11	581	0.03		11	0	0			11	0	0		
1-11	577	0.04		2-12	580	0.03		12	0	0			12	0	0		
1-12	577	0.03															
Total				Total	<u>13986</u>	<u>4.6769</u>		Total					Total				
Average				Average	<u>583.7500</u>	<u>0.1949</u>		Average					Average				

Sum of square roots. Circle correct bracketed units on data sheet.

QA/QC gkc
 Date 10/4/01
 E-10

NIST Thermocouple Serial Number: _____



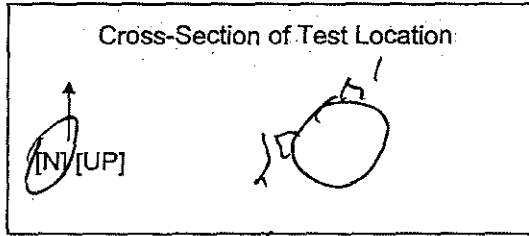
TEST LOCATION: Stack

VELOCITY DETERMINATION FIELD DATA SHEET

PAGE 1 OF 7

UNIT: EU00079

Client <u>Zuccher</u>	Project No. <u>14485</u>
Plant <u>Alcoa, NY</u>	Date <u>10/14/11</u>
Meter Operator <u>J. Kollig</u>	
Probe Operator <u>A. Nallone</u>	
Source of Moisture and Molecular Weight Data	



Amb. Temp. (°F) <u>81</u>	P _{bar} <u>29.10</u> [in./Hg] [mbar]
Pitot Cp <u>0.84</u>	Probe I.D. No. <u>TP-1683</u>
Duct Diameters from Disturbance	
Downstream <u>7.0</u>	Upstream <u>11.0</u>
First point all the way [In] [Out]	Port Len. (in.) <u>46</u>
Gas Flow [In] [Out] of page	
Duct Dimensions (in.) <u>129</u>	

Run	ALT-011 Ck. <input type="checkbox"/> or NA <input checked="" type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input checked="" type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input checked="" type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input checked="" type="checkbox"/>								
Start Time <u>16:49</u>	Stop Time	Start Time	Stop Time	Start Time <u>3:40</u>	Stop Time	Start Time	Stop Time								
Static Press. (in. H ₂ O) <u>-0.05</u>		Static Press. (in. H ₂ O)		Static Press. (in. H ₂ O)		Static Press. (in. H ₂ O)									
Post-Test Leak Check: Pass <input checked="" type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input checked="" type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input checked="" type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input type="checkbox"/> Fail <input type="checkbox"/>									
Post-Test Pitot Check: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input type="checkbox"/> Bad <input type="checkbox"/>									
Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes
1-1	591	0.04		1-1	591	0.04		1-1				1-1			
1-2	591	0.04		1-2	591	0.03		1-2				1-2			
1-3	591	0.04		1-3	591	0.04		1-3				1-3			
1-4	593	0.04		1-4	593	0.04		1-4				1-4			
1-5	593	0.05		1-5	594	0.04		1-5				1-5			
1-6	591	0.04		1-6	593	0.04		1-6				1-6			
1-7	590	0.05		1-7	593	0.05		1-7				1-7			
1-8	591	0.05		1-8	591	0.04		1-8				1-8			
1-9	590	0.04		1-9	591	0.05		1-9				1-9			
1-10	588	0.04		1-10	589	0.04		1-10				1-10			
1-11	587	0.04		1-11	588	0.03		1-11				1-11			
1-12	588	0.04		1-12	587	0.03		1-12				1-12			
Total				14186	4.8376										
Average				590.8	0.046										

Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC 96
Date 10/14/11
E-11

NIST Thermocouple Serial Number: _____



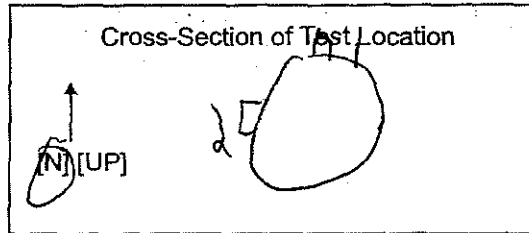
TEST LOCATION: Stack

VELOCITY DETERMINATION FIELD DATA SHEET

PAGE 1 OF 1

UNIT: EU00079

Client <u>Greiner</u>	Project No. <u>4498</u>
Plant <u>Crofton, Md.</u>	Date <u>10/5/04</u>
Meter Operator <u>J. Kelly</u>	
Probe Operator <u>AJ Nallone</u>	
Source of Moisture and Molecular Weight Data	



Amb. Temp. (°F)	P _{bar}	(in. Hg) [mbar]
Pitot Cp <u>0.84</u>	Probe I.D. No. <u>0-167-3</u>	
Duct Diameters from Disturbance		
Downstream <u>7.0</u>	Upstream <u>11.2</u>	
First point all the way (In) [Out]	Port Len. (in.) <u>46</u>	
Gas Flow (In) [Out] of page		
Duct Dimensions (in.) <u>129</u>		

Run <u>3</u>	ALT-011 Ck. <input checked="" type="checkbox"/> or NA <input type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input type="checkbox"/>	Run <u>4</u>	ALT-011 Ck. <input checked="" type="checkbox"/> or NA <input type="checkbox"/>	Run	ALT-011 Ck. <input type="checkbox"/> or NA <input type="checkbox"/>
Start Time <u>8:00</u>	Stop Time <u>8:00</u>	Start Time	Stop Time	Start Time <u>9:45</u>	Stop Time <u>10:00</u>	Start Time	Stop Time
Static Press. (in. H ₂ O) <u>-0.85</u>		Static Press. (in. H ₂ O)		Static Press. (in. H ₂ O) <u>-0.85</u>		Static Press. (in. H ₂ O)	
Post-Test Leak Check: Pass <input checked="" type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input checked="" type="checkbox"/> Fail <input type="checkbox"/>		Post-Test Leak Check: Pass <input type="checkbox"/> Fail <input type="checkbox"/>	
Post-Test Pitot Check: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input checked="" type="checkbox"/> Bad <input type="checkbox"/>		Post-Test Pitot Check: Good <input type="checkbox"/> Bad <input type="checkbox"/>	

Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in. H ₂ O)	Notes
1	583	0.04		1	584	0.03		1	584	0.04		1	583	0.04	
2	583	0.04		2	584	0.03		2	583	0.04		2	582	0.03	
3	583	0.04		3	583	0.04		3	583	0.03		3	583	0.03	
4	583	0.04		4	583	0.04		4	583	0.04		4	583	0.04	
5	584	0.04		5	583	0.04		5	583	0.04		5	584	0.04	
6	584	0.04		6	584	0.04		6	583	0.05		6	584	0.04	
7	584	0.05		7	583	0.04		7	584	0.05		7	583	0.04	
8	584	0.05		8	583	0.04		8	583	0.04		8	582	0.05	
9	583	0.04		9	581	0.04		9	581	0.04		9	581	0.04	
10	583	0.04		10	580	0.04		10	580	0.03		10	581	0.04	
11	580	0.03		11	580	0.04		11	579	0.03		11	579	0.04	
12	580	0.03		12	578	0.04		12	579	0.03		12	578	0.04	
Total															
Average															

Sum of square roots.

Circle correct bracketed units on data sheet.

139.66 4.623
152.1167 0.145

TEST LOCATION:

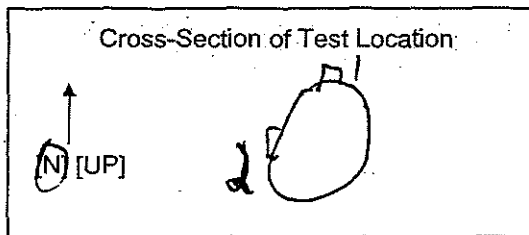
Stack

VELOCITY DETERMINATION FIELD DATA SHEET

PAGE 1 OF 1

UNIT: EUC0079

Client	Guardian	Project No.	14495
Plant	Garretts, MI	Date	10/5/11
Meter Operator	A. Killig		
Probe Operator	AT Phillips		
Source of Moisture and Molecular Weight Data			



Amb. Temp. (°F)	77	P _{bar}	19.40	[in. Hg] [mbar]
Pitot Cp	0.84	Probe I.D. No.	7-16833	
Duct Diameters from Disturbance				
Downstream	7.0	Upstream	11.1	
First point all the way [In] [Out]		Port Len. (in.)	46	
Gas Flow [In] [Out]		of page		
Duct Dimensions (in.)	7.19			

Run	4	ALT-011 Ck.	<input checked="" type="checkbox"/>	or NA	<input type="checkbox"/>	Run	5	ALT-011 Ck.	<input checked="" type="checkbox"/>	or NA	<input type="checkbox"/>	Run	5	ALT-011 Ck.	<input checked="" type="checkbox"/>	or NA	<input type="checkbox"/>			
Start Time	11:37	Stop Time	11:54	Start Time		Stop Time		Start Time	13:30	Stop Time	13:53	Start Time		Stop Time		Start Time		Stop Time		
Static Press. (in. H ₂ O)	-0.85		Static Press. (in. H ₂ O)			Static Press. (in. H ₂ O)	-0.85		Static Press. (in. H ₂ O)			Static Press. (in. H ₂ O)			Static Press. (in. H ₂ O)			Static Press. (in. H ₂ O)		
Post-Test Leak Check:	Pass <input checked="" type="checkbox"/>	Fail <input type="checkbox"/>	Post-Test Leak Check:	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>	Post-Test Leak Check:	Pass <input checked="" type="checkbox"/>	Fail <input type="checkbox"/>	Post-Test Leak Check:	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>	Post-Test Leak Check:	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>	Post-Test Leak Check:	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>	Post-Test Leak Check:	Pass <input type="checkbox"/>	Fail <input type="checkbox"/>
Post-Test Pitot Check:	Good <input checked="" type="checkbox"/>	Bad <input type="checkbox"/>	Post-Test Pitot Check:	Good <input type="checkbox"/>	Bad <input type="checkbox"/>	Post-Test Pitot Check:	Good <input checked="" type="checkbox"/>	Bad <input type="checkbox"/>	Post-Test Pitot Check:	Good <input type="checkbox"/>	Bad <input type="checkbox"/>	Post-Test Pitot Check:	Good <input type="checkbox"/>	Bad <input type="checkbox"/>	Post-Test Pitot Check:	Good <input type="checkbox"/>	Bad <input type="checkbox"/>	Post-Test Pitot Check:	Good <input type="checkbox"/>	Bad <input type="checkbox"/>

Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in.H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in.H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in.H ₂ O)	Notes	Traverse Point Number	Stack Temp. T _s (°F)	Velocity Head ΔP (in.H ₂ O)	Notes
1-1	588	0.03		1-1	584	0.03		1-1	586	0.03		1-1	584	0.04	
1-2	586	0.03		1-2	584	0.04		1-2	585	0.04		1-2	584	0.04	
2-1	585	0.04		2-1	585	0.04		2-1	585	0.03		2-1	583	0.04	
2-2	584	0.04		2-2	584	0.04		2-2	585	0.04		2-2	583	0.04	
3-1	584	0.04		3-1	583	0.04		3-1	584	0.04		3-1	583	0.04	
3-2	584	0.04		3-2	583	0.04		3-2	584	0.04		3-2	583	0.05	
4-1	584	0.04		4-1	583	0.05		4-1	583	0.04		4-1	583	0.05	
4-2	584	0.04		4-2	582	0.05		4-2	583	0.04		4-2	583	0.04	
5-1	584	0.04		5-1	581	0.04		5-1	583	0.04		5-1	582	0.04	
5-2	584	0.04		5-2	581	0.04		5-2	583	0.04		5-2	582	0.04	
6-1	583	0.03		6-1	581	0.04		6-1	583	0.04		6-1	582	0.03	
6-2	583	0.03		6-2	579	0.03		6-2	581	0.03		6-2	579	0.04	
7-1	581	0.03		7-1	578	0.03		7-1	581	0.03		7-1	579	0.03	
7-2	579	0.03						7-2	582	0.03					
Total					13993.00	4.6319							13988.00	4.6864	
Average					583.04	0.1930							581.93	0.1953	

Sum of square roots.

Circle correct bracketed units on data sheet.

QA/QC *g/k*
 Date *10/5/11*
 E - 13

NIST Thermocouple Serial Number:

APPENDIX F: FIELD DATA PRINTOUTS

USEPA Method 3 Laboratory Data

Location: EU00079 Stack
 Client: Guardian Industries, LLC
 Project No: 14485
 Method: EPA Method 3A
 Fuel Type: Natural Gas
 F_o for Fuel: 1.6 to 1.836

Test Method: USEPA Method 2
Analyte: Velocity & Flow Rate

Analyst: E. Doak
Analyst Emp No: 349

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis: CEM
3	1							
	2							
	3							
Avg.								
CEM or Other Avg:		7.90000		11.10000	81.00000	29.70800	1.24051	<input type="checkbox"/> Fo value within expected range.

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis: CEM
4	1							
	2							
	3							
Avg.								
CEM or Other Avg:		8.50000		10.80000	80.70000	29.79200	1.18824	<input type="checkbox"/> Fo value within expected range.

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis: CEM
5	1							
	2							
	3							
Avg.								
CEM or Other Avg:		8.90000		10.40000	80.70000	29.84000	1.17978	<input type="checkbox"/> Fo value within expected range.

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis:
	1							
	2							
	3							
Avg.								
CEM or Other Avg:								<input type="checkbox"/> Fo value within expected range.

102521 112208
 ©©©©

Field Data Printout

Test Method:
Analyte:

USEPA Method 2
Velocity & Flow Rate

Location: EU00079 Stack

Test Run: 3

Client: Guardian Industries, LLC

Project No: 14485

Source Area (ft²): 90.76258

Meter Operator: J. Kolling 684
Probe Operator: A. Pallone 675

Test Date: 10/05/21

Start Time: 09:45

Stop Time: 10:00

Leak Rate Before: N/A cfm N/A
Leak Rate After: N/A cfm N/A

Bar. Press. (in. Hg): 28.40
Static P: -0.85

O₂ (dry volume %): 11.10
CO₂ (dry volume %): 7.90
N₂+CO (dry volume %): 81.00

Nozzle ID No: N/A
Nozzle Diameter (D_n): N/A
Probe ID No: TP-168-3
Pitot C_p: 0.840
Pitot Leak Check: Pass Fail

Meter Box ID. No: N/A
Meter ΔH@: N/A
Meter Y_d: N/A

Traverse Point	Run Time 5.0 min/read	Pitot ΔP _s (in. H ₂ O)	Sample ΔH (in. H ₂ O)	Metered (dcf)	Stack T _s (°F)	Dry Gas Meter T _{m-in} T _{m-out} (°F) (°F)		√ΔP _s (calculated) (√in. H ₂ O)	Volume (calculated) (ft ³)	Isokinetics (calculated) (%)
2-01		0.04			584			0.20		
2-02		0.04			582			0.20		
2-03		0.03			582			0.17		
2-04		0.04			583			0.20		
2-05		0.04			583			0.20		
2-06		0.05			583			0.22		
2-07		0.05			584			0.22		
2-08		0.04			583			0.20		
2-09		0.04			581			0.20		
2-10		0.03			580			0.17		
2-11		0.03			579			0.17		
2-12		0.03			579			0.17		
1-01		0.03			583			0.17		
1-02		0.03			582			0.17		
1-03		0.03			583			0.17		
1-04		0.04			583			0.20		
1-05		0.04			584			0.20		
1-06		0.04			584			0.20		
1-07		0.04			583			0.20		
1-08		0.05			582			0.22		
1-09		0.04			581			0.20		
1-10		0.04			581			0.20		
1-11		0.04			579			0.20		
1-12		0.04			578			0.20		
Final					581.91667			0.19514		

24 points sampled
QC-Check: Field Averages

Sq.Rt. ΔP
0.1951 581.9169

Avg. OK Avg. OK Avg. OK Avg. OK Avg. OK

102521 112206
©

Field Data Printout

Test Method:
Analyte:

USEPA Method 2
Velocity & Flow Rate

Location: EU00079 Stack
 Test Run: 4
 Client: Guardian Industries, LLC
 Project No: 14485
 Source Area (ft²): 90.76258
 Meter Operator: J. Kolling 684
 Probe Operator: A. Pallone 675
 Test Date: 10/05/21
 Start Time: 11:37
 Stop Time: 11:54
 Leak Rate Before: N/A cfm N/A
 Leak Rate After: N/A cfm N/A

Bar. Press. (in. Hg): 28.40
 Static P: -0.85
 O₂ (dry volume %): 10.80
 CO₂ (dry volume %): 8.50
 N₂+CO (dry volume %): 80.70

Nozzle ID No: N/A
 Nozzle Diameter (D_n): N/A
 Probe ID No: TP-168-3
 Pitot C_p: 0.840
 Pitot Leak Check: Pass Fail

Meter Box ID. No: N/A
 Meter ΔH@: N/A
 Meter Y_d: N/A

Traverse Point	Run Time 5.0 min/read	Pitot	Sample	Metered (dcf)	Stack T _s (°F)	Dry Gas Meter		√ΔP _s (calculated) (√in. H ₂ O)	Volume (calculated) (ft ³)	Isokinetics (calculated) (%)
		ΔP _s (in. H ₂ O)	ΔH (in. H ₂ O)			T _{m-in} (°F)	T _{m-out} (°F)			
1-01		0.03			588			0.17		
1-02		0.03			586			0.17		
1-03		0.04			585			0.20		
1-04		0.04			584			0.20		
1-05		0.04			584			0.20		
1-06		0.04			584			0.20		
1-07		0.04			584			0.20		
1-08		0.04			584			0.20		
1-09		0.04			584			0.20		
1-10		0.03			583			0.17		
1-11		0.03			581			0.17		
1-12		0.03			579			0.17		
2-01		0.03			584			0.17		
2-02		0.04			584			0.20		
2-03		0.04			585			0.20		
2-04		0.04			584			0.20		
2-05		0.04			583			0.20		
2-06		0.04			583			0.20		
2-07		0.05			583			0.22		
2-08		0.05			582			0.22		
2-09		0.04			581			0.20		
2-10		0.04			581			0.20		
2-11		0.03			579			0.17		
2-12		0.03			578			0.17		
Final					583.04167			0.19304		

24 points sampled
 QC-Check: Field Averages
 Sq.RLAP

0.1930	583.0417
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 Avg. OK Avg. OK Avg. OK Avg. OK Avg. OK

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Field Data Printout

Test Method:
Analyte:

USEPA Method 2
Velocity & Flow Rate

Location: EU00079 Stack

Test Run: 5

Client: Guardian Industries, LLC

Project No: 14485

Source Area (ft²): 90.76258

Meter Operator:	J. Kolling	684
Probe Operator:	A. Pallone	675

Test Date: 10/05/21

Start Time: 13:30

Stop Time: 13:50

Leak Rate Before:	N/A	cfm	N/A
Leak Rate After:	N/A	cfm	N/A

Bar. Press. (in. Hg): 28.40

Static P: -0.85

O₂ (dry volume %): 10.40

CO₂ (dry volume %): 8.90

N₂+CO (dry volume %): 80.70

Nozzle ID No: N/A

Nozzle Diameter (D_n): N/A

Probe ID No: TP-168-3

Pitot C_p: 0.840

Pitot Leak Check: Pass Fail

Meter Box ID. No: N/A

Meter ΔH@: N/A

Meter Y_d: N/A

Traverse Point	Run Time 5.0 min/read	Pitot	Sample	Metered (dcf)	Stack	Dry Gas Meter		√ΔP _s	Volume	Isokinetics
		ΔP _s (in. H ₂ O)	ΔH (in. H ₂ O)		T _s (°F)	T _{m-in} (°F)	T _{m-out} (°F)	(calculated) (√in. H ₂ O)	(calculated) (ft ³)	(calculated) (%)
1-01		0.03			586			0.17		
1-02		0.04			585			0.20		
1-03		0.03			585			0.17		
1-04		0.04			585			0.20		
1-05		0.04			584			0.20		
1-06		0.04			584			0.20		
1-07		0.04			583			0.20		
1-08		0.04			583			0.20		
1-09		0.04			583			0.20		
1-10		0.04			583			0.20		
1-11		0.03			581			0.17		
1-12		0.03			580			0.17		
2-01		0.04			584			0.20		
2-02		0.04			584			0.20		
2-03		0.04			583			0.20		
2-04		0.04			583			0.20		
2-05		0.04			583			0.20		
2-06		0.05			583			0.22		
2-07		0.05			583			0.22		
2-08		0.04			583			0.20		
2-09		0.04			582			0.20		
2-10		0.03			580			0.17		
2-11		0.04			579			0.20		
2-12		0.03			579			0.17		
Final					582.83333			0.19527		

24 points sampled
QC-Check: Field Averages

Sq.Rt.ΔP	0.1953			582.8333
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Avg. OK Avg. OK Avg. OK Avg. OK Avg. OK

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USEPA Method 3 Laboratory Data

Location: EU00079 Stack
 Client: Guardian Industries, LLC
 Project No: 14485
 Method: EPA Method 3A
 Fuel Type: Natural Gas
 F_o for Fuel: 1.6 to 1.836

Test Method: CTM-013
Analyte: H2SO4

Analyst: E. Doak
 Analyst Emp No: 349

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis: CEM
1	1							
	2							
	3							
Avg.								
CEM or Other Avg:		7.90000	11.10000	81.00000	29.70800	1.24051	<input type="checkbox"/> Fo value within expected range.	

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis: CEM
2	1							
	2							
	3							
Avg.								
CEM or Other Avg:		8.50000	10.80000	80.70000	29.79200	1.18824	<input type="checkbox"/> Fo value within expected range.	

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis: CEM
3	1							
	2							
	3							
Avg.								
CEM or Other Avg:		8.90000	10.40000	80.70000	29.84000	1.17978	<input type="checkbox"/> Fo value within expected range.	

Run Number	Trial	Percent CO ₂	Percent O ₂ +CO ₂	Percent O ₂	Percent N ₂	Dry Mol. Weight	F _o	Method of Analysis:
	1							
	2							
	3							
Avg.								
CEM or Other Avg:								<input type="checkbox"/> Fo value within expected range.

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USEPA Method 4 Laboratory Data

Location: EU00079 Stack
 Client: Guardian Industries, LLC
 Project No: 14485

Test Method: CTM-013
Analyte: H2SO4
 Analyst: J. Lord
 Analyst Emp No: 676

Test Run: 1

	Contents	Gross (gm)	Tare (gm)	Net (gm)	
Impinger 1	100 mL DI Water	619.5	552.8	66.7	
Impinger 2	100 mL DI Water	570.8	565.0	5.8	
Impinger 3	Empty	447.4	445.9	1.5	
Impinger 4	Silica Gel	745.8	739.9	5.9	
Impinger 5					
Impinger 6					
Impinger 7					
Impinger 8					

74.0 Liquid (gm)	Field Data Check	
0.0 less rinse (gm)		
74.0 Net Liquid (gm)		<u>74.0</u>
+ 5.9 Silica Gel (gm)		<u>5.9</u>
79.9 Total Vlc (gm)		<u>79.9</u>

Rinse: _____ (ml or gm)

Test Run: 2

	Contents	Gross (gm)	Tare (gm)	Net (gm)	
Impinger 1	100 mL DI Water	672.4	612.0	60.4	
Impinger 2	100 mL DI Water	650.9	647.5	3.4	
Impinger 3	Empty	441.9	439.9	2.0	
Impinger 4	Silica Gel	745.5	740.2	5.3	
Impinger 5					
Impinger 6					
Impinger 7					
Impinger 8					

65.8 Liquid (gm)	Field Data Check	
0.0 less rinse (gm)		
65.8 Net Liquid (gm)		<u>65.8</u>
+ 5.3 Silica Gel (gm)		<u>5.3</u>
71.1 Total Vlc (gm)		<u>71.1</u>

Rinse: _____ (ml or gm)

Test Run: 3

	Contents	Gross (gm)	Tare (gm)	Net (gm)	
Impinger 1	100 mL DI Water	684.4	619.5	64.9	
Impinger 2	100 mL DI Water	578.6	570.8	5.8	
Impinger 3	Empty	449.6	447.4	2.2	
Impinger 4	Silica Gel	752.9	745.8	7.1	
Impinger 5					
Impinger 6					
Impinger 7					
Impinger 8					

72.9 Liquid (gm)	Field Data Check	
0.0 less rinse (gm)		
72.9 Net Liquid (gm)		<u>72.9</u>
+ 7.1 Silica Gel (gm)		<u>7.1</u>
80.0 Total Vlc (gm)		<u>80.0</u>

Rinse: _____ (ml or gm)

Test Run: _____

	Contents	Gross (gm)	Tare (gm)	Net (gm)	
Impinger 1					
Impinger 2					
Impinger 3					
Impinger 4					
Impinger 5					
Impinger 6					
Impinger 7					
Impinger 8					

Liquid (gm)	Field Data Check	
less rinse (gm)		
Net Liquid (gm)		
Silica Gel (gm)		
Total Vlc (gm)		

Rinse: _____ (ml or gm)

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Field Data Printout

Location: EU00079 Stack
 Test Run: 1
 Client: Guardian Industries, LLC
 Project No: 14485
 Source Area (ft²): 90.76258
 Meter Operator: J. Kolling 684
 Probe Operator: A. Pallone 675
 Test Date: 10/05/21
 Start Time: 08:40
 Stop Time: 09:40
 Leak Rate Before: 0.001 cfm @ 15 "Hg
 Leak Rate After: 0.001 cfm @ 15 "Hg

Test Method:
Analyte:

CTM-013
H2SO4

Bar. Press. (in. Hg): 29.40
 Static P: -0.85
 O₂ (dry volume %): 11.10
 CO₂ (dry volume %): 7.90
 N₂+CO (dry volume %): 81.00

Nozzle ID No: N/A
 Nozzle Diameter (D_n): N/A
 Probe ID No: 68-CC-9-4
 Pitot C_p: 0.840
 Pitot Leak Check: Pass Fail

H₂O (condensate, ml or gm): 74.0
 H₂O (silica, g): 5.9
 Actual Moisture (%): 14.60

Meter Box ID. No: 68-4
 Meter ΔH@: 1.87540
 Meter Y_d: 1.00040

Traverse Point	Run Time 5.0 min/read	Pitot ΔP _s (in. H ₂ O)	Sample ΔH (in. H ₂ O)	Metered (dcf)	Stack T _s (°F)	Dry Gas Meter		√ΔP _s (calculated) (√in. H ₂ O)	Volume (calculated) (ft ³)	Isokinetics (calculated) (%)
						T _{m-in} (°F)	T _{m-out} (°F)			
	0.0			715.260						
2-01	5.0		0.50	717.170	589	71	71		1.91	
2-01	10.0		0.50	719.050	588	72	71		1.88	
2-01	15.0		0.50	720.940	588	73	72		1.89	
2-01	20.0		0.50	722.810	588	73	72		1.87	
2-01	25.0		0.50	724.680	589	75	73		1.87	
2-01	30.0		0.50	726.560	588	76	73		1.88	
2-01	35.0		0.50	728.450	588	78	73		1.89	
2-01	40.0		0.50	730.340	589	78	73		1.89	
2-01	45.0		0.50	732.220	589	78	73		1.88	
2-01	50.0		0.50	734.100	589	79	73		1.88	
2-01	55.0		0.50	736.000	588	79	73		1.90	
2-01	60.0		0.50	737.880	589	79	74		1.88	
Final	60.0		0.50000	22.62000	588.50000	74.25000			22.62000	

2 points sampled
 QC-Check: Field Averages

Sq,RLAP	0.5000	22.6200	588.5000	74.2500
<input type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK

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Field Data Printout

Test Method:
Analyte:

CTM-013
H2SO4

Location: EU00079 Stack

Test Run: 2

Client: Guardian Industries, LLC

Project No: 14485

Source Area (ft²): 90.76258

Meter Operator: J. Kolling 684

Probe Operator: A. Pallone 675

Test Date: 10/05/21

Start Time: 10:35

Stop Time: 11:35

Leak Rate Before: 0.001 cfm @ 15 "Hg

Leak Rate After: 0.001 cfm @ 15 "Hg

Bar. Press. (in. Hg): 29.40

Static P: -0.85

O₂ (dry volume %): 10.80

CO₂ (dry volume %): 8.50

N₂+CO (dry volume %): 80.70

H₂O (condensate, ml or gm): 65.8

H₂O (silica, g): 5.3

Actual Moisture (%): 13.23

Nozzle ID No: N/A

Nozzle Diameter (D_n): N/A

Probe ID No: 68-CC-9-4

Pitot C_p: 0.840

Pitot Leak Check: Pass Fail

Meter Box ID No: 68-4

Meter ΔH@: 1.87540

Meter Y_a: 1.00040

Traverse Point	Run Time 5.0 min/read	Pitot ΔP _s (in. H ₂ O)	Sample ΔH (in. H ₂ O)	Metered (dcf)	Stack T _s (°F)	Dry Gas Meter		√ΔP _s (calculated) (√in. H ₂ O)	Volume (calculated) (ft ³)	Isokinetics (calculated) (%)
						T _{m-in} (°F)	T _{m-out} (°F)			
	0.0			743.850						
2-01	5.0		0.50	745.760	589	77	76		1.91	
2-01	10.0		0.50	747.660	589	79	76		1.90	
2-01	15.0		0.50	749.560	589	79	76		1.90	
2-01	20.0		0.50	751.450	589	80	77		1.89	
2-01	25.0		0.50	753.340	589	81	77		1.89	
2-01	30.0		0.50	755.240	588	82	77		1.90	
2-01	35.0		0.50	757.150	589	84	78		1.91	
2-01	40.0		0.50	759.060	589	84	78		1.91	
2-01	45.0		0.50	760.960	588	85	79		1.90	
2-01	50.0		0.50	762.860	588	84	78		1.90	
2-01	55.0		0.50	764.750	589	84	78		1.89	
2-01	60.0		0.50	766.640	589	84	78		1.89	
Final	60.0		0.50000	22.79000	588.75000	79.62500			22.79000	
2 points sampled		Sq,RLAP								
QC-Check: Field Averages			0.5000	22.7900	588.7800	79.6250				

Avg. OK Avg. OK Avg. OK Avg. OK Avg. OK

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Field Data Printout

Location: EU00079 Stack
 Test Run: 3
 Client: Guardian Industries, LLC
 Project No: 14485
 Source Area (ft²): 90.76258
 Meter Operator: J. Kolling 684
 Probe Operator: A. Pallone 675
 Test Date: 10/05/21
 Start Time: 12:26
 Stop Time: 13:26
 Leak Rate Before: 0.001 cfm @ 15 "Hg
 Leak Rate After: 0.001 cfm @ 15 "Hg

Test Method:
Analyte:

CTM-013
H2SO4

Bar. Press. (in. Hg): 29.40
 Static P: -0.85
 O₂ (dry volume %): 10.40
 CO₂ (dry volume %): 8.90
 N₂+CO (dry volume %): 80.70

Nozzle ID No: N/A
 Nozzle Diameter (D_n): N/A
 Probe ID No: 68-CC-9-4
 Pitot C_p: 0.840
 Pitot Leak Check: Pass Fail

H₂O (condensate, ml or gm): 72.9
 H₂O (silica, g): 7.1
 Actual Moisture (%): 14.66

Meter Box ID. No: 68-4
 Meter ΔH@: 1.87540
 Meter Y_d: 1.00040

Traverse Point	Run Time 5.0 min/read	Pitot ΔP _s (in. H ₂ O)	Sample ΔH (in. H ₂ O)	Metered (dcf)	Stack T _s (°F)	Dry Gas Meter		√ΔP _s (calculated) (√in. H ₂ O)	Volume (calculated) (ft ³)	Isokinetics (calculated) (%)
						T _{m-in} (°F)	T _{m-out} (°F)			
2-01	5.0		0.50	773.390	587	77	74		1.89	
2-01	10.0		0.50	775.280	586	77	75		1.89	
2-01	15.0		0.50	777.160	585	78	75		1.88	
2-01	20.0		0.50	779.050	586	79	75		1.89	
2-01	25.0		0.50	780.940	586	80	75		1.89	
2-01	30.0		0.50	782.830	586	80	75		1.89	
2-01	35.0		0.50	784.720	586	81	76		1.89	
2-01	40.0		0.50	786.620	586	81	76		1.90	
2-01	45.0		0.50	788.520	586	82	77		1.90	
2-01	50.0		0.50	790.420	586	83	78		1.90	
2-01	55.0		0.50	792.310	586	83	78		1.89	
2-01	60.0		0.50	794.210	586	83	78		1.90	
Final	60.0		0.50000	22.71000	586.00000	78.16667			22.71000	

2 points sampled
QC-Check: Field Averages

Sq.RI.ΔP	0.5000	22.7100	586.0000	78.1167
<input type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK	<input checked="" type="checkbox"/> Avg. OK	<input type="checkbox"/> Avg. OK

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APPENDIX G: LABORATORY DATA

CHROMATOGRAPHIC DATA REDUCTION
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Stock Standard: 4998.91 mg/L
 Working Stock Conc.: 49.9891 mg/L
 CCV: 1.60 mg/L
 QC: 1.50 mg/L

Analyte:

Calibration Point Conc. (mg/L)	Date of Injection	Sulfate Standards Calibration Data						
		1	2	3	4	5	6	7
Cal 1 Trial 1	10/04/2021	0.0000	0.0454	0.0752	0.1449	0.2845	0.7352	0.8935
Cal 1 Trial 2		0.0000	0.0465	0.0755	0.1465	0.2860	0.7379	0.9084
Cal 2 Trial 1	10/05/2021	0.0000	0.0493	0.0818	0.1452	0.2930	0.7342	0.9009
Cal 2 Trial 2		0.0000	0.0509	0.0770	0.1481	0.2995	0.7389	0.9048
n		4	4	4	4	4	4	4
Average		0.0000	0.0480	0.0774	0.1469	0.2908	0.7366	0.9019
Standard Deviation		0.0000	0.0025	0.0031	0.0015	0.0069	0.0022	0.0064
%RSD		0.00	5.26	3.95	1.01	2.38	0.30	0.71

Quality Control Checks							
Measured Area Counts (Counts)	Actual Concentration (mg/L)	Regression Concentration (mg/L)	Difference pt-Line (% Scale)	Is Difference Less Than 2% of Scale?	Difference pt-Line (Relative %)	Is Relative Difference Less Than 10%?	
0.0000	0.000	0.005	-0.08%	Yes	0.00%	Yes	
0.0480	0.300	0.327	-0.45%	Yes	-9.08%	Yes	
0.0774	0.500	0.524	-0.40%	Yes	-4.84%	Yes	
0.1459	1.000	0.984	0.26%	Yes	1.59%	Yes	
0.2908	2.000	1.955	0.74%	Yes	2.21%	Yes	
0.7366	4.999	4.946	0.88%	Yes	1.06%	Yes	
0.9019	5.999	6.055	-0.94%	Yes	-0.94%	Yes	
Regression Constants			Is Coefficient of Regression > 0.995?				
Slope	m =	6.7083	Yes				
Intercept	b =	0.0050					
Coeff.	R ² =	0.9997					

Stock Solution Standard Mixing Recipe (Cations)
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Order of Elution	1	2	3	4	5	6
Analyte	Lithium	Sodium	Ammonium	Potassium	Magnesium	Calcium
Analyte Weight (g/g-mole)	6.94	22.99	18.05	39.1	24.31	40.08
Solid Formula	LiCl	NaCl	NH ₄ Cl	KCl	MgCl ₂ ·6H ₂ O	CaCl ₂ ·2H ₂ O
Number of Ions/Formula	1	1	1	1	1	1
Formula Weight (g/g-mole)	42.39	58.44	53.49	74.55	203.3	147.02
% Analyte in Solid	16.37%	39.34%	33.74%	52.45%	11.96%	27.26%

Recommended Analyte Concentration (mg/l)	500	1,200	2,500	2,500	2,500	3,500
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Amount of Solid Required to Achieve the Above Stock Solution Concentration in The Listed Volumetric Flask:						
500 ml	1,5270	1,5252	3,7043	2,3833	10,4535	6,4193

Size of Flask	500 ml					
Amount of Solid Used						

Actual Concentration (mg/l)

Concentration in the Five Cal Flasks (mg/L)
Stock (1 liter Flask) Solution Concentrations
10 ml Original Solution Used

Dilution Flask Size	Aliquot	Stock	
500	3		1
500	5		2
500	10		3
250	8		CCV
250	10		4
200	10		5
500	30		6

Stock Solution Standard Mixing Recipe (Anions)
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Order of Elution	8	9	10	11	12	13	14	15
Analyte	Fluoride	Chloride	Nitrite	Bromide	Nitrate	Phosphate	Sulfate	Iodide
Analyte Weight (g/g-mole)	19.00	35.45	46.01	79.90	62.01	94.97	96.07	126.91
Solid Formula	NaF	NaCl	NaNO ₂	NaBr	NaNO ₃	Na ₂ HPO ₄	Na ₂ SO ₄	NaI
Number of ions/Formula	1	1	1	1	1	1	1	1
Formula Weight (g/g-mole)	41.99	58.44	69.00	102.89	85.00	141.96	142.04	149.90
% Analyte in Solid	45.25%	60.66%	66.68%	77.66%	72.95%	66.90%	67.63%	84.66%

Recommended Analyte Concentration (mg/L)	500	1007.21	2000	3000	3000	5000	5000	7000
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Amount of Solid Required to Achieve the Above Stock Solution Concentration In The Listed Volumetric Flask:								
500 ml	0.5525	0.8302	1.4997	1.9316	2.0561	3.7370	3.6964	4.1341

Size of Flask	500 ml							
Amount of Solid Used							3.6956 g	

Actual Concentration (mg/L) 4998.91

Concentration in the Five Cal Flasks (mg/L)

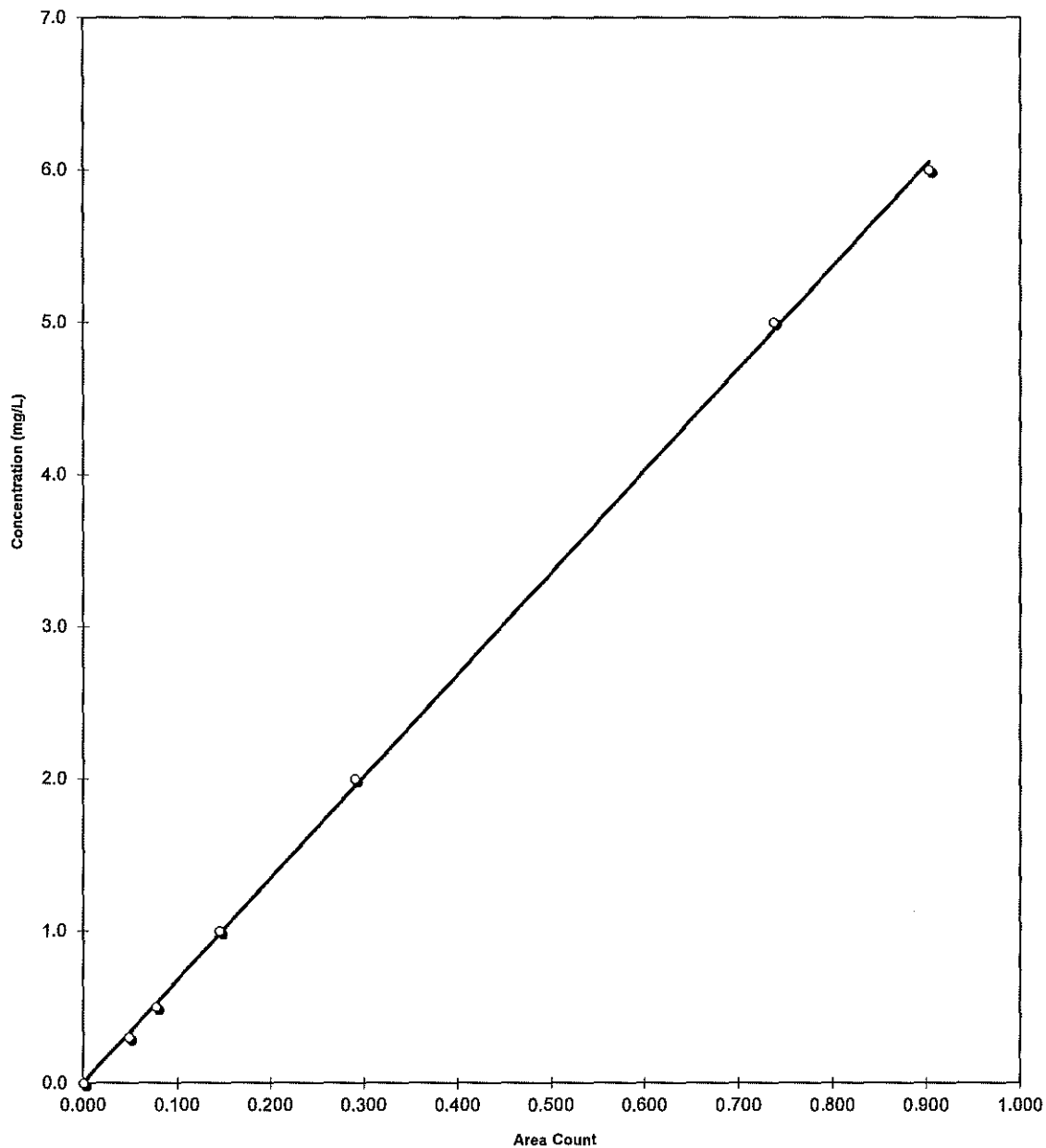
Stock (1 liter Flask) Solution Concentrations 49.9891
10 ml Original Solution Used

Dilution Flask Size	Aliquot Stock		
500	3	0.2999	1
500	5	0.4999	2
250	5	0.9998	3
31.25	1	1.5997	CCV
250	10	1.9996	4
200	20	4.9989	5
250	30	5.9987	6

CHROMATOGRAPHIC DATA REDUCTION
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Sulfate Calibration Curve



Sample Information

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Sample Identification Number	Sample Location	Run No.	Sample Identification	Sample Recovery Date	Field Tech	Sample Volume (mL)
14485-01	Clean Air		Audit			1
14485-02	Clean Air		Run0			1
14485-03	Clean Air		Run1			1
14485-04	Clean Air		Run2			1
14485-05	Clean Air		Run3			1

CHROMATOGRAPHIC DATA REDUCTION
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U. S. EPA Method 300.1			Analyte:	Sulfate

MDL=	0.018 mg/L	Average Flow Rate
MRL=	0.088 mg/L	

Sample Location	Sample Identification Number	Sample Identification	Date of Injection	Area Counts Trial 1	Area Counts Trial 2	Area Count Average	DF (Analysis Dilution Factor)	V _{soin} (Total Sample Volume, mL)	C _{Reg} (Concentration, mg/L from Reg Curve)	M _{analyte} Total Amount of Analyte (mg)
Clean Air	14485-01	Audit	10/05/21	0.6135	0.6185	0.6160	13	1.0	51.72	0.05
Clean Air	14485-02	Run0	10/05/21	0.2651	0.2709	0.2680	13	1.0	22.54	0.02
Clean Air	14485-03	Run1	10/05/21	0.2230	0.2220	0.2225	13	1.0	18.72	0.02
Clean Air	14485-04	Run2	10/05/21	0.1387	0.1391	0.1389	13	1.0	11.71	0.01
Clean Air	14485-05	Run3	10/05/21	0.2523	0.2557	0.2540	13	1.0	21.36	0.02

CHROMATOGRAPHIC DATA REDUCTION
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

QUALITY CONTROL CHECKS

Sample Location	Sample Identification Number	Sample Identification	Date of Injection	Area Counts Trial 1	Area Counts Trial 2	Area Count Average	Area Count Duplicate Difference	Duplicate Relative Difference (%)	Is Duplicate Difference < 5%?
Clean Air	14485-01	Audit	10/05/21	0.6135	0.6185	0.6160	0.0050	0.8%	Yes
Clean Air	14485-02	Run0	10/05/21	0.2651	0.2709	0.2680	0.0058	2.2%	Yes
Clean Air	14485-03	Run1	10/05/21	0.2230	0.2220	0.2225	0.0010	0.4%	Yes
Clean Air	14485-04	Run2	10/05/21	0.1387	0.1391	0.1389	0.0004	0.3%	Yes
Clean Air	14485-05	Run3	10/05/21	0.2523	0.2557	0.2540	0.0034	1.3%	Yes

CHROMATOGRAPHIC DATA REDUCTION

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

CCV Concentration: 1.60 mg/L
 QC Concentration: 1.50 mg/L

MDL=	0.018 mg/L
MRL=	0.088 mg/L

QC Dilution Factor
1

QUALITY CONTROL CHECKS (CONT)

Sample Location	Sample Identification Number	Sample Identification	Date of Injection	Area Counts Trial 1	Area Counts Trial 2	Area Count Average	Area Count Duplicate Difference	Duplicate Relative Difference (%)	C _{Reg} (Concentration, mg/L from Reg Curve)	Percent Difference from Actual Value (%)	Is Percent Difference from Actual Value <10%?
CleanAir	14485-00	CCB	10/05/21	0.0000	0.0000	0.0000	na	na	<		
CleanAir	14485-990	CCV	10/05/21	0.2294	0.2367	0.2331	0.0073	3.1%	1.57	1.96%	Yes
CleanAir	14485-991	QC	10/05/21	0.2157	0.2217	0.2187	0.0060	2.7%	1.47	1.69%	Yes
CleanAir	14485-00	CCB	10/05/21	0.0000	0.0000	0.0000	na	na	<		
CleanAir	14485-992	CCV	10/05/21	0.2350	0.2347	0.2349	0.0003	0.1%	1.58	1.20%	Yes

Matrix Spike Recoveries

Matrix Spike	Sample Identification Number	Sample Identification	Date of Injection	Area Counts Trial 1	Area Counts Trial 2	Area Count Average	Area Count Duplicate Difference	Duplicate Relative Difference (%)	Precision	Spike Recovery	Is Spike Recovery Between 90-110%?
Matrix Spike	14485-10	#N/A	10/05/21	0.5462	0.5473	0.5468	0.0011	0.2%		105.9%	Yes

**Determination of Method Detection Limit
Ion Chromatography Analysis**

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Non-Iterative Study

MDL Reference	40 CFR 136, Appendix B	No. of Replicates	$t_{(n-1,0.99)}$
CleanAir Reference	SOP EPA5-11	7	3.143
Matrix	Deionized Water	8	2.998
		9	2.896
		10	2.821
		11	2.764
Analyte	Sulfate	16	2.602
Spike Concentration	0.2999 mg/L	21	2.528
Slope	6.7083		
Intercept	0.0050		
Coefficient of Corr.	0.9997		

Spike Aliquots	Spike Result Area Count	Measured Concentration (mg/L)
1	0.0454	0.310
2	0.0465	0.317
3	0.0462	0.315
4	0.0478	0.326
5	0.0458	0.312
6	0.0477	0.325
7	0.0465	0.317
8	0.0458	0.312

Average Spike Concentration:	0.317
Recovery (R_a):	105.59%
Standard Deviation (S_a):	0.00589
RMS Deviation:	1.9%
$t_{(n-1,0.99)}$:	2.998
MDL:	0.018
MRL:	0.088

Is the spike level higher than the MDL?	Yes
Is the spike level less than ten times the MDL?	No
Is the Avg Recovery between 90% < R_a < 110% ?	Yes

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

1. Difference between duplicate injections for pre-test calibration (Pre Cal 1).

$$\Delta_{Injection} = |Area_{Trial2} - Area_{Trial1}|$$

$\Delta_{Injection}$ = Area count difference between duplicate injections

$Area_{Trial2}$ = Area count for injection Trial 2

$Area_{Trial1}$ = Area count for injection Trial 1

$$\Delta_{Injection} = 0.0003$$

$$Area_{Trial2} = 0.0755$$

$$Area_{Trial1} = 0.0752$$

2. Average area count value for duplicate injections for pre-test calibration (Pre Cal 1).

$$Avg_{PreInj} = \frac{(Area_{Trial1} + Area_{Trial2})}{2}$$

Avg_{PreInj} = Average of duplicate injection area counts

$Area_{Trial2}$ = Area count for injection Trial 2

$Area_{Trial1}$ = Area count for injection Trial 1

2 = Constant (number of values)

$$Avg_{Inj} = 0.0754$$

$$Area_{Trial2} = 0.0755$$

$$Area_{Trial1} = 0.0752$$

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

3. Difference between individual injection and average area count for pre-test calibration.

$$\Delta_{PreMean\%} = \frac{|Area_{Trial2} - Avg_{PreInj}|}{Avg_{PreInj}} \cdot 100$$

- D_{PreMean%} = Difference between individual injection and average area count (%).
- Avg_{PreInj} = Average of duplicate injection area counts
- Area_{Trial2} = Area count for injection Trial 2
- 100 = Constant (conversion factor for percentage)

- D_{PreMean%} = 0.1987
- Avg_{PreInj} = 0.0754
- Area_{Trial2} = 0.0755

Note: EPA Method 26 requires D_{PreMean%} to be less than 5%.

4. Average of all area count values for a given calibration point.

$$\bar{X} = \frac{\sum_{i=1}^n x_i}{n}$$

- \bar{X} = Average of all area count values for a given calibration point.
- x_i = Individual area count values for each individual injection.
- i = Iteration value.
- n = Number of injections for the calibration point under question.

- \bar{X} = 0.0774
- x_1 = 0.0752
- x_2 = 0.0755
- n = 4

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

5. Average of all concentration values used for generating calibration curve.

$$\overline{Y}_{All} = \frac{\sum_{i=1}^n y_i}{n}$$

\overline{Y}_{All} = Average of all area concentration values.
 y_i = Individual concentration values for each individual injection.
 n = Number of injections.

\overline{Y}_{All} = 2.1138
 y_1 = 0.0000
 y_2 = 0.2999
 n = 7

6. Average of all area count values for the calibration curve.

$$\overline{X}_{All} = \frac{\sum_{i=1}^n x_i}{n}$$

\overline{X}_{All} = Average of all area count values.
 x_i = Individual area count values.
 i = Iteration value.
 n = Number of injections.

\overline{X}_{All} = 0.3144
 x_1 = 0.0752
 x_2 = 0.0755
 n = 28

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

7. Determination of slope (least-squares regression) value for calibration curve.

$$m = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

- m = Slope of least-squares regression curve.
- x_i = Individual area count values for each individual injection.
- \bar{x} = Average of all area count values = \bar{X}_{All}
- y_i = Actual area concentration values for each individual injection.
- \bar{y} = Average of all concentration values = \bar{Y}_{All}
- i = Iteration value.
- n = Number of injections.

m	=	6.70825
x_1	=	0.0752
x_2	=	0.0755
\bar{x}	=	0.3144
y_1	=	0.0000
y_2	=	0.2999
\bar{y}	=	2.1138
n	=	28

8. Determination of y-intercept (least-squares regression) value for calibration curve.

$$b = \bar{y} - m \bar{x}$$

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er,
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5853
0-
9507

- Where:
- b = Y-axis intercept.
 - \bar{x} = Average of all area count values = \bar{X}_{All}
 - \bar{y} = Average of all concentration values = \bar{Y}_{All}
- | | | |
|-----------|---|---------|
| b | = | 0.00501 |
| m | = | 6.70825 |
| \bar{x} | = | 0.3144 |
| \bar{y} | = | 2.1138 |

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

9. Determination of coefficient of correlation (least-squares regression) value for calibration curve.

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}}$$

- r^2 = Square of the Pearson product moment correlation coefficient through data points in known y's and known x's.
- r = Pearson product moment correlation coefficient through data points in known y's and known x's.
- x_i = Individual area count values for each individual injection.
- y_i = Actual area concentration values for each individual injection.
- \bar{x} = Average of all area count values = \bar{X}_{All}
- \bar{y} = Average of all concentration values = \bar{Y}_{All}
- i = Iteration value.
- n = Number of injections.

- r^2 = 0.99973
- r = 0.99986
- x_1 = 0.0752
- x_2 = 0.0755
- \bar{x} = 0.3144
- y_1 = 0.0000
- y_2 = 0.2999
- \bar{y} = 2.1138
- n = 28

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

10. Determination of average sample area counts from duplicate injections.

$$Avg_{Sample} = \frac{(Area_{Trial1} + Area_{Trial2})}{2}$$

- Avg_{Sample} = Average of duplicate injection area counts
- Area_{Trial2} = Area count for injection Trial 2
- Area_{Trial1} = Area count for injection Trial 1
- 2 = Constant (number of injections)

- Avg_{Inj} = 0.2225
- Area_{Trial2} = 0.2220
- Area_{Trial1} = 0.2230

11. Difference between duplicate injections for the sample.

$$\Delta_{Injection} = |Area_{Trial2} - Area_{Trial1}|$$

- D_{Injection} = Area count difference between duplicate injections
- Area_{Trial2} = Area count for injection Trial 2
- Area_{Trial1} = Area count for injection Trial 1

- D_{Injection} = 0.0010
- Area_{Trial2} = 0.2220
- Area_{Trial1} = 0.2230

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

12. Difference between individual injection and average area count for the sample.

$$\Delta_{Injection} = \frac{|Area_{Trial2} - Avg_{Inj}|}{Avg_{Inj}} 100$$

- $D_{Injection}$ = Difference between individual injection and average area count (%).
- Avg_{Inj} = Average of duplicate injection area counts
- $Area_{Trial2}$ = Area count for injection Trial 2
- 100 = Constant (conversion factor for percentage)

- $D_{Injection}$ = 0.2%
- Avg_{Inj} = 0.2225
- $Area_{Trial2}$ = 0.2220

Note: EPA Method 26 requires $D_{Injection}$ to be less than 5%.

13. Determination of sample concentration from least-squares regression curve (mg/L).

$$C_{Reg} = DF [m(Avg_{Inj}) + b]$$

Where:

- C_{Reg} = Sample concentration determined using the regression curve (mg/L)
- DF = Sample dilution factor
- Avg_{Inj} = Average of duplicate injection area counts.
- m = Slope of least-squares regression curve.
- b = Y-intercept of least-squares regression curve.

- C_{Reg} = 18.72
- DF = 12.5
- Avg_{Inj} = 0.2225
- m = 6.7083
- b = 0.0050

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

14. Determination of total amount of analyte in sample (total mg).

$$M_{Analyte} = \frac{(C_{Reg})(V_{Soln})}{1000}$$

- $M_{Analyte}$ = Amount of analyte in sample (total mg)
- C_{Reg} = Sample concentration determined using the response factor (mg/L)
- V_{Soln} = Sample volume (ml)
- 1000 = Conversion constant (ml to L)

- $M_{Analyte}$ = 0.02
- C_{Reg} = 18.7200
- V_{Soln} = 1.0

15. Determination of Detection Limits.

15a. Determination of average spike result.

$$AvgM_{f-i} = \frac{\sum_{i=1}^n M_{f-i}}{n}$$

- $AvgM_{f-i}$ = Average of spike result (mg/L)
- M_{f-i} = Net results recorded for each iteration (mg/L)
- n = Number of iterations.
- i = Placeholder for iteration.

$AvgM_{f-i}$	=	0.317			
M_{f-1}	=	0.310	M_{f-5}	=	0.312
M_{f-2}	=	0.317	M_{f-6}	=	0.325
M_{f-3}	=	0.315	M_{f-7}	=	0.317
M_{f-4}	=	0.326	M_{f-8}	=	0.312
n	=	8			

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

15b. Determination of standard deviation of spike result.

$$\sigma_{f-i} = \sqrt{\frac{\sum_{i=1}^n (M_{f-i} - AvgM_{f-i})^2}{(n-1)}}$$

where:

- $s_{f,i}$ = Standard deviation of spike result.
- $AvgM_{f,i}$ = Average spike result (mg/L)
- $M_{f,i}$ = Concentration recorded for each iteration (mg/L)
- n = Number of iterations.
- i = Placeholder for iteration.

$s_{f,i}$	=	0.0059		
$AvgM_{f,i}$	=	0.317		
$M_{f,1}$	=	0.310	$M_{f,5}$	= 0.312
$M_{f,2}$	=	0.317	$M_{f,6}$	= 0.325
$M_{f,3}$	=	0.315	$M_{f,7}$	= 0.317
$M_{f,4}$	=	0.326	$M_{f,8}$	= 0.312
n	=	8		

15c. Determination of variance of spike result.

$$V_{f-i} = (\sigma_{f-i})^2$$

where:

- $V_{f,i}$ = Variance of spike result.
- $s_{f,i}$ = Standard deviation of spike result.

$V_{f,i}$	=	3.47E-05
$s_{f,i}$	=	0.0059

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

15d. Determination of RMS deviation of spike result.

$$RMS_{f-i} = 100 \frac{\sigma_{f-i}}{AvgM_{f-i}}$$

Where:

- RMS_{f-i} = RMS deviation of spike results (%)
- s_{f-i} = Standard deviation of spike result
- AvgM_{f-i} = Average spike result (mg/L)
- 100 = Conversion constant (fraction to percent)

- RMS_{f-i} = 0.0186
- s_{f-i} = 0.0059
- AvgM_{f-i} = 0.3167

15e. Determination of average spike recovery.

$$R_f = 100 \frac{AvgM_{f-i}}{RA}$$

- R_f = Average spike recovery (%)
- AvgM_{f-i} = Average spike result (mg/L)
- RA = Spike concentration added (mg/L)
- 100 = Conversion constant (fraction to percent)

- R_f = 105.6%
- AvgM_{f-i} = 0.31670
- RA = 0.29993

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	10/5/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

15f. Determination of $t_{(n-1, 0.99)}$.
Value taken from the following Table:

n	$t_{(n-1, 0.99)}$
7	3.143
8	2.998
9	2.896
10	2.821
11	2.764
16	2.602
21	2.528

Where:

$t_{(n-1, 0.99)}$ = Students' t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom.

n = Number of iterations.

$t_{(n-1, 0.99)}$ = 2.998

n = 8

15g. Determination of Method Detection Limit (MDL).

$$MDL = \sigma_{f-1} t_{(n-1, 0.99)}$$

Where:

MDL = Method detection limit (mg/L)

$t_{(n-1, 0.99)}$ = Students' t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom.

s_{f-1} = Standard deviation of spike result.

MDL = 0.018

$t_{(n-1, 0.99)}$ = 2.998

s_{f-1} = 0.0059

Sample Calculations
Ion Chromatography Analysis

Customer:	Guardian	Lab Project No:	14485	Analyst:	Josh Lord
Plant:	Carleton, MI	Customer Reference No:	G000243910	Received:	105/21
Applicable Analytical Method:	U.S. EPA Method 300.1			Analyte:	Sulfate

Calibration Point No: 3
Sample No: 14485-03
Sample Location: Clean Air

15h. Determination of Method Reporting Limit (MRL).

$$MRL = 5(MDL)$$

Where:

MRL = Method reporting limit (mg/L)
MDL = Method detection Limit (mg/L)
5 = Constant

MRL = 0.088
MDL = 0.018

APPENDIX H: FACILITY OPERATING DATA

Guardian
 Clean Air Project No. 14485

Date and Time	Production rate ton/hr
10/5/2021 0:00	411.6
10/5/2021 1:00	411.6
10/5/2021 2:00	411.6
10/5/2021 3:00	411.6
10/5/2021 4:00	411.6
10/5/2021 5:00	411.6
10/5/2021 6:00	411.5
10/5/2021 7:00	411
10/5/2021 8:00	411
10/5/2021 9:00	411
10/5/2021 10:00	411
10/5/2021 11:00	411
10/5/2021 12:00	411
10/5/2021 13:00	411
10/5/2021 14:00	411
10/5/2021 15:00	411
10/5/2021 16:00	411
10/5/2021 17:00	411
10/5/2021 18:00	411
10/5/2021 19:00	410.9
10/5/2021 20:00	410.9
10/5/2021 21:00	410.9
10/5/2021 22:00	410.9
10/5/2021 23:00	410.9

Run 1

10/5/2021 8:00	411
10/5/2021 9:00	411
10/5/2021 10:00	411
Average	411

Run 2

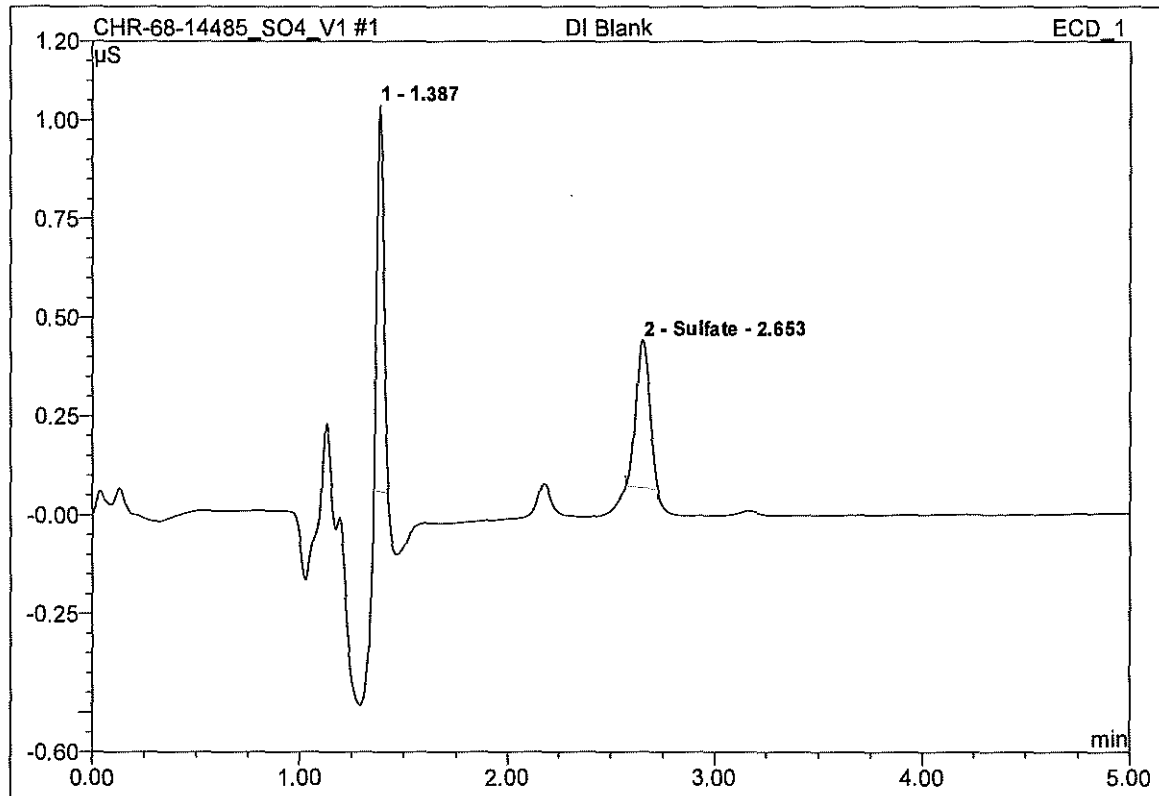
10/5/2021 10:00	411
10/5/2021 11:00	411
10/5/2021 12:00	411
Average	411

Run 3

10/5/2021 12:00	411
10/5/2021 13:00	411
10/5/2021 14:00	411
Average	411

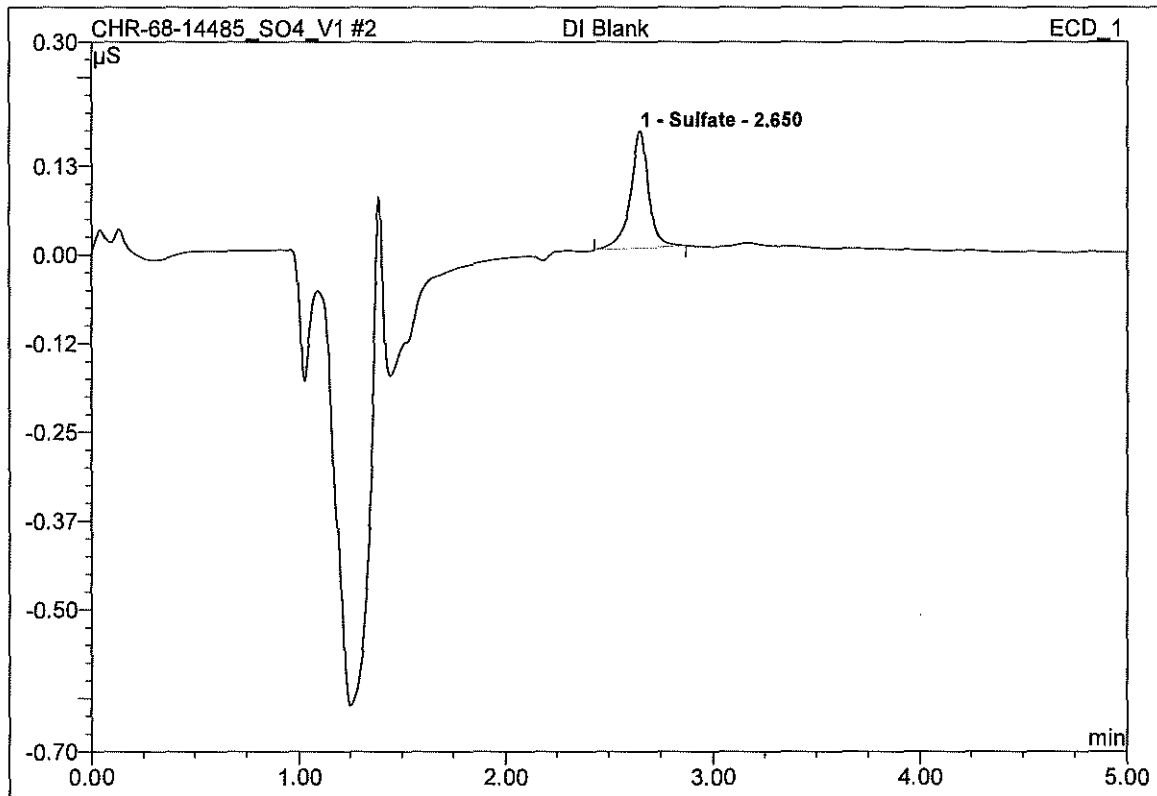
APPENDIX I: CHROMATOGRAMS

1 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	1	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj1Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:05	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



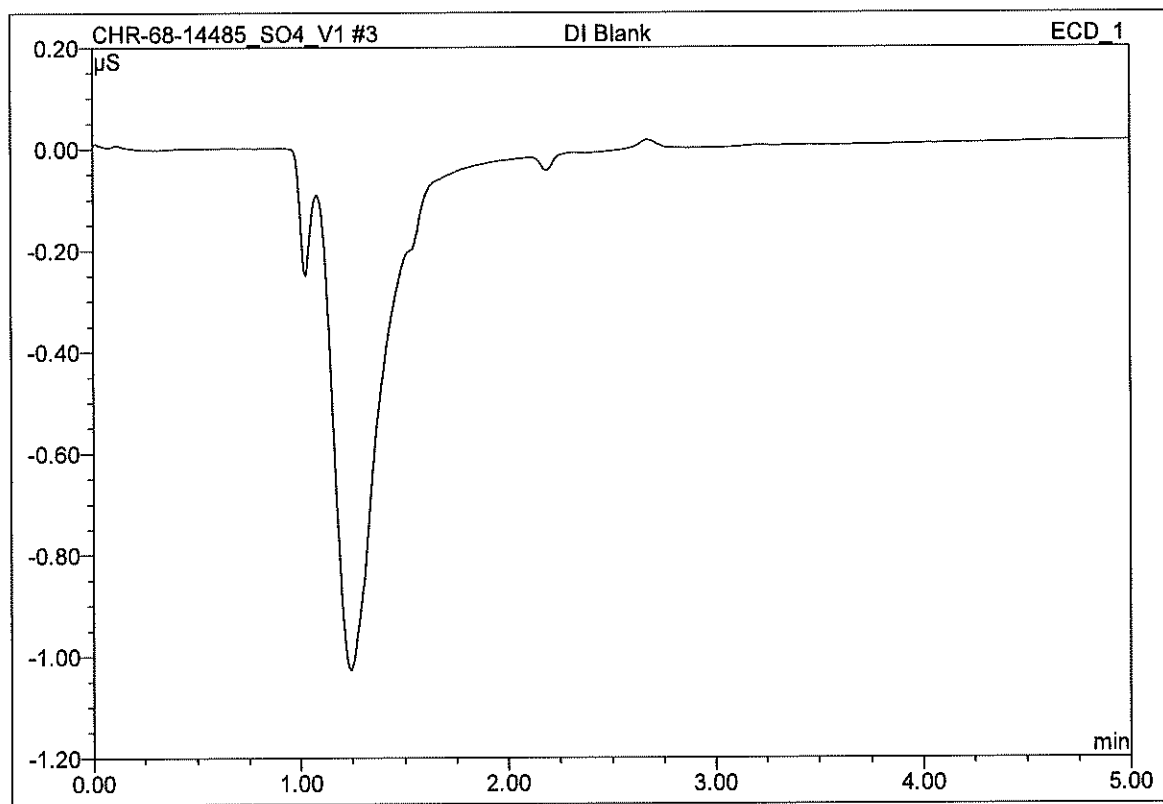
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.39	n.a.	0.977	0.037	57.05	n.a.	BM
2	2.65	Sulfate	0.374	0.028	42.95	n.a.	BMB
Total:			1.351	0.065	100.00	0.000	

2 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	2	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:12	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



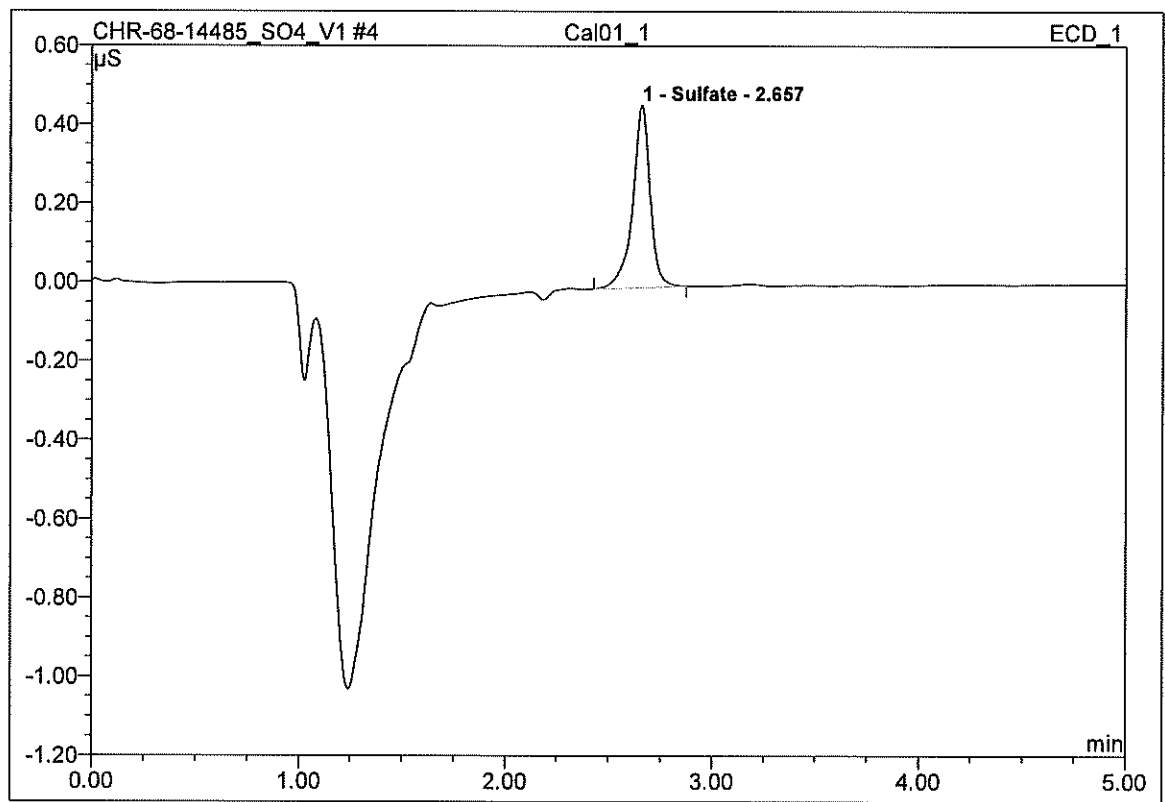
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	0.164	0.017	100.00	n.a.	BMB
Total:			0.164	0.017	100.00	0.000	

3 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	3	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:17	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



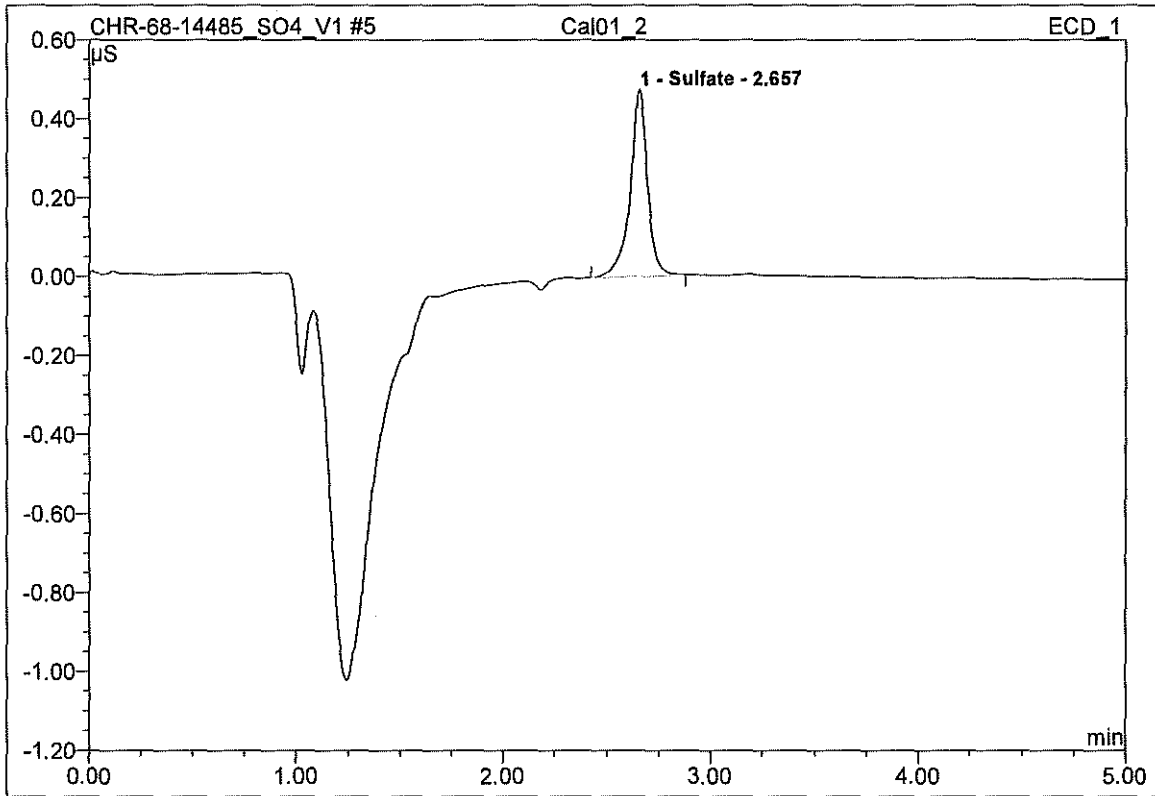
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

4 Cal01_1			
Clean Air			
Sample Name:	Cal01_1	Injection Volume:	1.0
Vial Number:	4	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:22	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



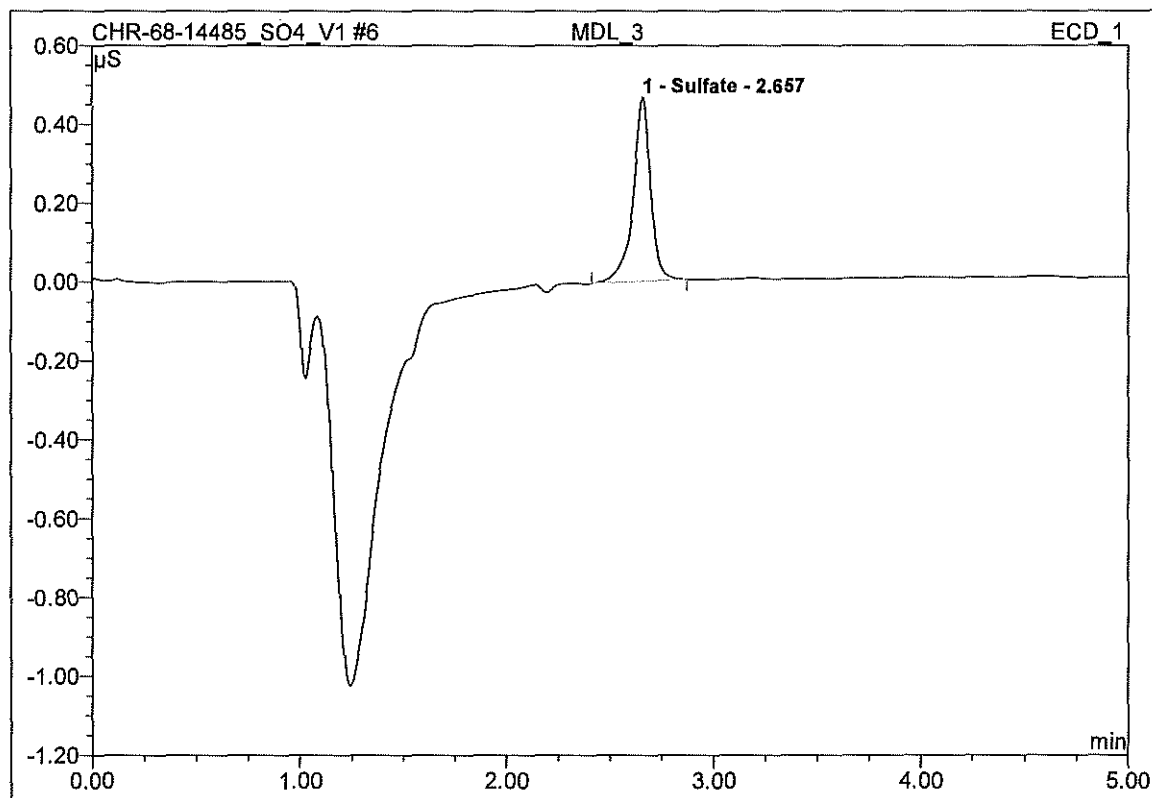
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.462	0.045	100.00	n.a.	BMB
Total:			0.462	0.045	100.00	0.000	

5 Cal01_2			
Clean Air			
Sample Name:	Cal01_2	Injection Volume:	1.0
Vial Number:	5	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:27	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



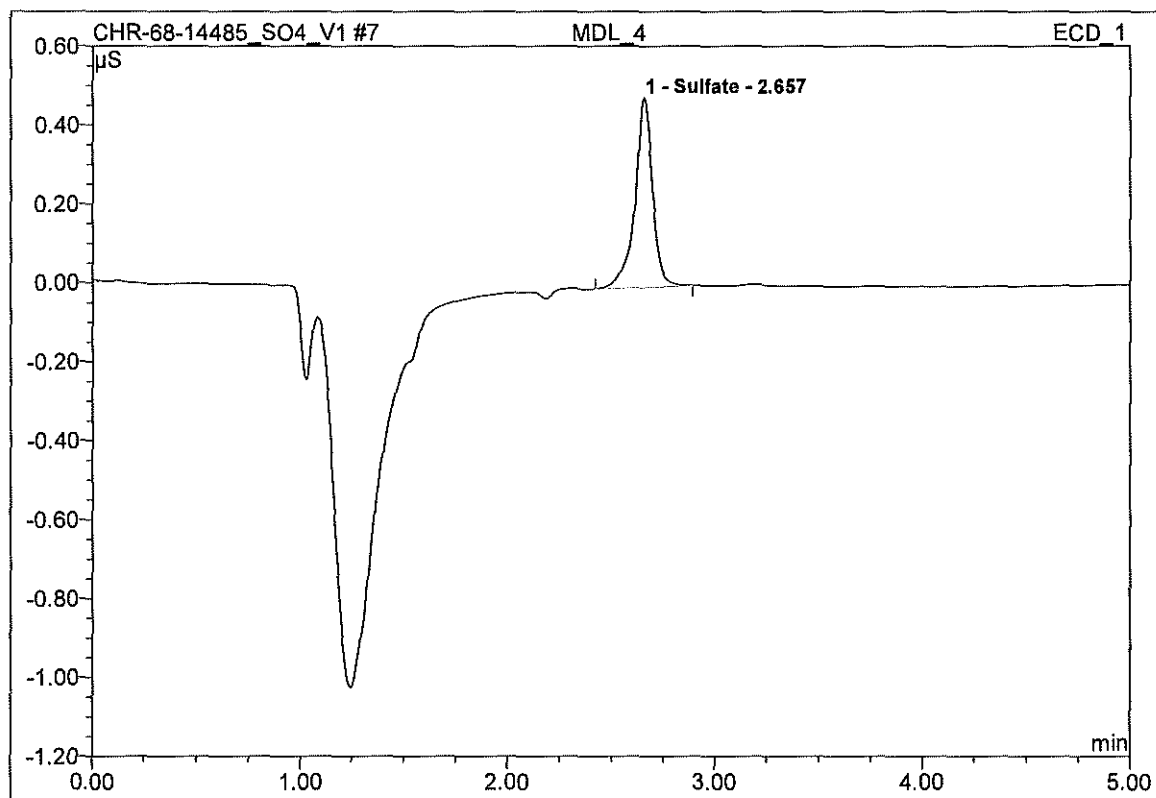
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.472	0.047	100.00	n.a.	BMB
Total:			0.472	0.047	100.00	0.000	

6 MDL_3			
Clean Air			
Sample Name:	MDL_3	Injection Volume:	1.0
Vial Number:	6	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:32	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



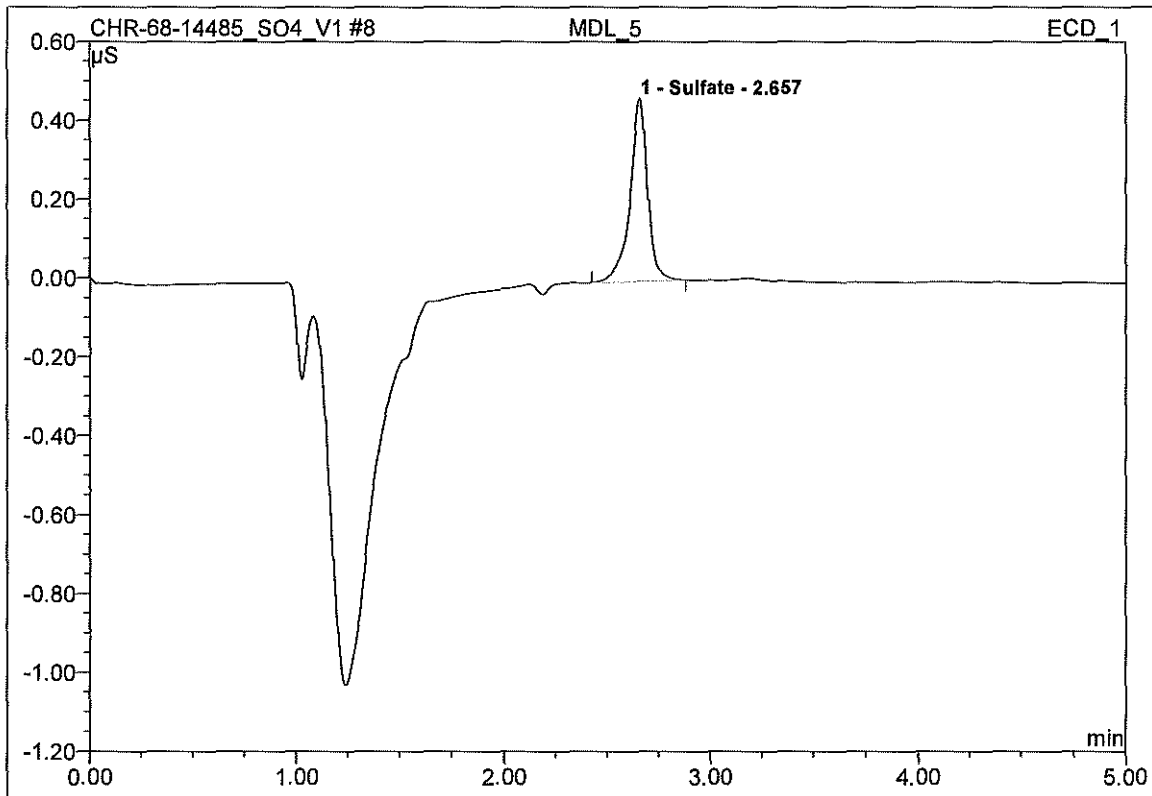
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.466	0.046	100.00	n.a.	BMB
Total:			0.466	0.046	100.00	0.000	

7 MDL_4			
Clean Air			
Sample Name:	MDL_4	Injection Volume:	1.0
Vial Number:	6	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:37	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



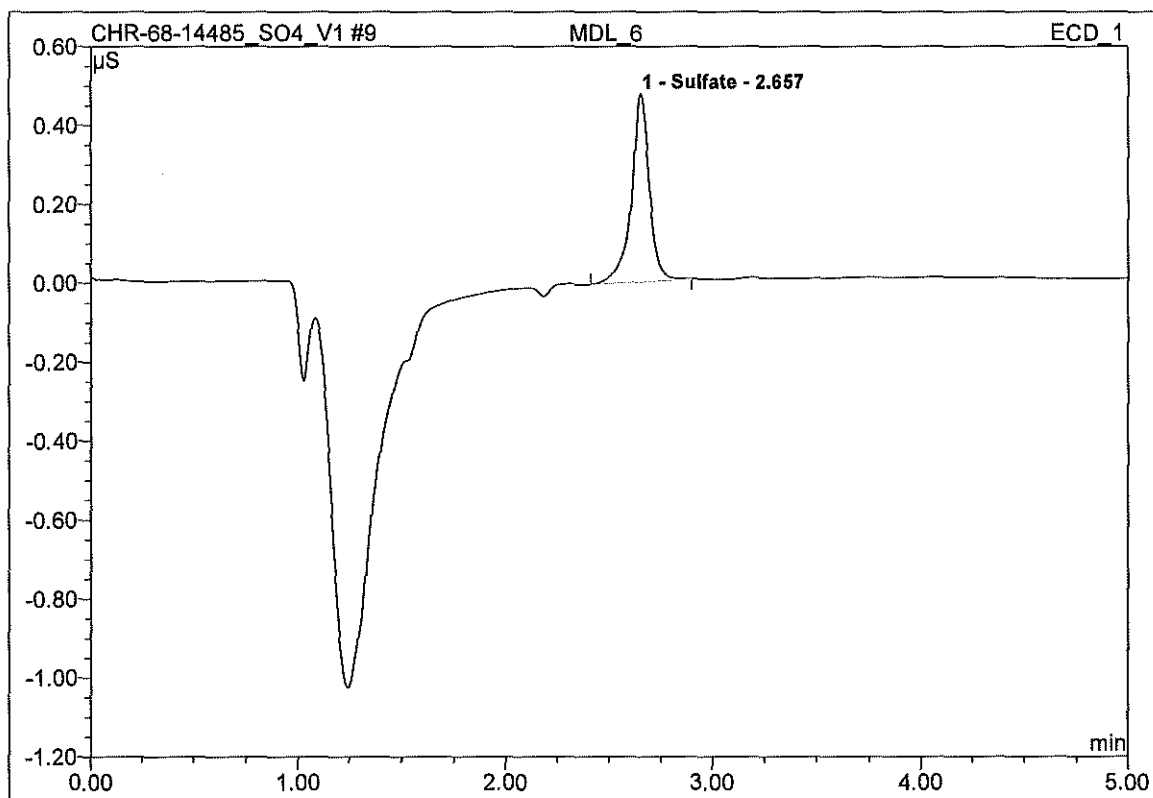
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.481	0.048	100.00	n.a.	BMB
Total:			0.481	0.048	100.00	0.000	

8 MDL_5			
Clean Air			
Sample Name:	MDL_5	Injection Volume:	1.0
Vial Number:	6	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:43	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



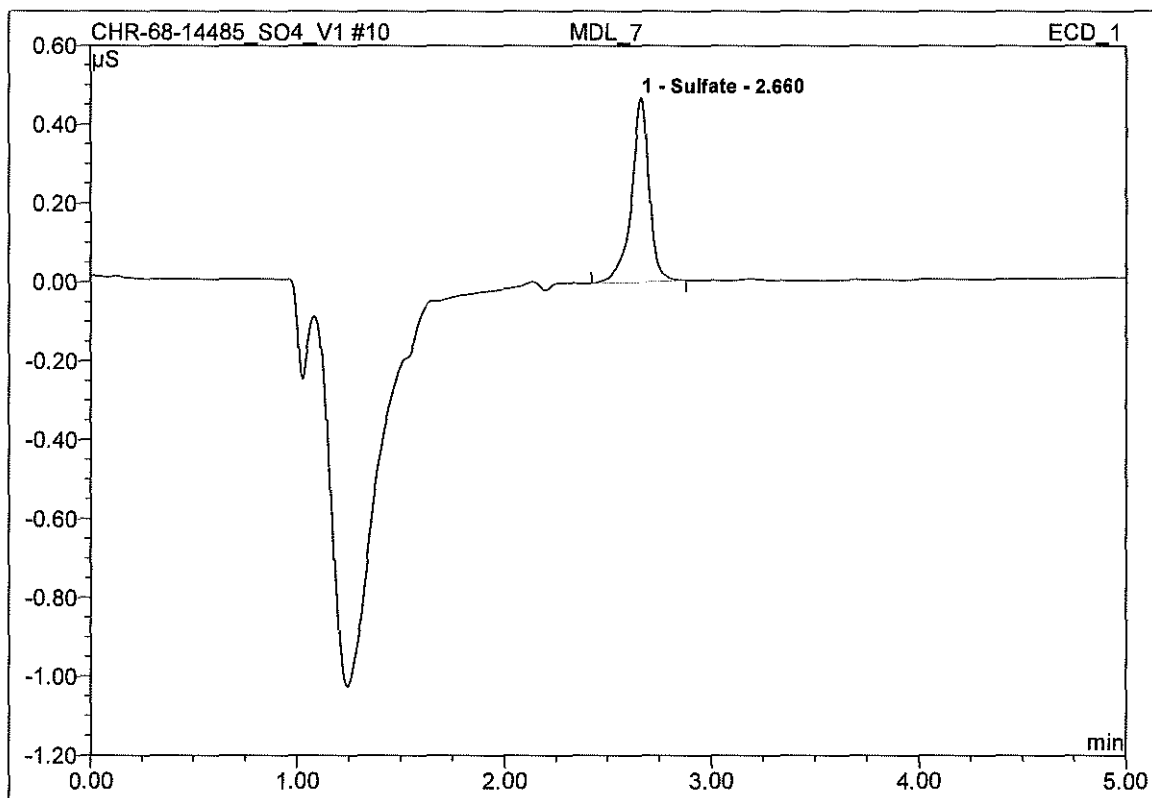
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.462	0.046	100.00	n.a.	BMB
Total:			0.462	0.046	100.00	0.000	

9 MDL_6			
Clean Air			
Sample Name:	MDL_6	Injection Volume:	1.0
Vial Number:	6	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:48	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



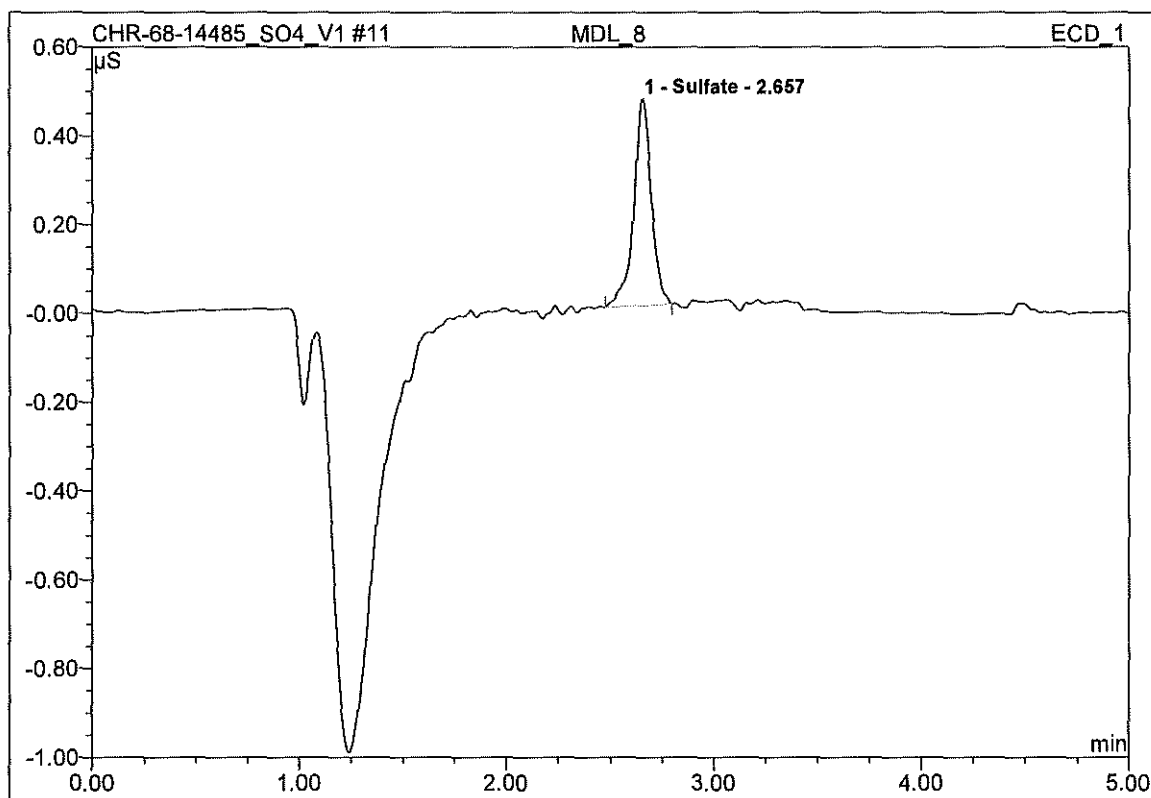
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.478	0.048	100.00	n.a.	BMB
Total:			0.478	0.048	100.00	0.000	

10 MDL_7			
Clean Air			
Sample Name:	MDL_7	Injection Volume:	1.0
Vial Number:	5	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:53	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



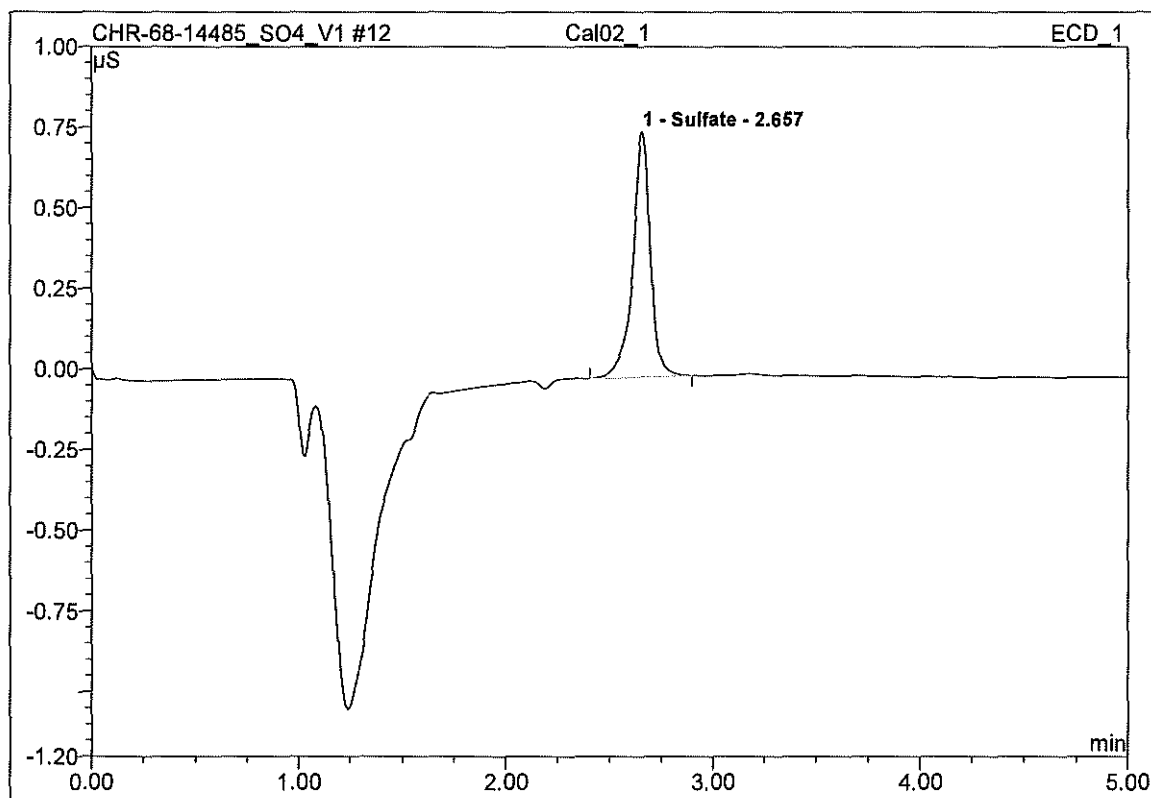
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.467	0.046	100.00	n.a.	BMB
Total:			0.467	0.046	100.00	0.000	

11 MDL_8			
Clean Air			
Sample Name:	MDL_8	Injection Volume:	1.0
Vial Number:	5	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 16:58	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



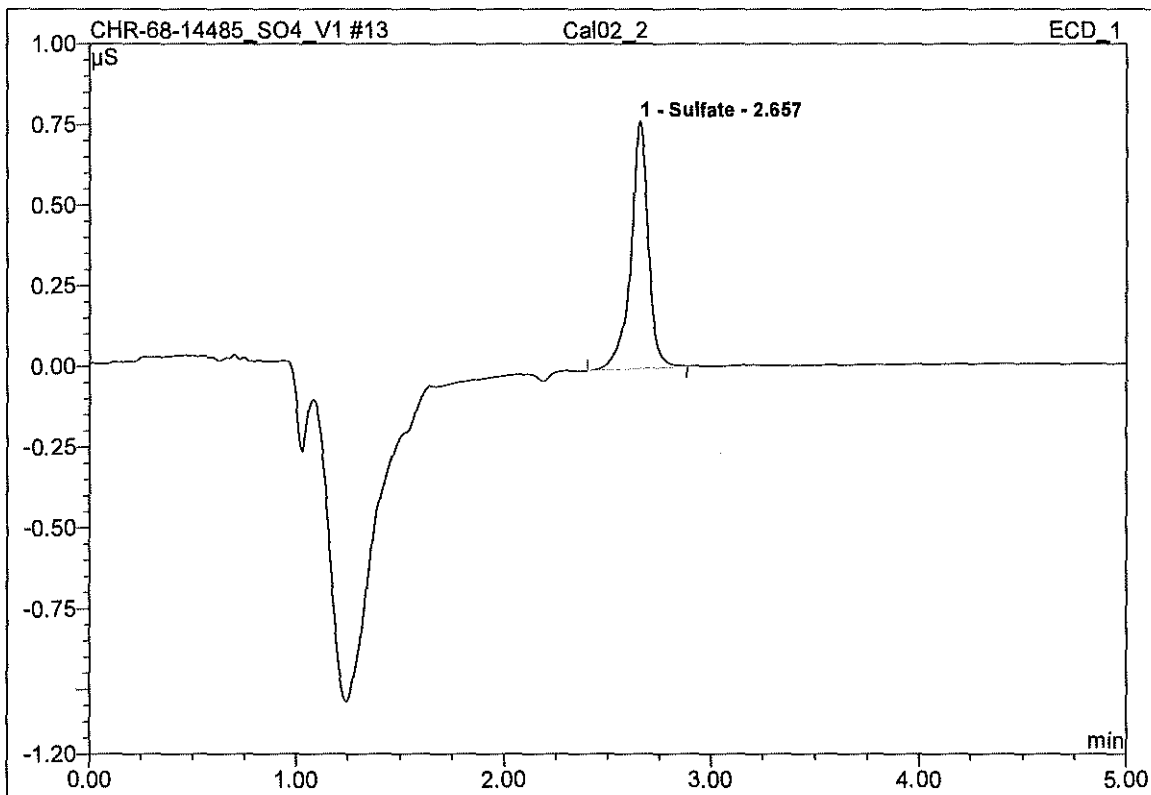
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.467	0.046	100.00	n.a.	BMB
Total:			0.467	0.046	100.00	0.000	

12 Cal02_1			
Clean Air			
Sample Name:	Cal02_1	Injection Volume:	1.0
Vial Number:	6	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:03	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



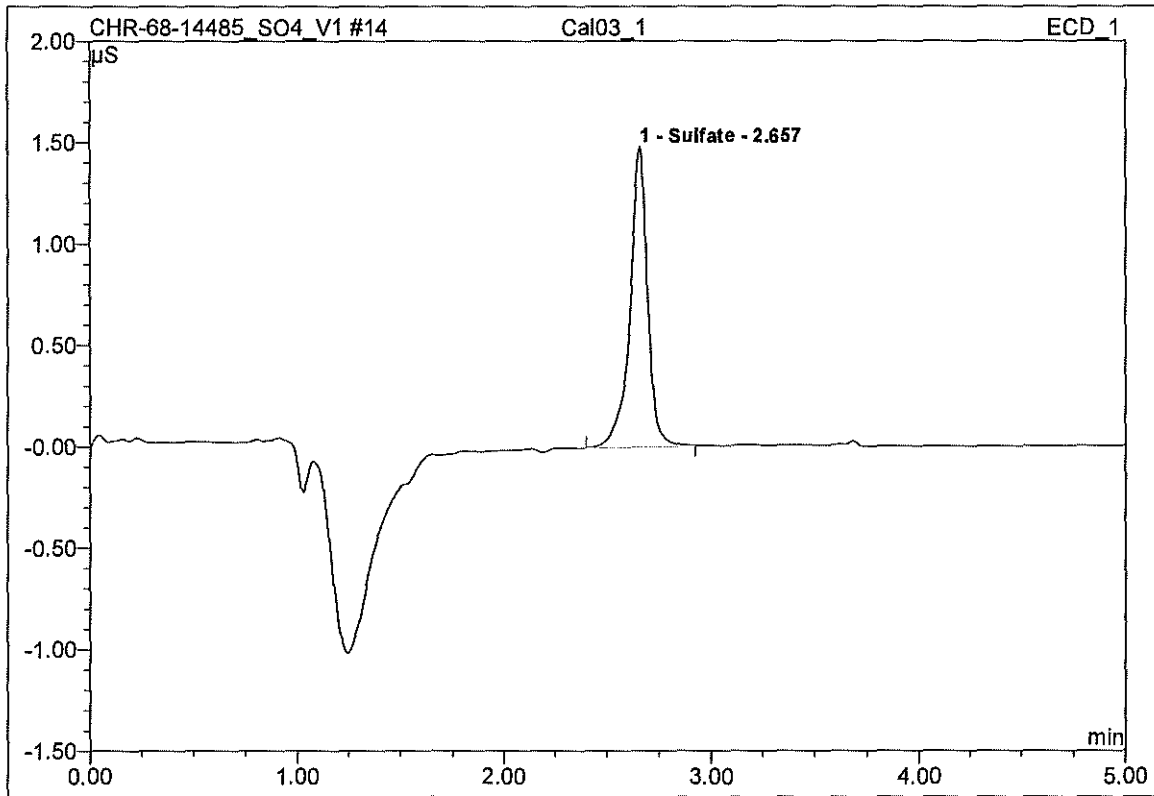
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.763	0.075	100.00	n.a.	BMB
Total:			0.763	0.075	100.00	0.000	

13 Cal02_2			
Clean Air			
Sample Name:	Cal02_2	Injection Volume:	1.0
Vial Number:	7	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:08	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



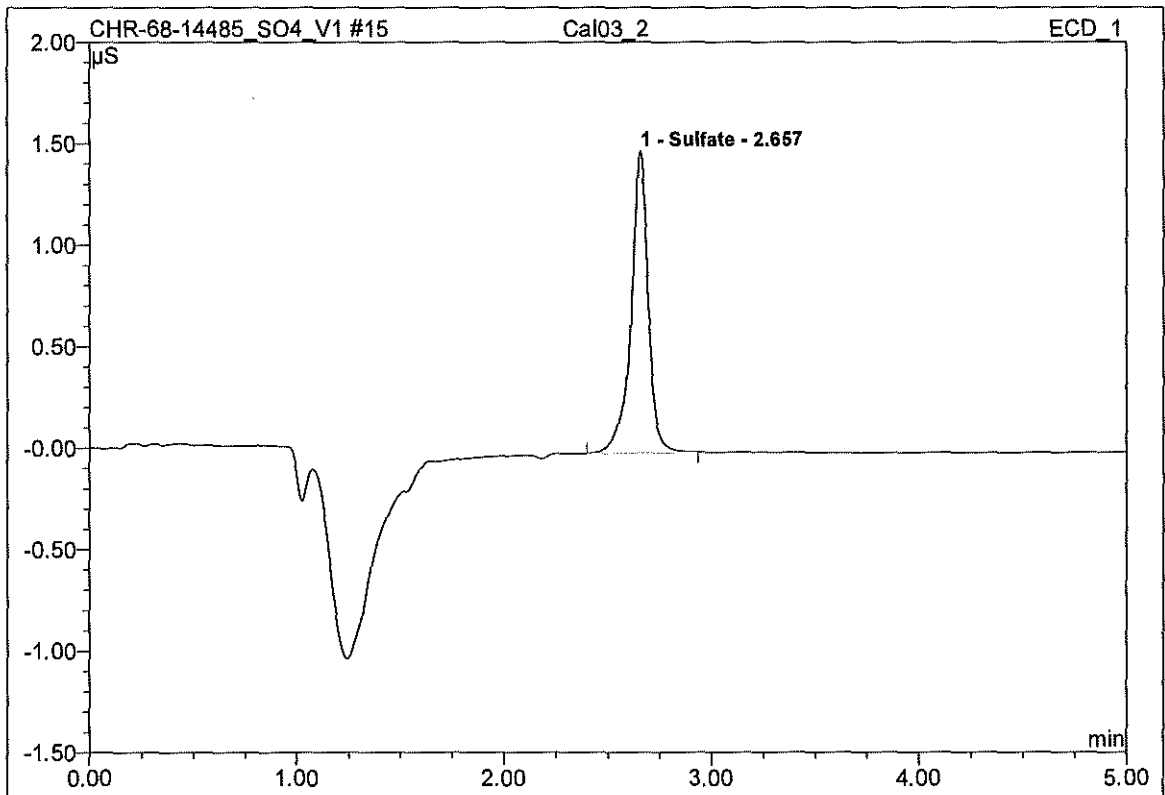
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	0.766	0.075	100.00	n.a.	BMB
Total:			0.766	0.075	100.00	0.000	

14 Cal03_1			
Clean Air			
Sample Name:	Cal03_1	Injection Volume:	1.0
Vial Number:	8	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:13	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



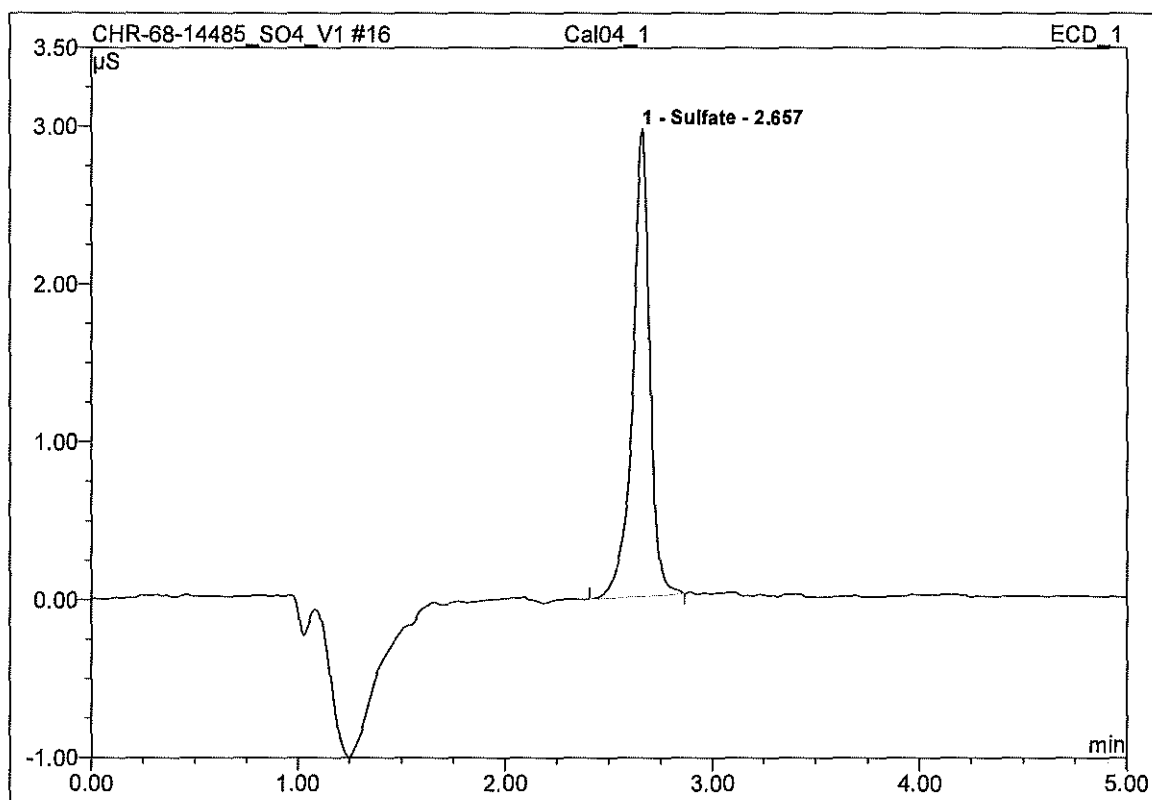
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.478	0.145	100.00	n.a.	BMB
Total:			1.478	0.145	100.00	0.000	

15 Cal03_2			
Clean Air			
Sample Name:	Cal03_2	Injection Volume:	1.0
Vial Number:	9	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:18	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



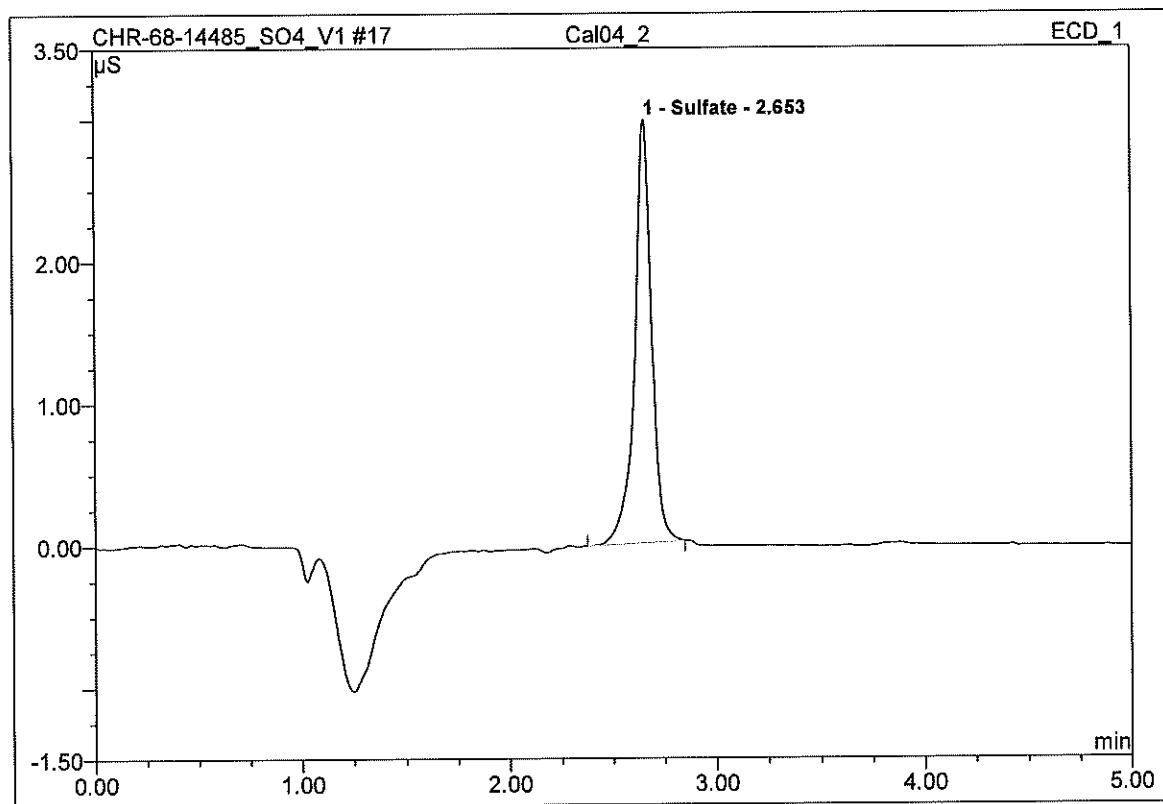
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.489	0.146	100.00	n.a.	BMB
Total:			1.489	0.146	100.00	0.000	

16 Cal04_1			
Clean Air			
Sample Name:	Cal04_1	Injection Volume:	1.0
Vial Number:	10	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:23	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



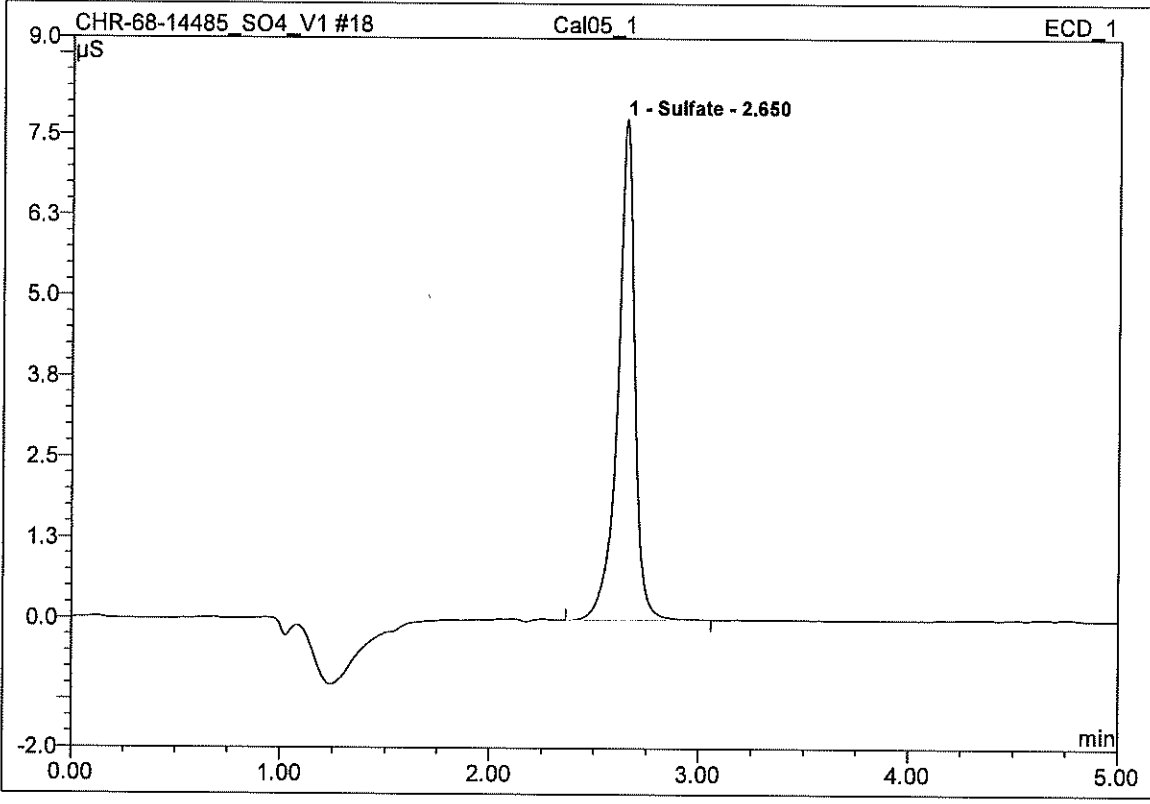
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	2.959	0.284	100.00	n.a.	BMB
Total:			2.959	0.284	100.00	0.000	

17 Cal04_2			
Clean Air			
Sample Name:	Cal04_2	Injection Volume:	1.0
Vial Number:	11	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:29	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



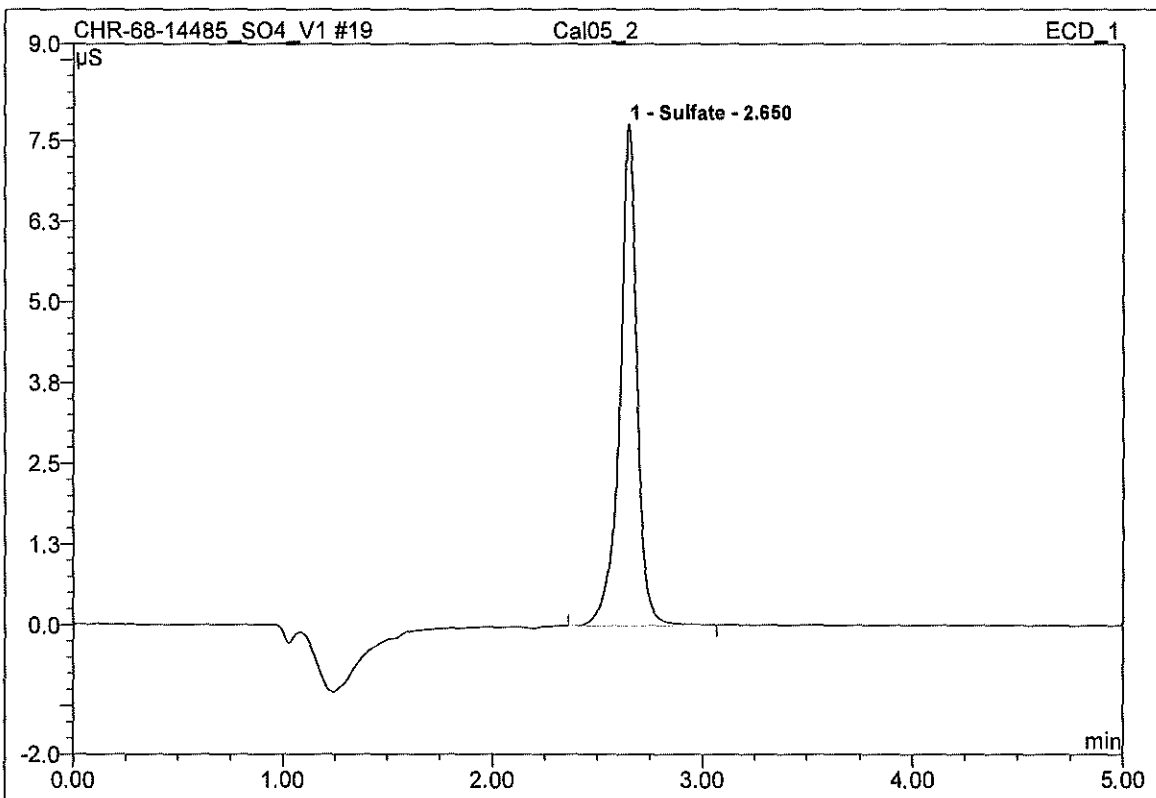
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	2.978	0.286	100.00	n.a.	BMB
Total:			2.978	0.286	100.00	0.000	

18 Cal05_1			
Clean Air			
Sample Name:	Cal05_1	Injection Volume:	1.0
Vial Number:	12	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:34	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



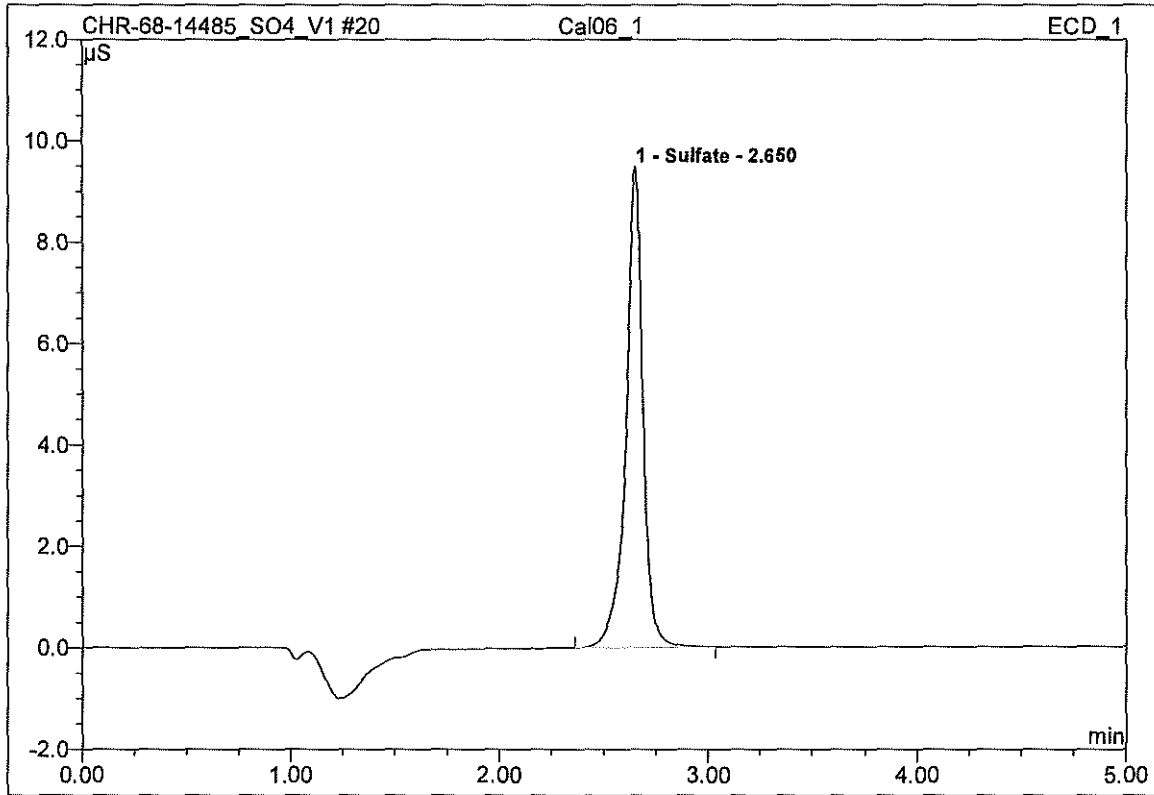
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	7.757	0.735	100.00	n.a.	BMB
Total:			7.757	0.735	100.00	0.000	

19 Cal05_2			
Clean Air			
Sample Name:	Cal05_2	Injection Volume:	1.0
Vial Number:	13	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:39	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



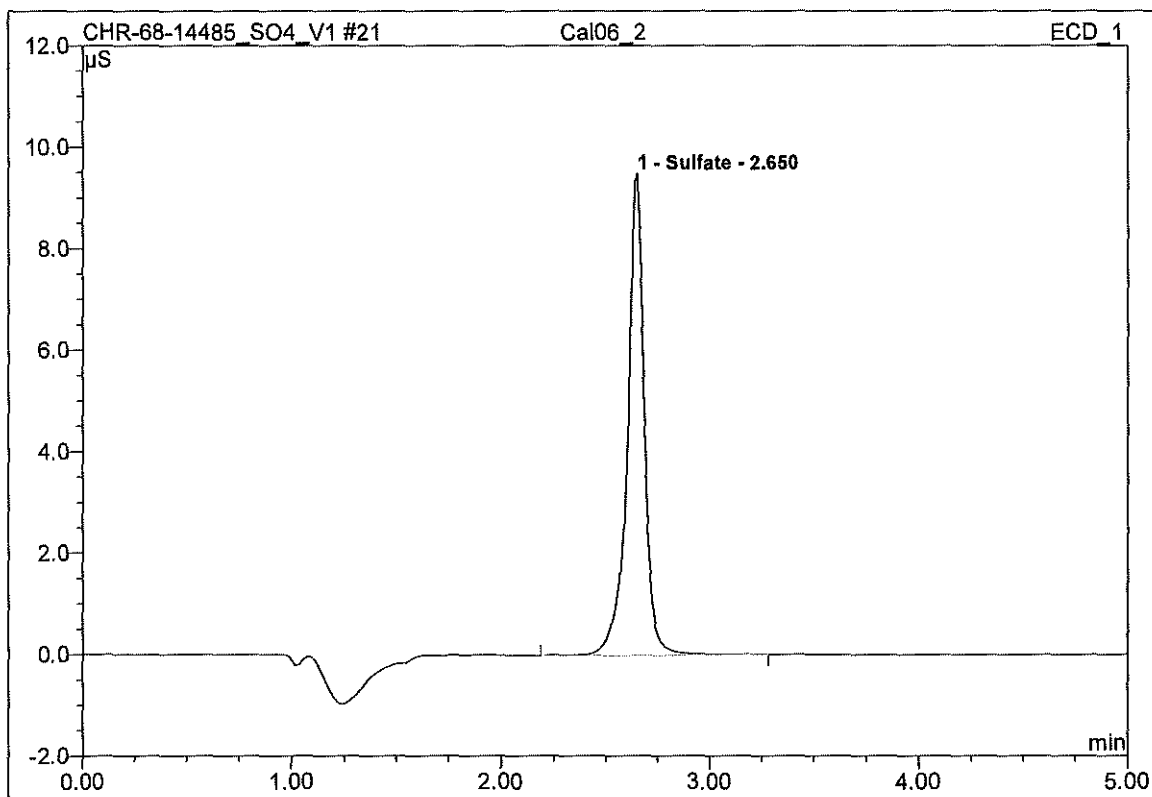
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	7.770	0.738	100.00	n.a.	BMB
Total:			7.770	0.738	100.00	0.000	

20 Cal06_1			
Clean Air			
Sample Name:	Cal06_1	Injection Volume:	1.0
Vial Number:	14	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:44	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



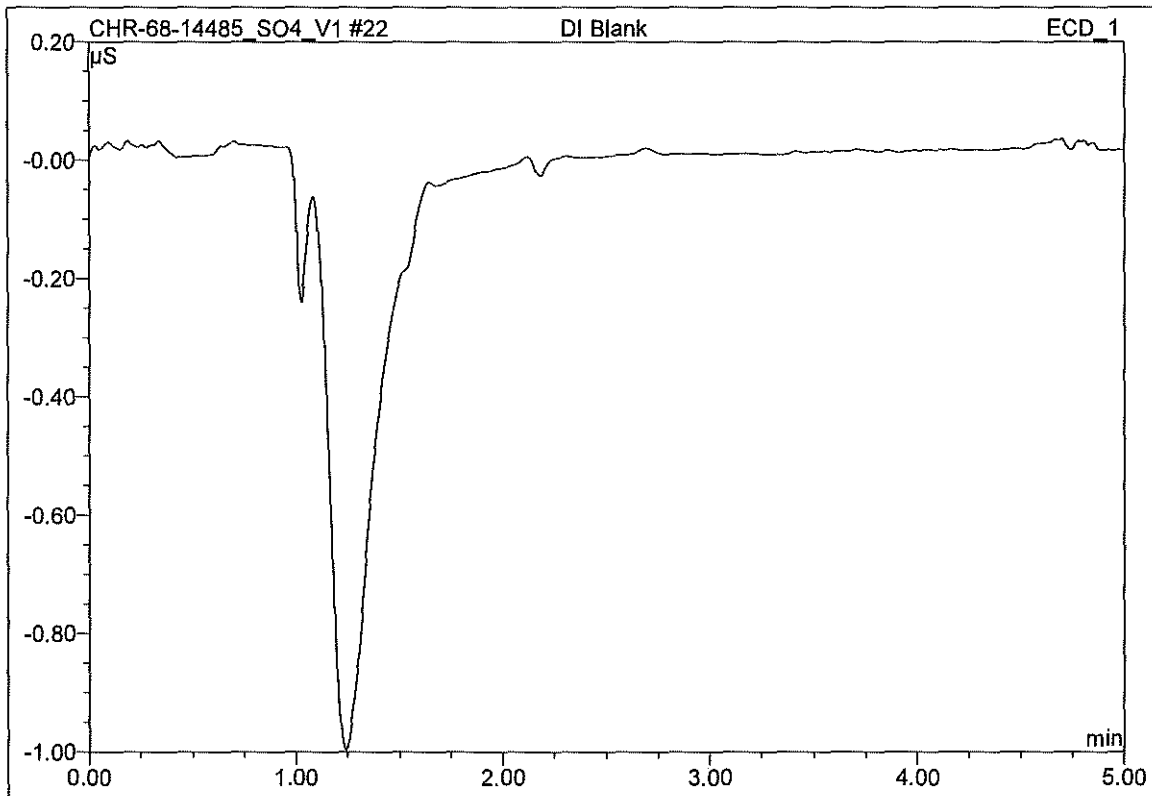
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	9.477	0.894	100.00	n.a.	BMB
Total:			9.477	0.894	100.00	0.000	

21 Cal06_2			
Clean Air			
Sample Name:	Cal06_2	Injection Volume:	1.0
Vial Number:	15	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:49	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	9.490	0.908	100.00	n.a.	BMB
Total:			9.490	0.908	100.00	0.000	

22 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	16	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:54	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

23 END			
Clean Air			
Sample Name:	END	Injection Volume:	1.0
Vial Number:	17	Channel:	n.a.
Sample Type:	blank	Wavelength:	n.a.
Control Program:	End	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/4/2021 17:59	Sample Weight:	1.0000
Run Time (min):	n.a.	Sample Amount:	1.0000

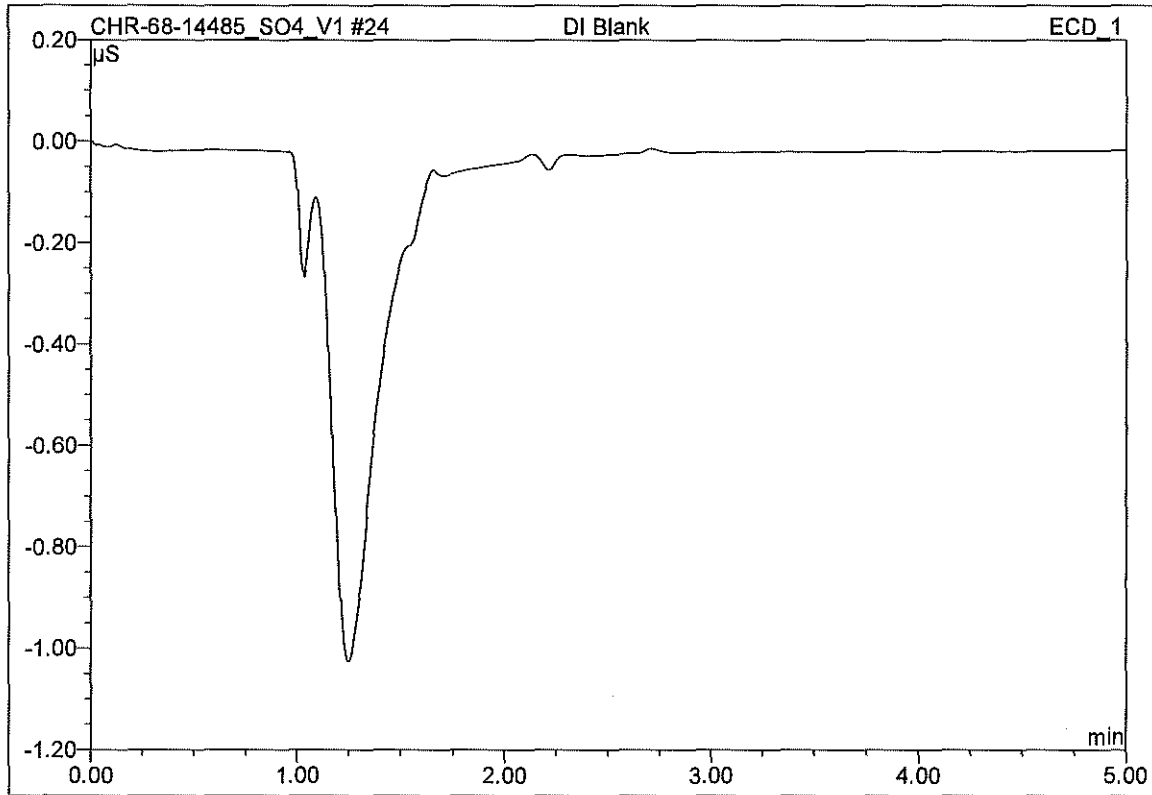
CHR-68-14485_SO4_V1 #23	END	ECD_1
Can't open raw data file "C:\Chromel\data\08011110_1\2_Data\14485\CHR-68-14485_SO4_V1.SEQ\ECD_1.CHLV1434.acd". The system cannot find the file specified.		

n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	n.a.		n.a.	n.a.	n.a.	n.a.	
Total:			0.000	0.000	0.00	0.000	

24 DI Blank

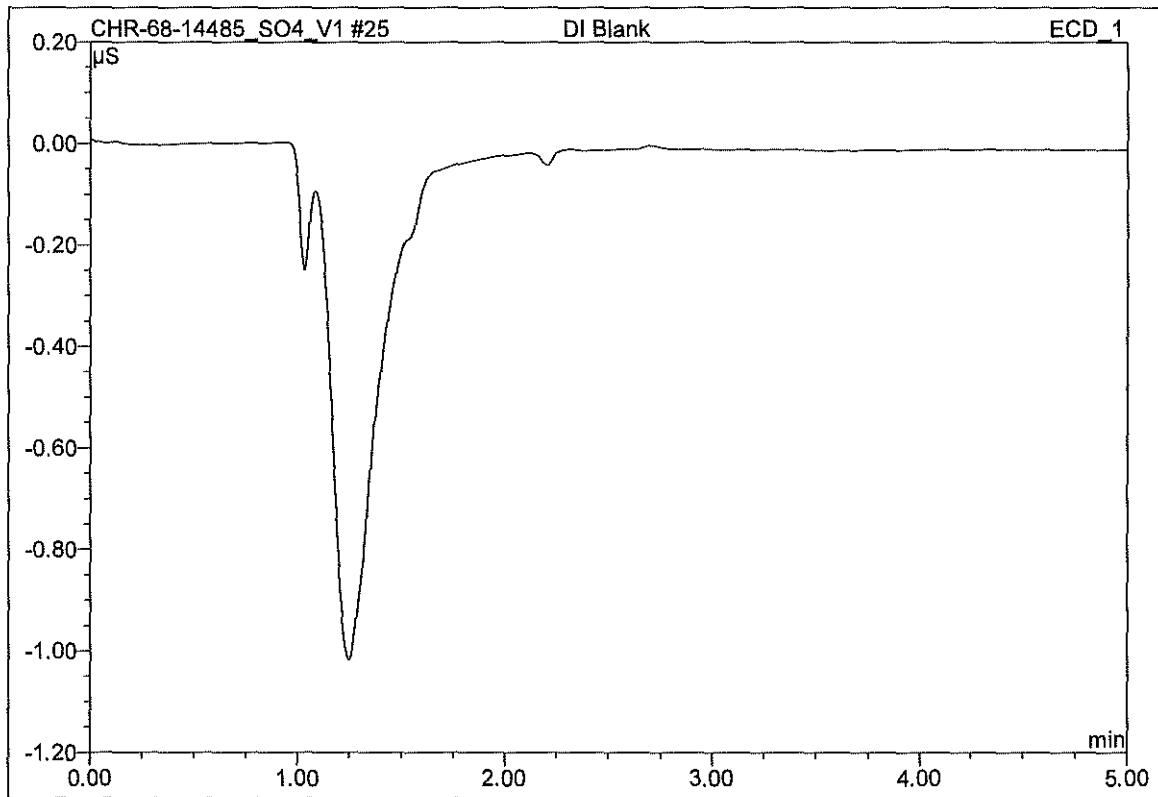
Clean Air

Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	18	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj1Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:15	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



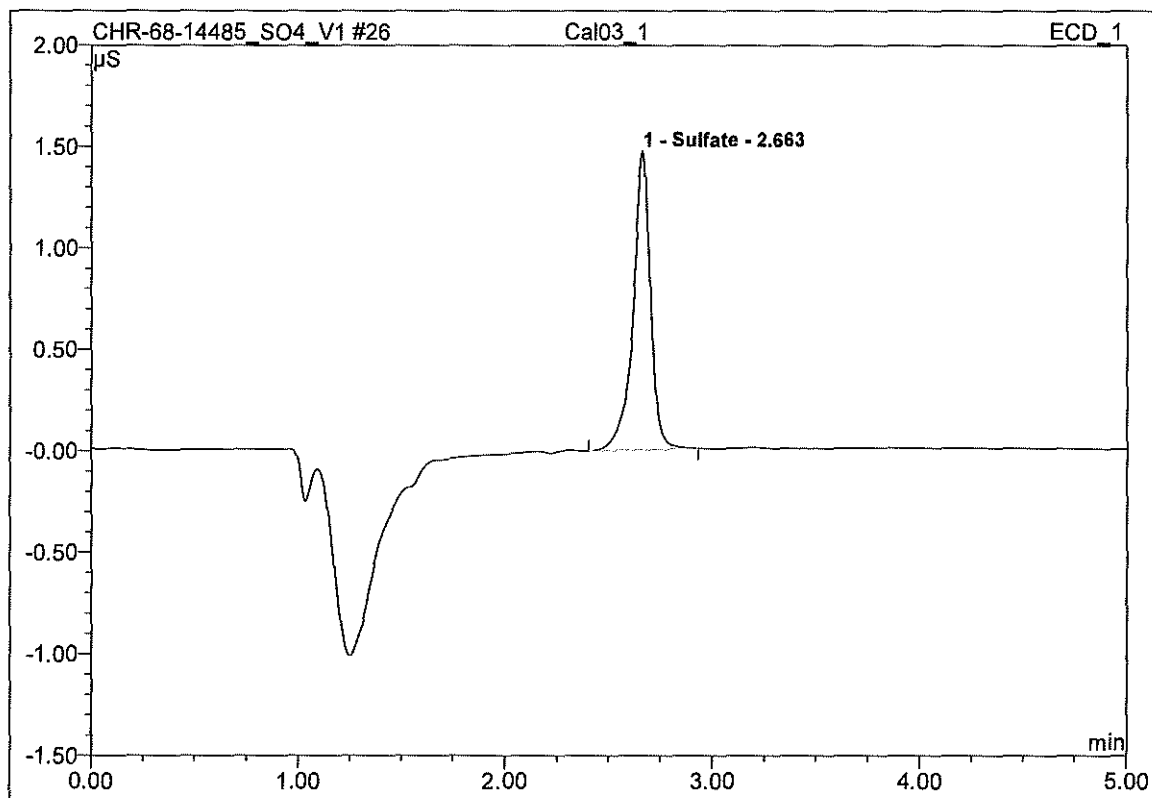
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

25 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	19	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:22	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



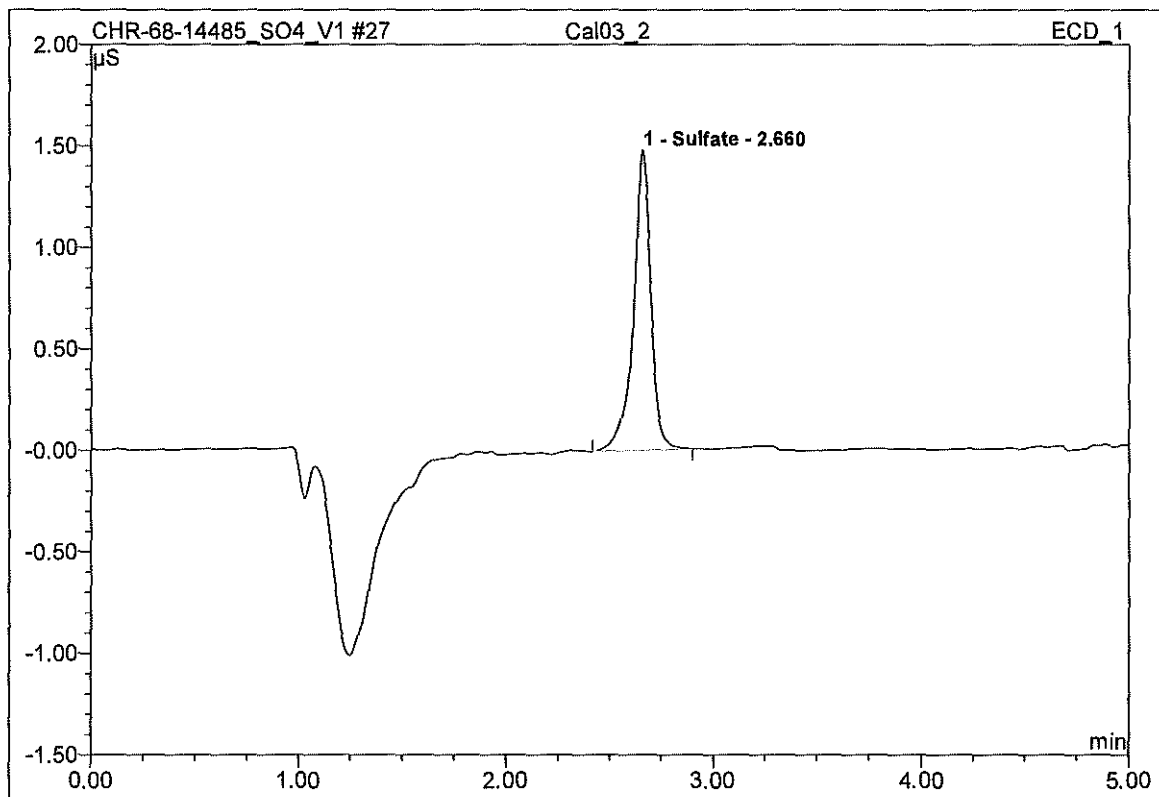
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

26 Cal03_1			
Clean Air			
Sample Name:	Cal03_1	Injection Volume:	1.0
Vial Number:	20	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:27	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



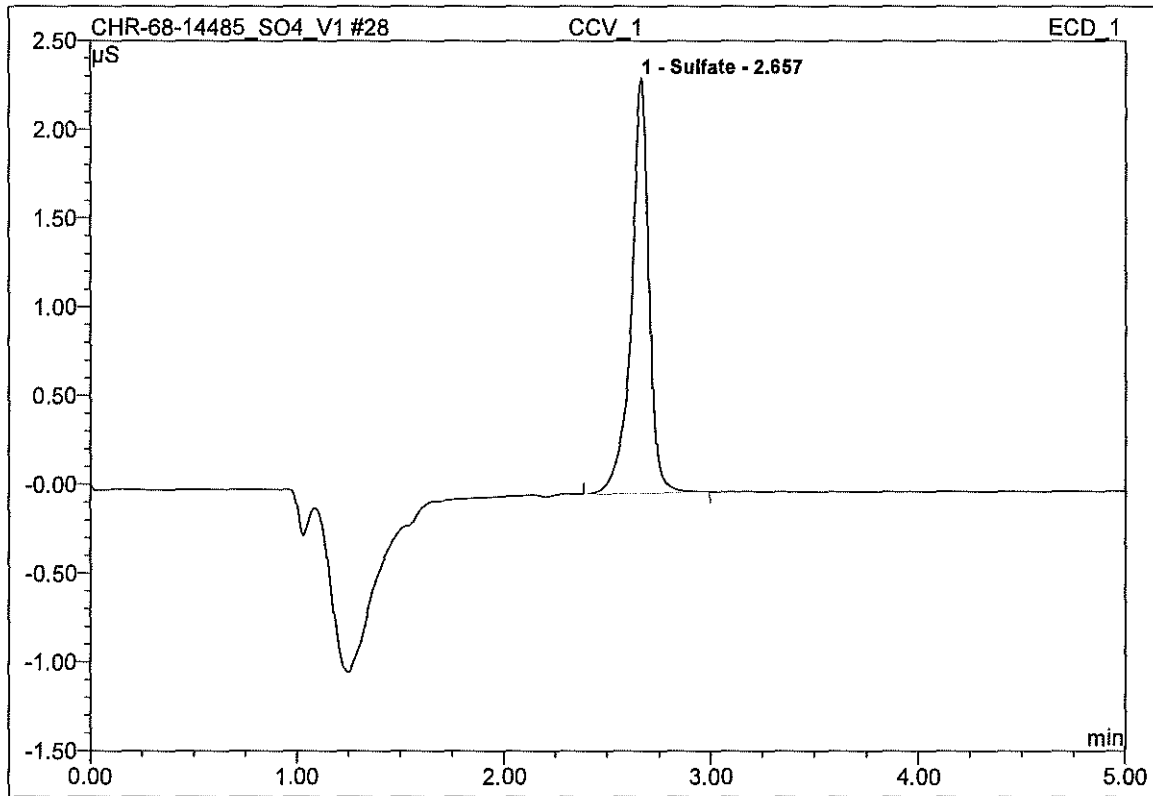
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.472	0.145	100.00	n.a.	BMB
Total:			1.472	0.145	100.00	0.000	

27 Cal03_2			
Clean Air			
Sample Name:	Cal03_2	Injection Volume:	1.0
Vial Number:	21	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:32	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



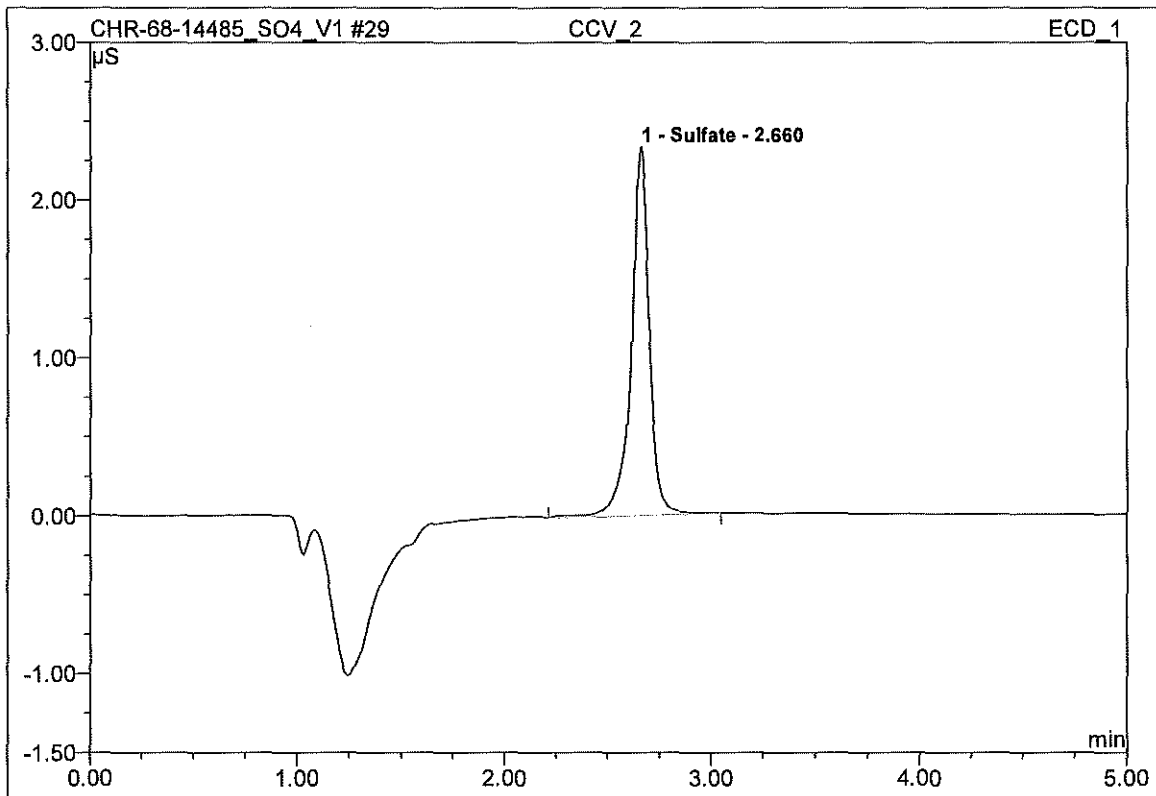
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	1.478	0.146	100.00	n.a.	BMB
Total:			1.478	0.146	100.00	0.000	

28 CCV_1			
Clean Air			
Sample Name:	CCV_1	Injection Volume:	1.0
Vial Number:	22	Channel:	ECD_1
Sample Type:	validate	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:37	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



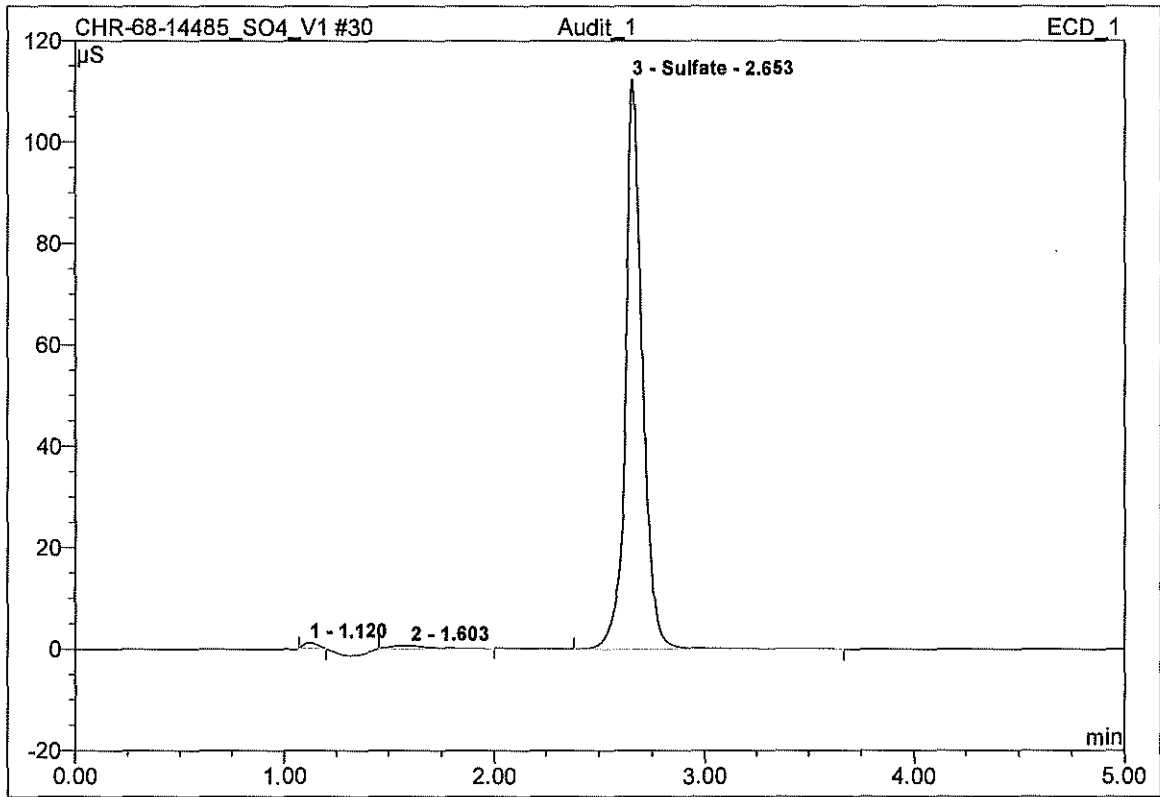
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	2.337	0.229	100.00	n.a.	BMB
Total:			2.337	0.229	100.00	0.000	

29 CCV_2			
Clean Air			
Sample Name:	CCV_2	Injection Volume:	1.0
Vial Number:	23	Channel:	ECD_1
Sample Type:	validate	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:42	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



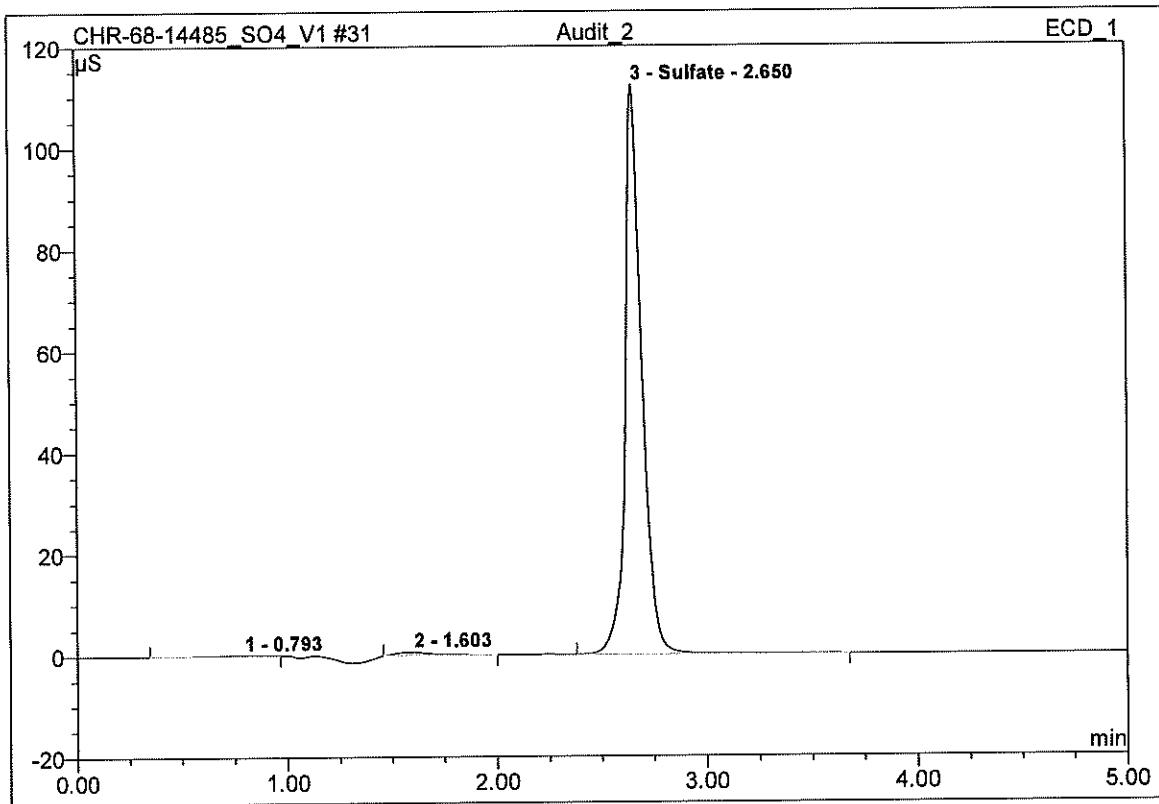
No.	Ret. Time min	Peak Name	Height μS	Area μS*min	Rel. Area %	Amount	Type
1	2.66	Sulfate	2.337	0.237	100.00	n.a.	BMB
Total:			2.337	0.237	100.00	0.000	

30 Audit_1			
Clean Air			
Sample Name:	Audit_1	Injection Volume:	1.0
Vial Number:	24	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1 Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 8:57	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



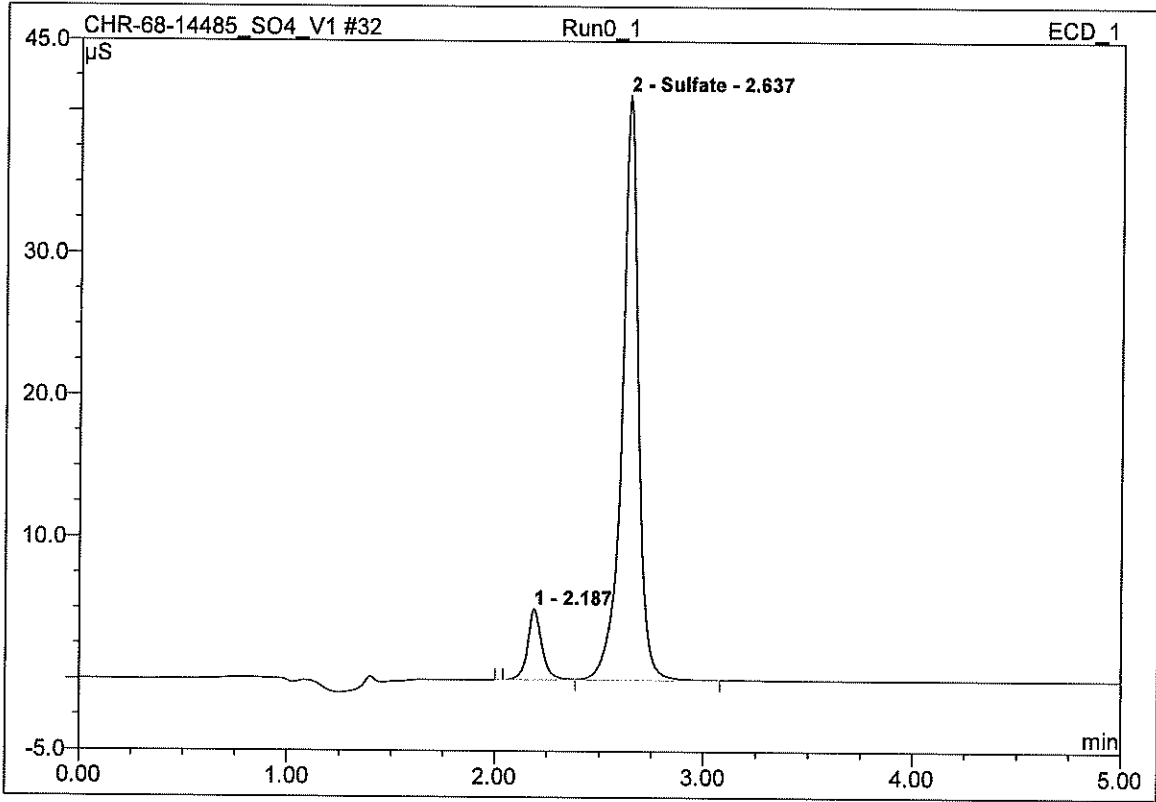
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.12	n.a.	1.170	0.090	0.84	n.a.	BMB
2	1.60	n.a.	0.654	0.124	1.17	n.a.	BMB
3	2.65	Sulfate	112.297	10.447	97.99	n.a.	BMB
Total:			114.122	10.661	100.00	0.000	

31 Audit_2			
Clean Air			
Sample Name:	Audit_2	Injection Volume:	1.0
Vial Number:	25	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 9:03	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



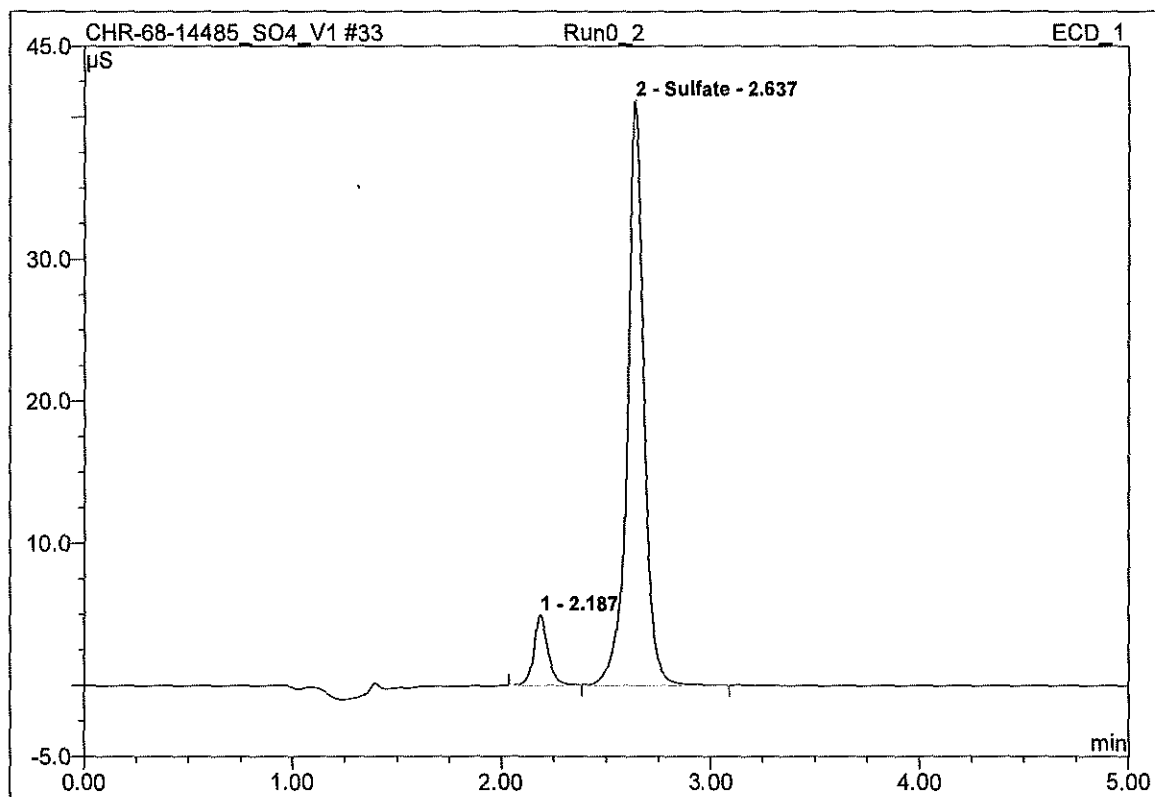
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	0.79	n.a.	0.160	0.039	0.37	n.a.	BM
2	1.60	n.a.	0.638	0.120	1.13	n.a.	BMB
3	2.65	Sulfate	112.229	10.443	98.50	n.a.	BMB
Total:			113.027	10.602	100.00	0.000	

32 Run0_1			
Clean Air			
Sample Name:	Run0_1	Injection Volume:	1.0
Vial Number:	26	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 9:09	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



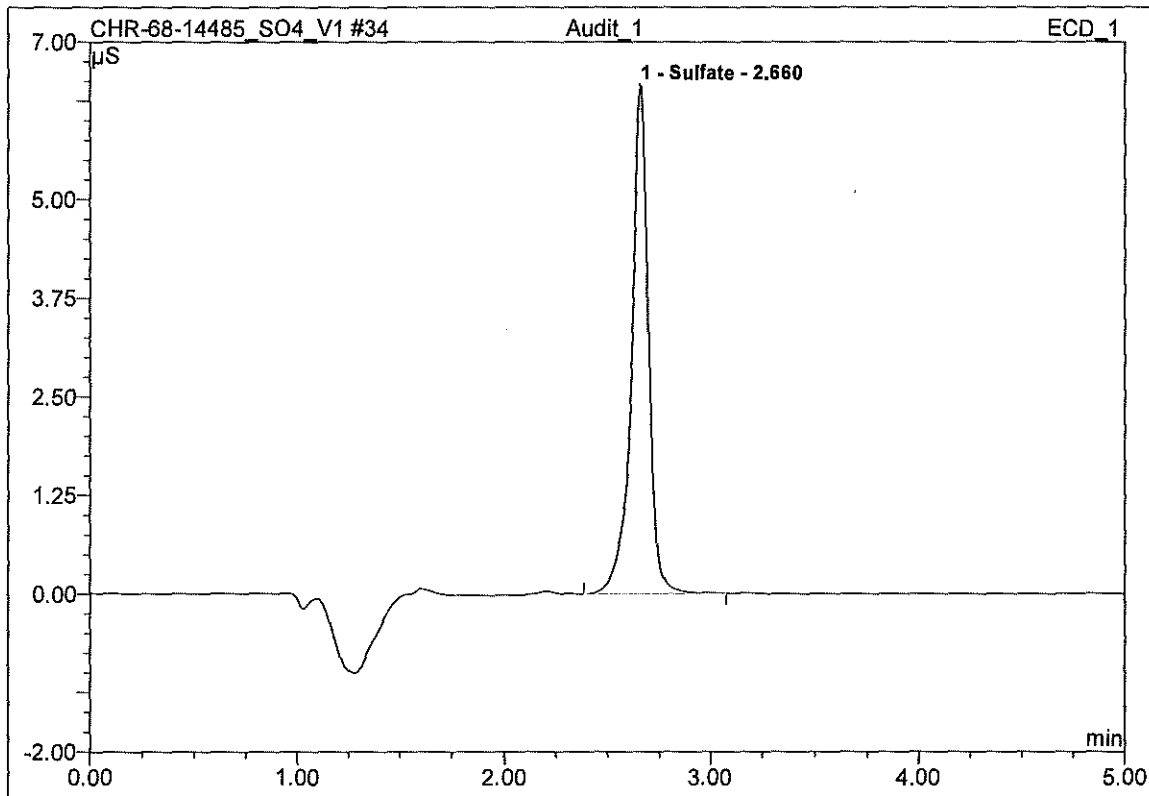
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.19	n.a.	4.953	0.386	9.24	n.a.	Ru
2	2.64	Sulfate	41.161	3.792	90.76	n.a.	BMB
Total:			46.114	4.178	100.00	0.000	

33 Run0_2			
Clean Air			
Sample Name:	Run0_2	Injection Volume:	1.0
Vial Number:	27	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 9:14	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



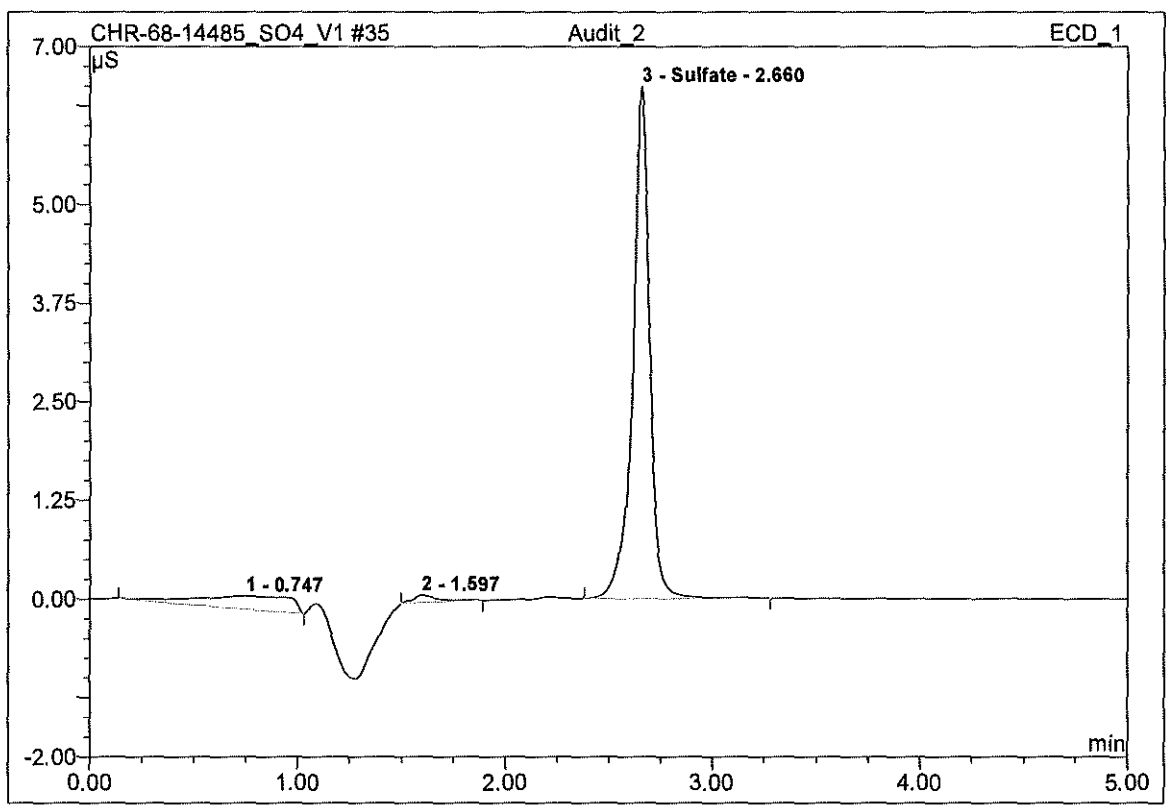
No.	Ret.Time min	Peak Name	Height μS	Area $\mu\text{S}\cdot\text{min}$	Rel.Area %	Amount	Type
1	2.19	n.a.	4.948	0.386	9.24	n.a.	Ru
2	2.64	Sulfate	41.191	3.793	90.76	n.a.	BMB
Total:			46.139	4.179	100.00	0.000	

34 Audit_1			
Clean Air			
Sample Name:	Audit_1	Injection Volume:	1.0
Vial Number:	28	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 9:44	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



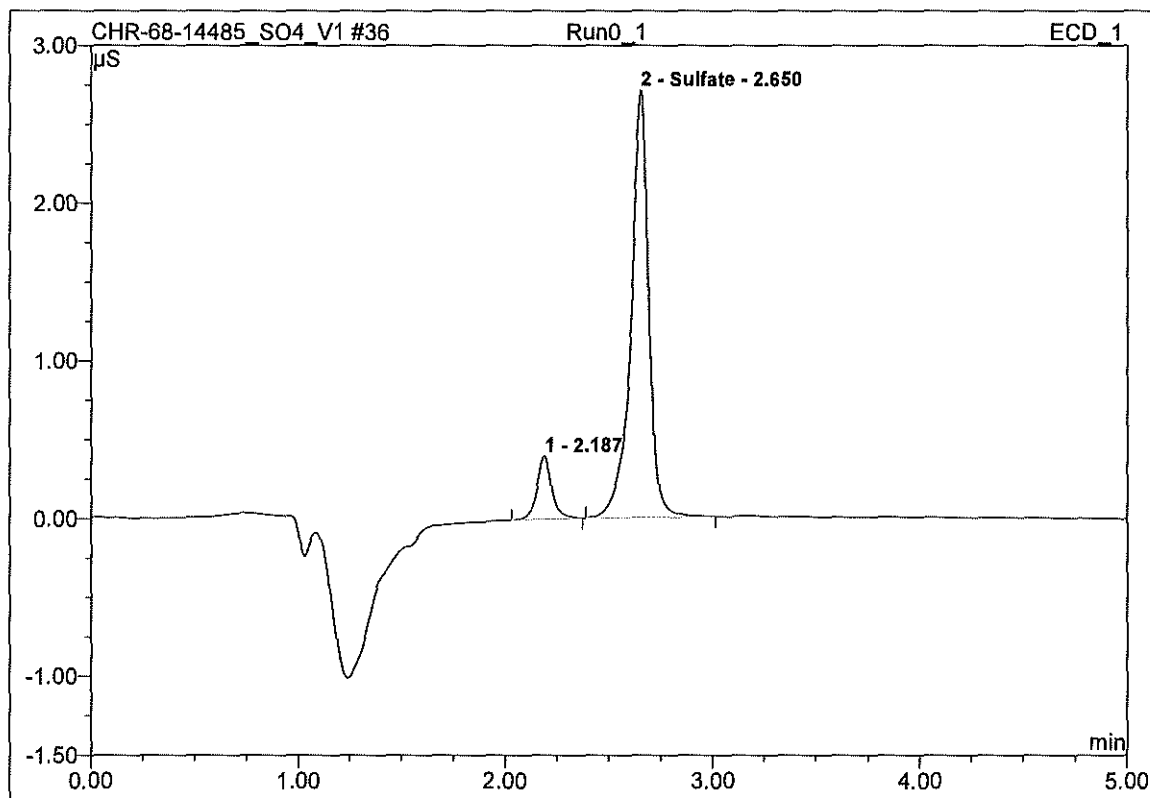
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.66	Sulfate	6.460	0.614	100.00	n.a.	BMB
Total:			6.460	0.614	100.00	0.000	

35 Audit_2			
Clean Air			
Sample Name:	Audit_2	Injection Volume:	1.0
Vial Number:	29	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 9:51	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



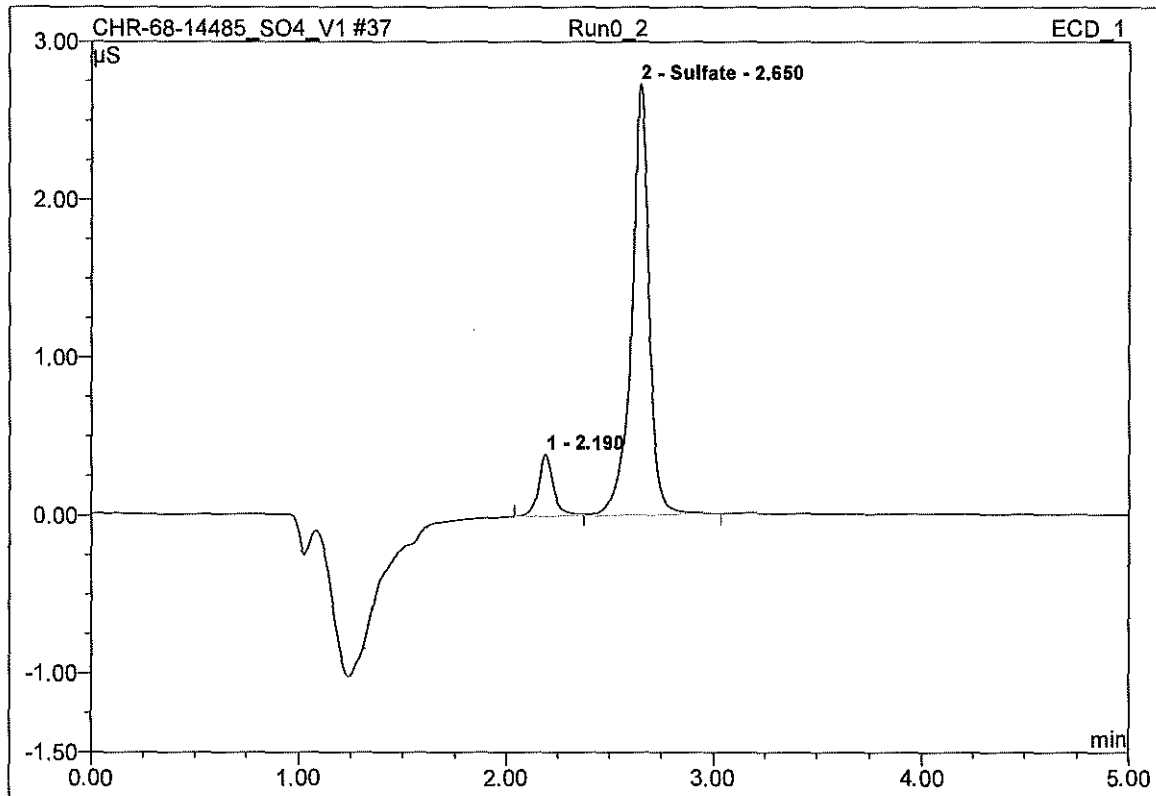
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	0.75	n.a.	0.163	0.088	12.28	n.a.	BMB
2	1.60	n.a.	0.094	0.013	1.79	n.a.	BMB
3	2.66	Sulfate	6.488	0.618	85.93	n.a.	BMB
Total:			6.745	0.720	100.00	0.000	

36 Run0_1			
Clean Air			
Sample Name:	Run0_1	Injection Volume:	1.0
Vial Number:	30	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 9:56	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



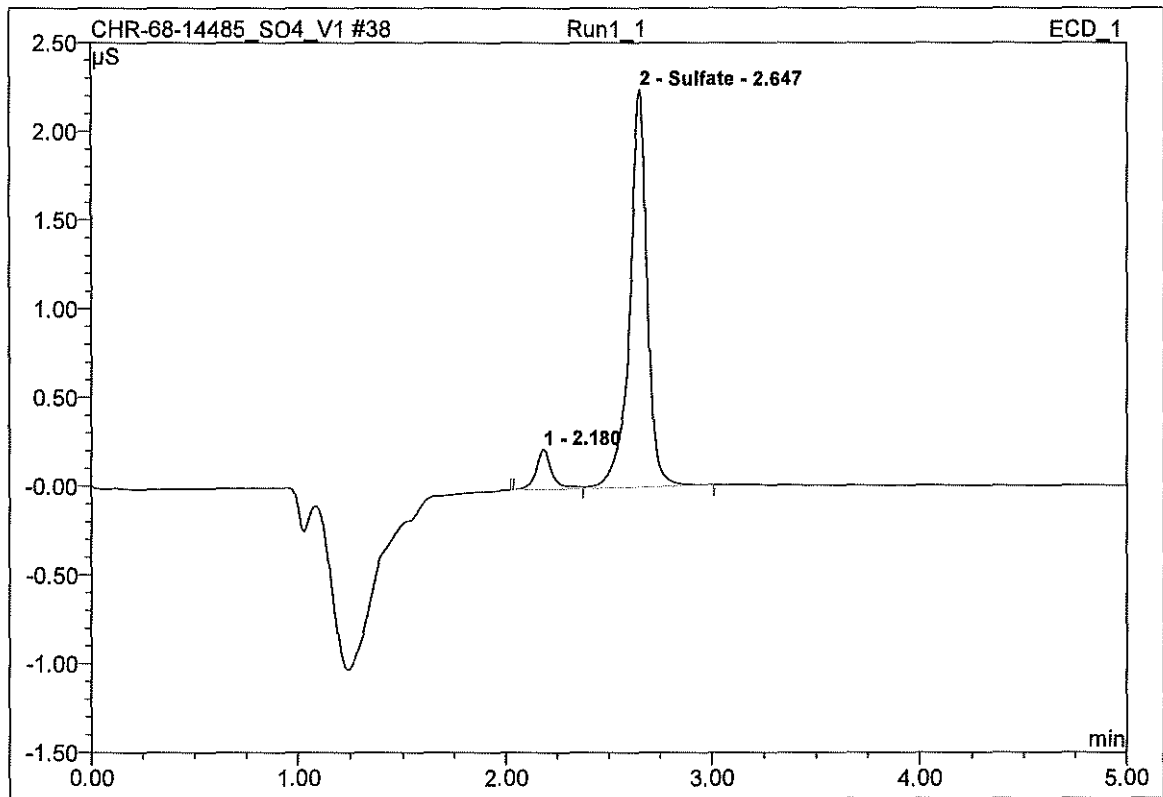
No.	Ret.Time min	Peak Name	Height μS	Area $\mu\text{S}\cdot\text{min}$	Rel.Area %	Amount	Type
1	2.19	n.a.	0.398	0.033	11.01	n.a.	BMB
2	2.65	Sulfate	2.704	0.265	88.99	n.a.	BMB
Total:			3.101	0.298	100.00	0.000	

37 Run0_2			
Clean Air			
Sample Name:	Run0_2	Injection Volume:	1.0
Vial Number:	31	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 10:01	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



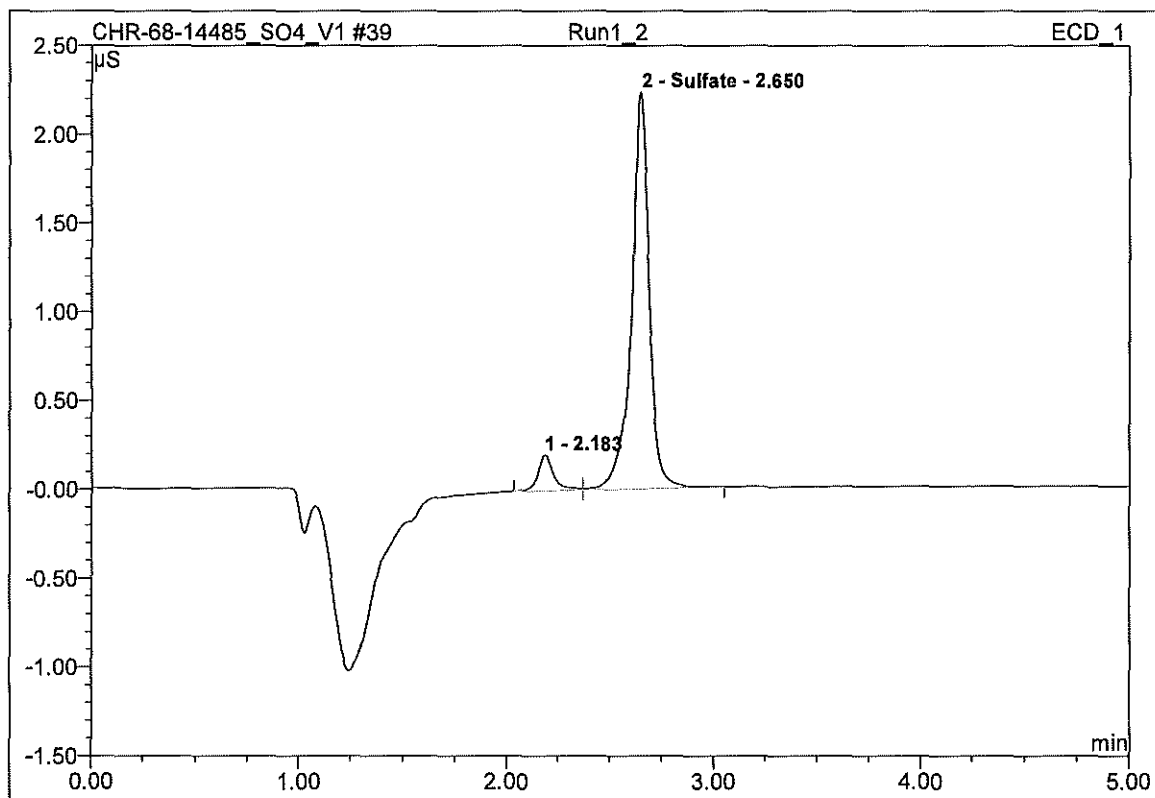
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.19	n.a.	0.389	0.032	10.51	n.a.	Ru
2	2.65	Sulfate	2.726	0.271	89.49	n.a.	BMB
Total:			3.115	0.303	100.00	0.000	

38 Run1_1			
Clean Air			
Sample Name:	Run1_1	Injection Volume:	1.0
Vial Number:	32	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 10:57	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



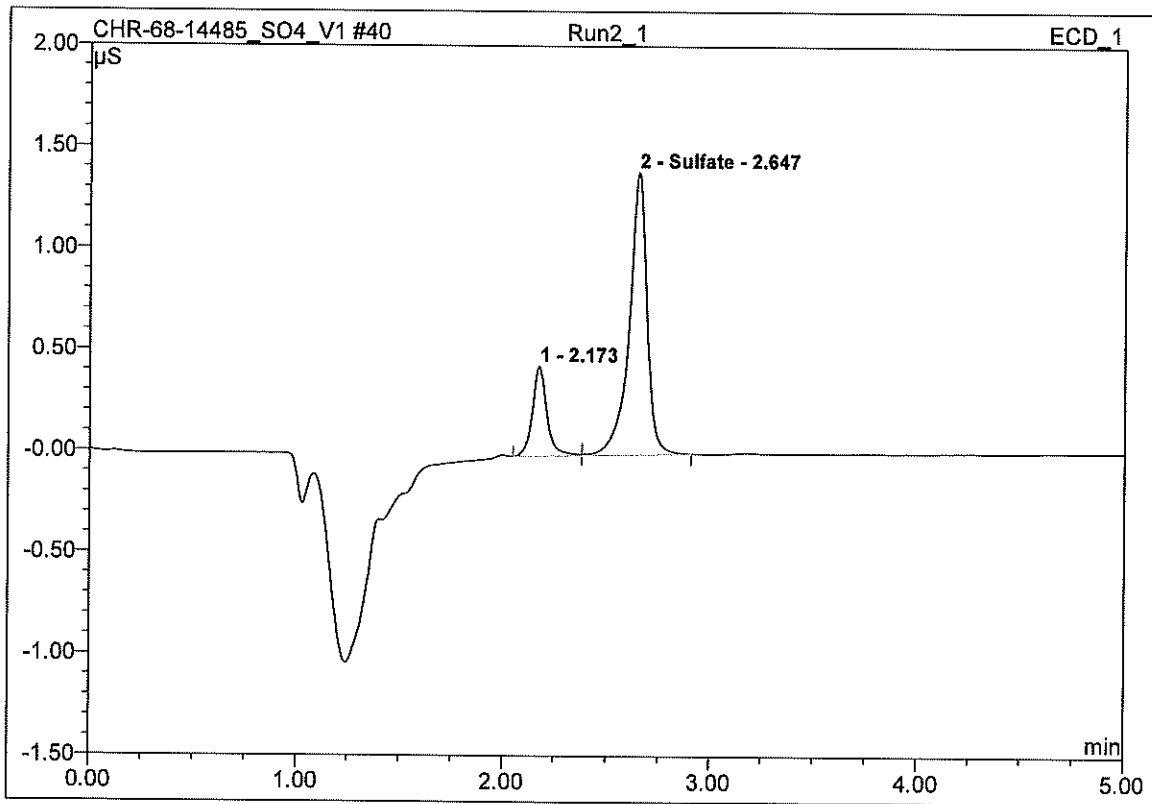
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.18	n.a.	0.223	0.019	7.82	n.a.	Ru
2	2.65	Sulfate	2.238	0.223	92.18	n.a.	BMB
Total:			2.461	0.242	100.00	0.000	

39 Run1_2			
Clean Air			
Sample Name:	Run1_2	Injection Volume:	1.0
Vial Number:	33	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 11:04	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



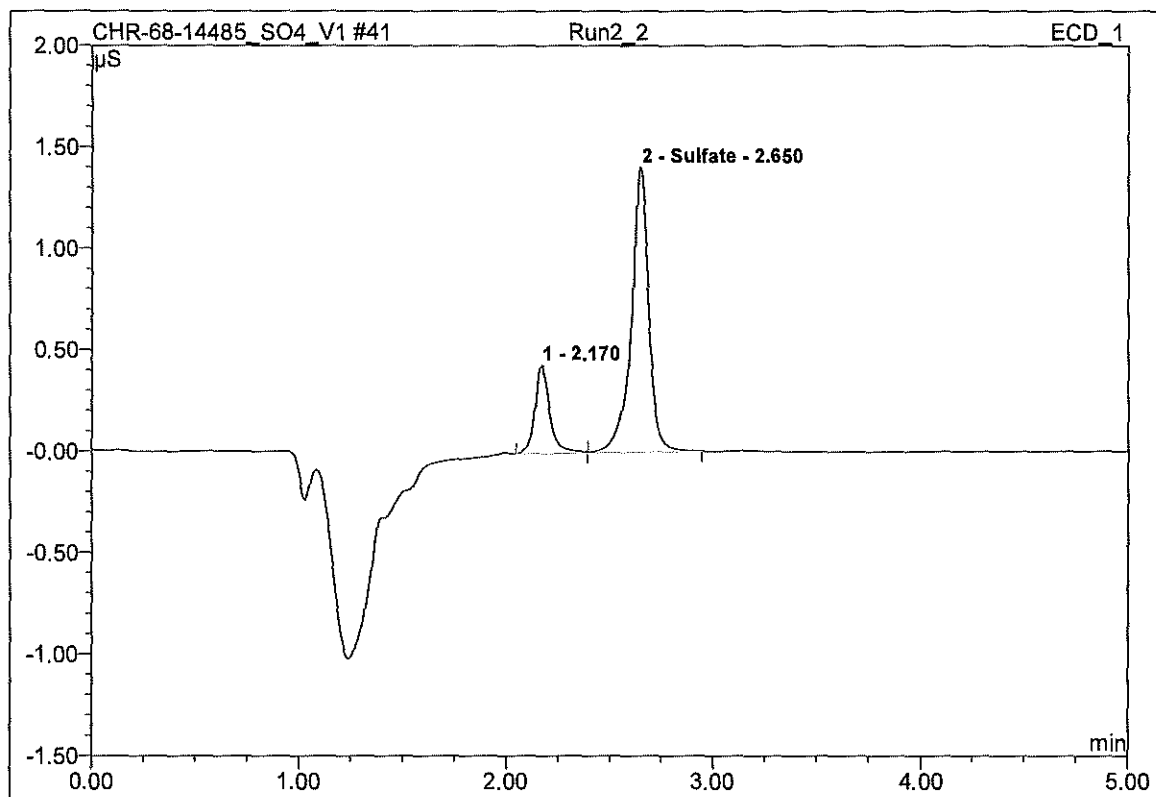
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.18	n.a.	0.202	0.018	7.47	n.a.	BM
2	2.65	Sulfate	2.233	0.222	92.53	n.a.	MB
Total:			2.435	0.240	100.00	0.000	

40 Run2_1			
Clean Air			
Sample Name:	Run2_1	Injection Volume:	1.0
Vial Number:	34	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 12:46	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



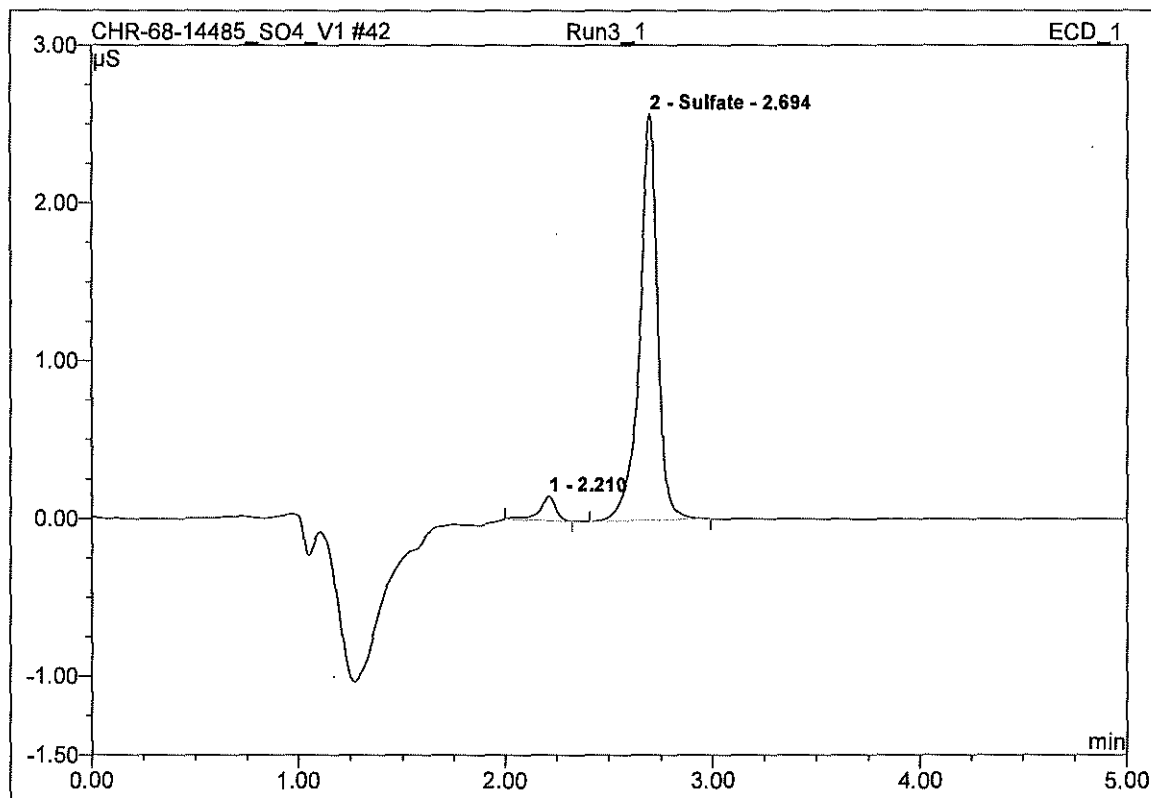
No.	Ret.Time min	Peak Name	Height μS	Area $\mu\text{S}\cdot\text{min}$	Rel.Area %	Amount	Type
1	2.17	n.a.	0.444	0.037	20.86	n.a.	BM
2	2.65	Sulfate	1.392	0.139	79.14	n.a.	MB
Total:			1.836	0.175	100.00	0.000	

41 Run2_2			
Clean Air			
Sample Name:	Run2_2	Injection Volume:	1.0
Vial Number:	35	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 12:53	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



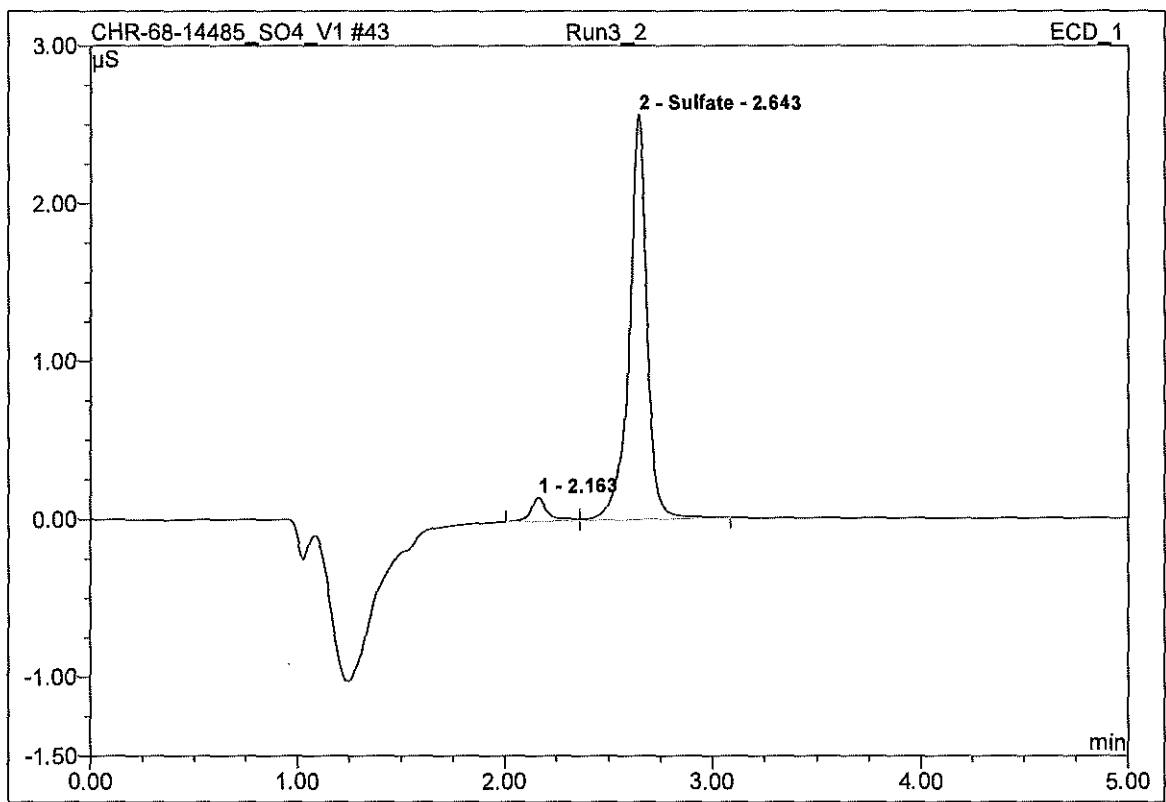
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.17	n.a.	0.436	0.036	20.50	n.a.	BM
2	2.65	Sulfate	1.403	0.139	79.50	n.a.	MB
Total:			1.839	0.175	100.00	0.000	

42 Run3_1			
Clean Air			
Sample Name:	Run3_1	Injection Volume:	1.0
Vial Number:	36	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj1 Start	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 14:04	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



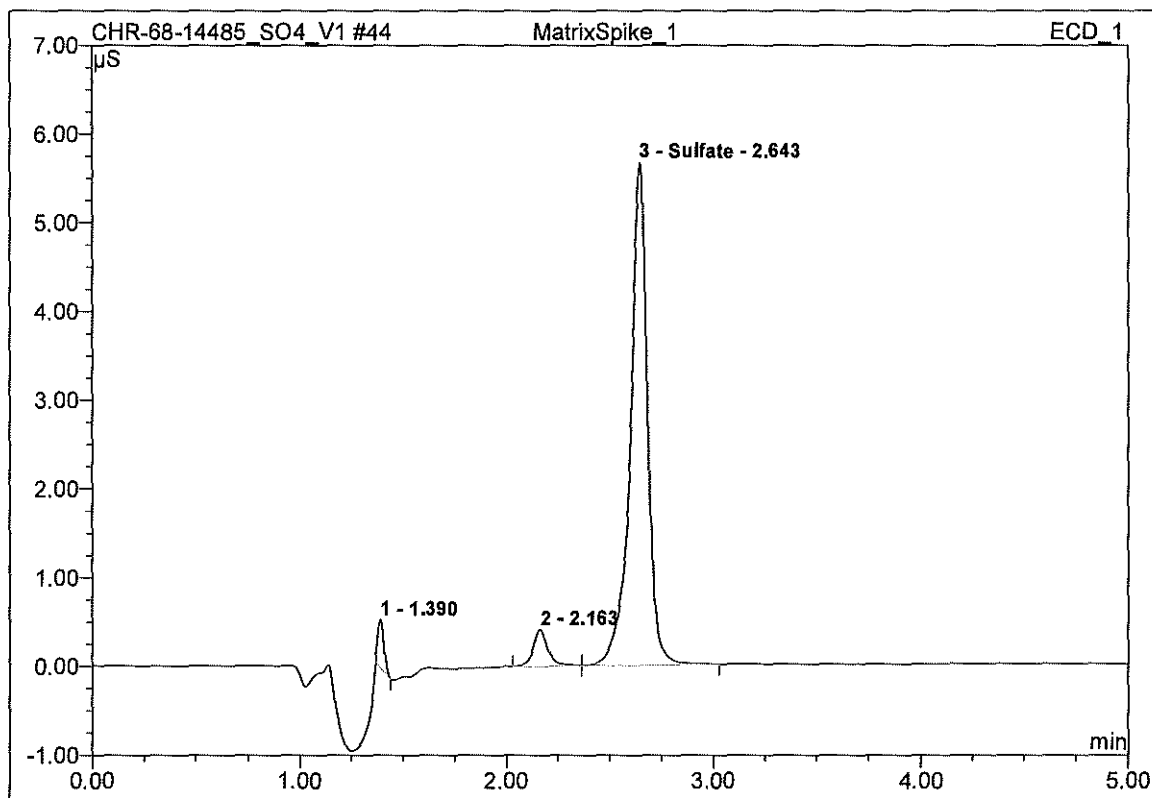
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.21	n.a.	0.155	0.014	5.37	n.a.	BMB
2	2.69	Sulfate	2.575	0.252	94.63	n.a.	BMB
Total:			2.730	0.267	100.00	0.000	

43 Run3_2			
Clean Air			
Sample Name:	Run3_2	Injection Volume:	1.0
Vial Number:	37	Channel:	ECD_1
Sample Type:	unknown	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 14:11	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



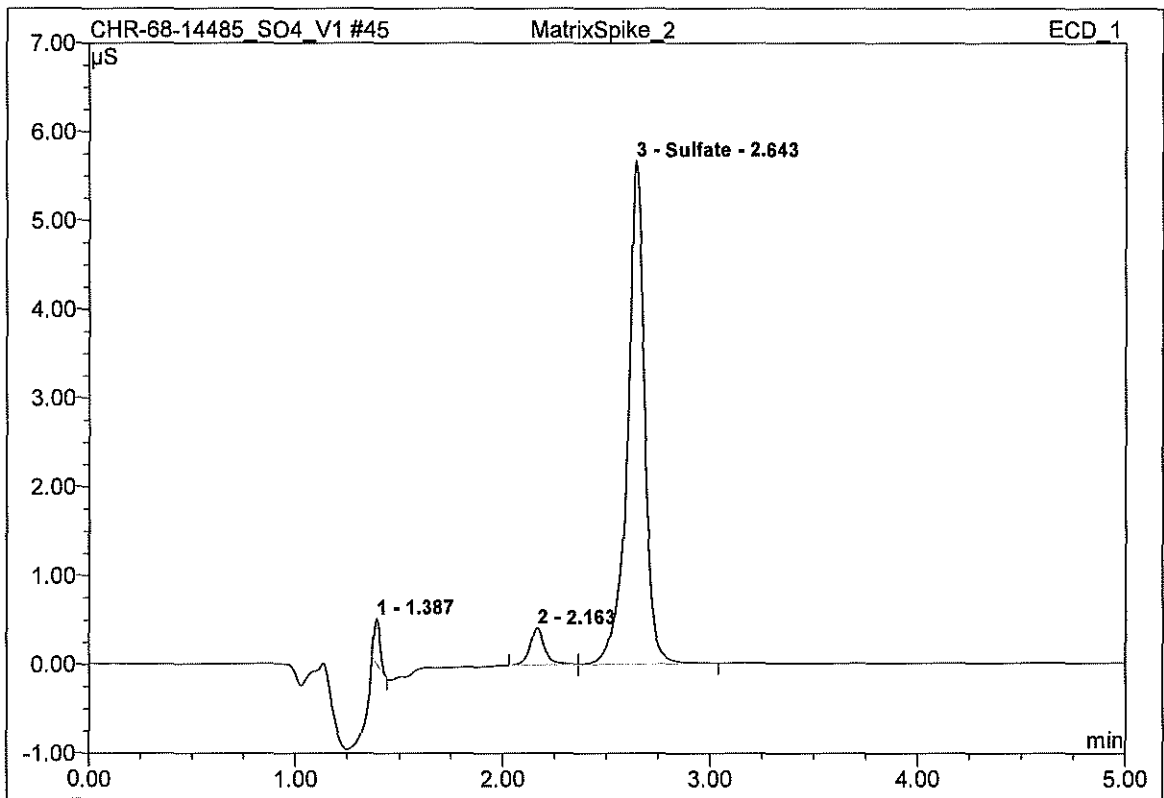
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.153	0.014	5.24	n.a.	BM
2	2.64	Sulfate	2.567	0.256	94.76	n.a.	MB
Total:			2.720	0.270	100.00	0.000	

44 MatrixSpike_1			
Clean Air			
Sample Name:	MatrixSpike_1	Injection Volume:	1.0
Vial Number:	38	Channel:	ECD_1
Sample Type:	spiked	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 14:16	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



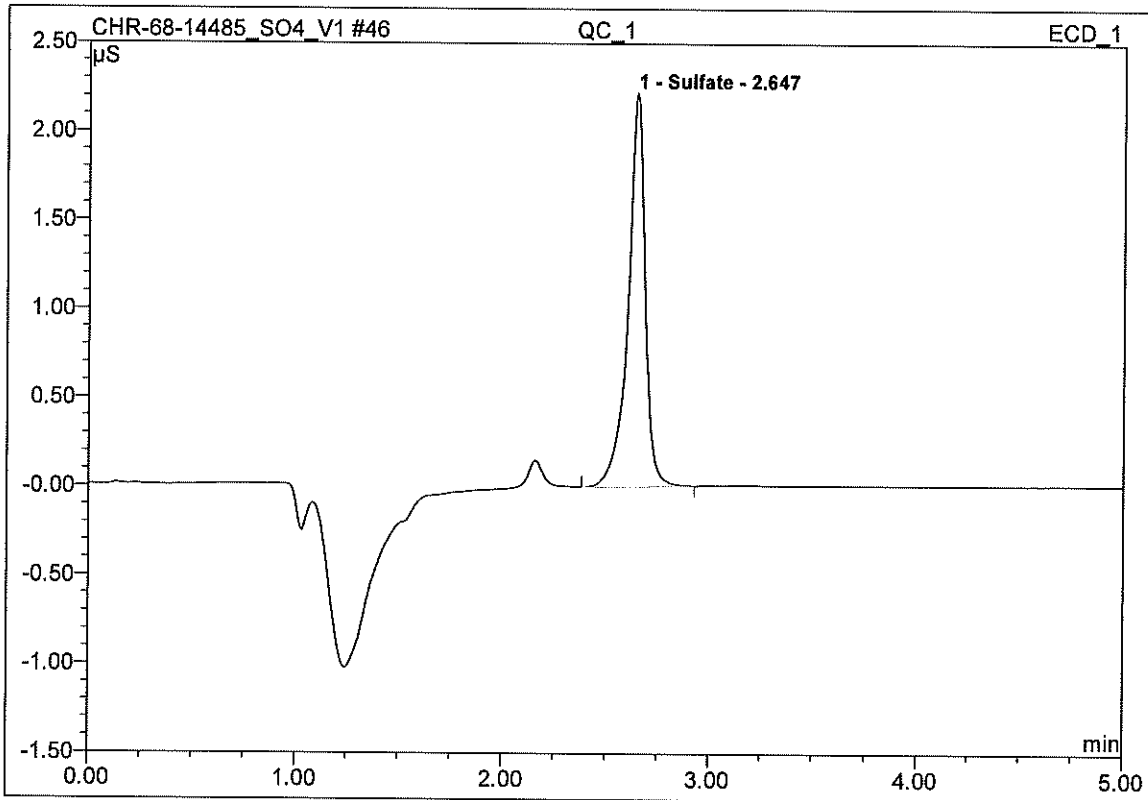
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	1.39	n.a.	0.542	0.019	3.20	n.a.	BMB
2	2.16	n.a.	0.418	0.035	5.77	n.a.	BM
3	2.64	Sulfate	5.666	0.546	91.03	n.a.	MB
Total:			6.626	0.600	100.00	0.000	

45 MatrixSpike_2			
Clean Air			
Sample Name:	MatrixSpike_2	Injection Volume:	1.0
Vial Number:	39	Channel:	ECD_1
Sample Type:	spiked	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	12.5000
Recording Time:	10/5/2021 14:21	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



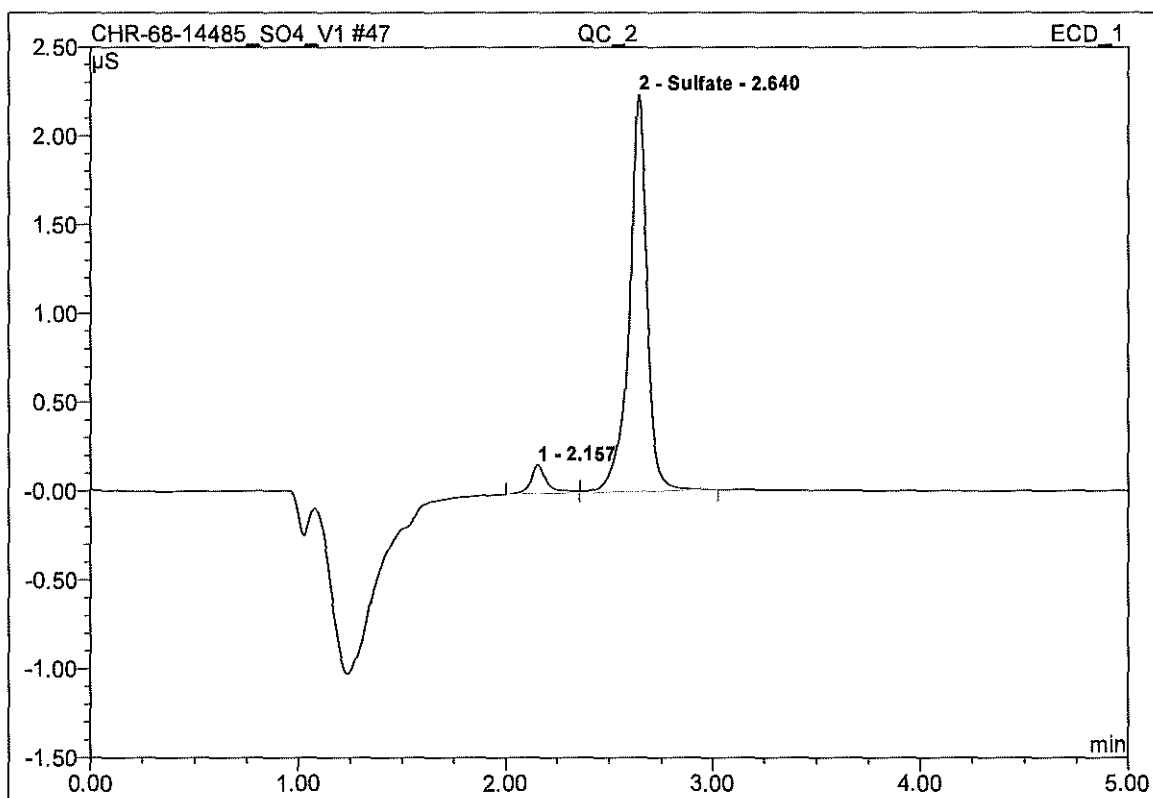
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	1.39	n.a.	0.500	0.017	2.86	n.a.	BMB
2	2.16	n.a.	0.416	0.034	5.73	n.a.	BM
3	2.64	Sulfate	5.668	0.547	91.42	n.a.	MB
Total:			6.583	0.599	100.00	0.000	

46 QC_1			
Clean Air			
Sample Name:	QC_1	Injection Volume:	1.0
Vial Number:	40	Channel:	ECD_1
Sample Type:	validate	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:26	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



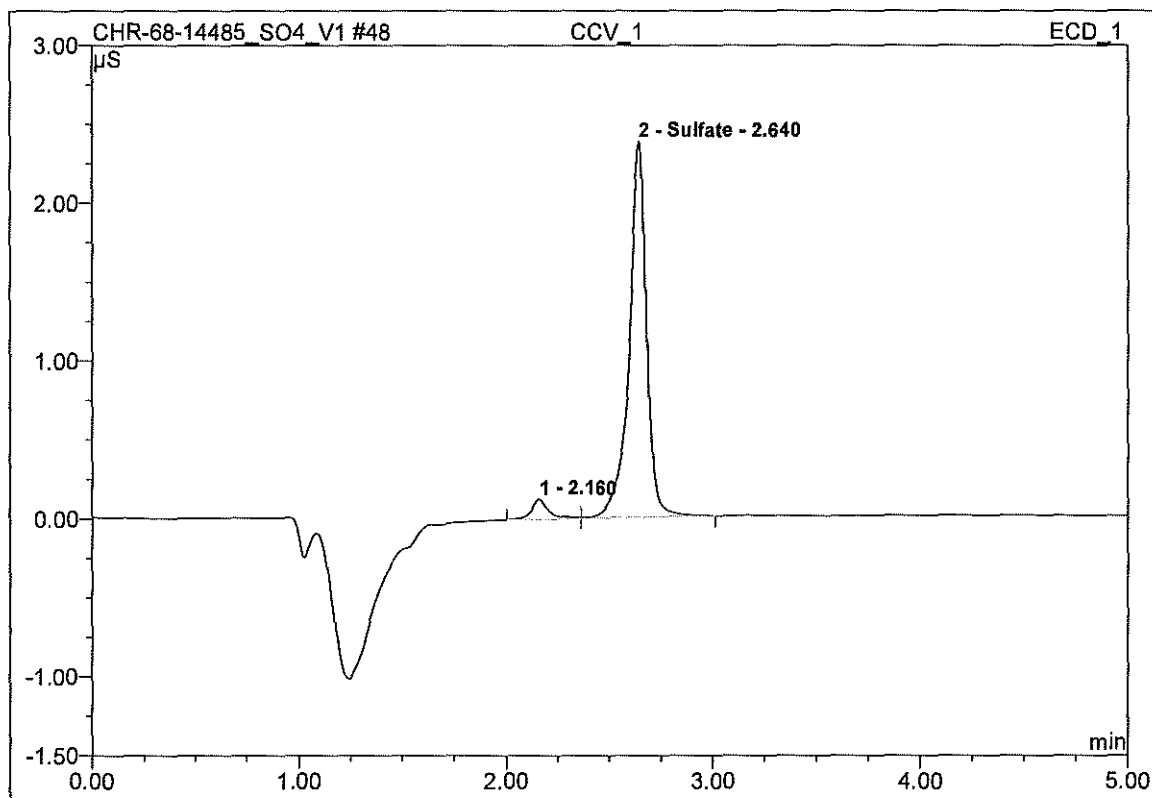
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.65	Sulfate	2.216	0.216	100.00	n.a.	BMB
Total:			2.216	0.216	100.00	0.000	

47 QC_2			
Clean Air			
Sample Name:	QC_2	Injection Volume:	1.0
Vial Number:	41	Channel:	ECD_1
Sample Type:	validate	Wavelength:	n.a.
Control Program:	AS40-5inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:31	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



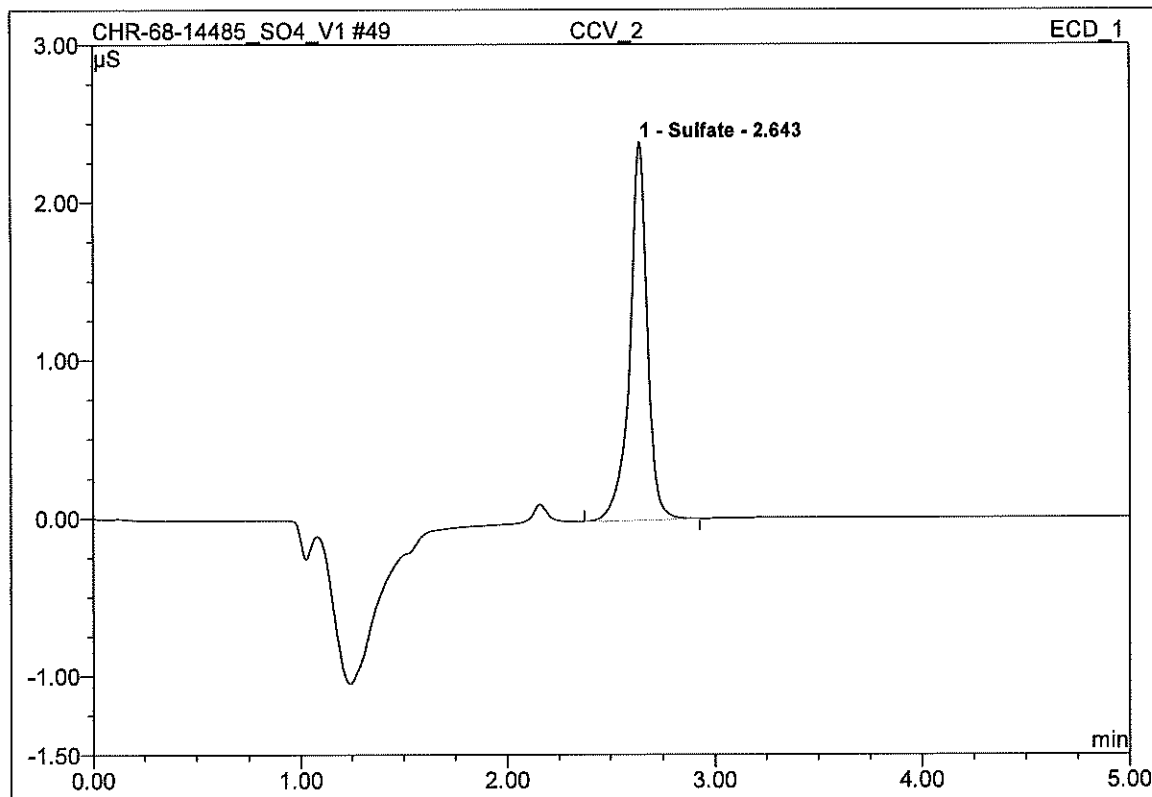
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.160	0.015	6.21	n.a.	BM
2	2.64	Sulfate	2.233	0.222	93.79	n.a.	MB
Total:			2.393	0.236	100.00	0.000	

48 CCV_1			
Clean Air			
Sample Name:	CCV_1	Injection Volume:	1.0
Vial Number:	42	Channel:	ECD_1
Sample Type:	validate	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:36	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



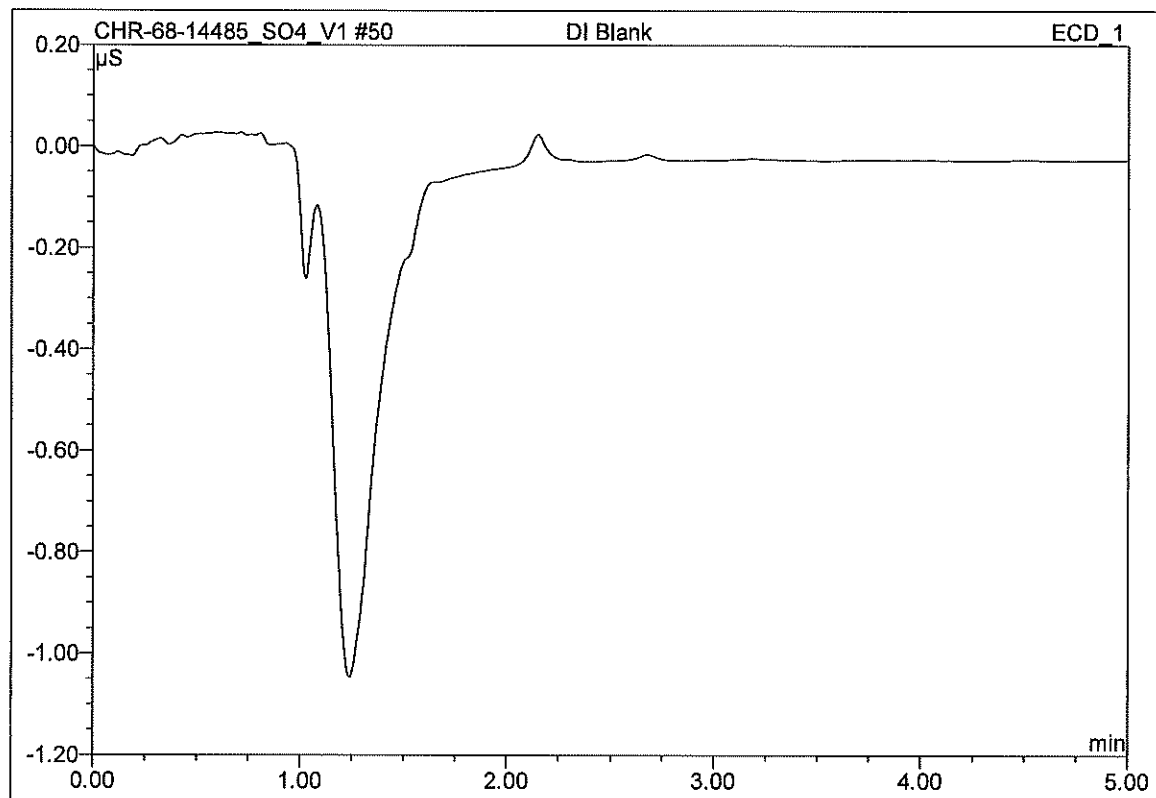
No.	Ret.Time min	Peak Name	Height μS	Area $\mu\text{S}\cdot\text{min}$	Rel.Area %	Amount	Type
1	2.16	n.a.	0.128	0.012	5.00	n.a.	BM
2	2.64	Sulfate	2.382	0.235	95.00	n.a.	MB
Total:			2.510	0.247	100.00	0.000	

49 CCV_2			
Clean Air			
Sample Name:	CCV_2	Injection Volume:	1.0
Vial Number:	43	Channel:	ECD_1
Sample Type:	validate	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:41	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



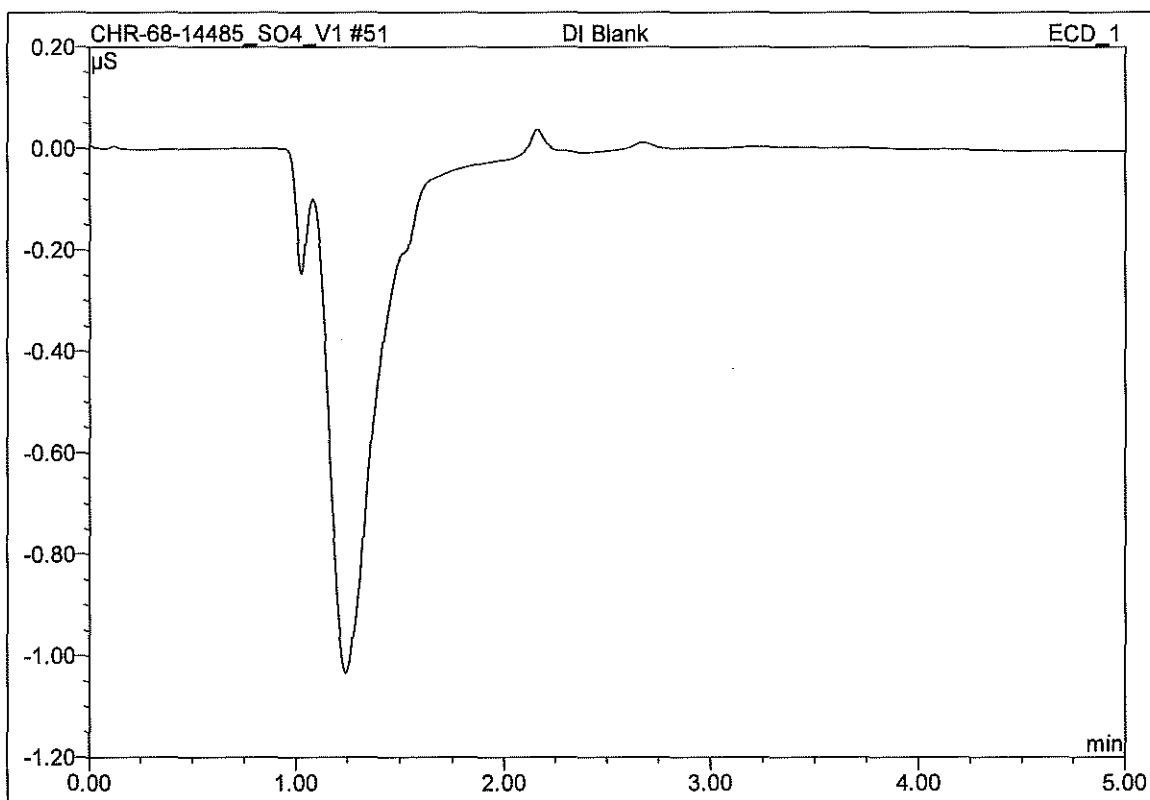
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	2.397	0.235	100.00	n.a.	BMB
Total:			2.397	0.235	100.00	0.000	

50 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	44	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:46	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



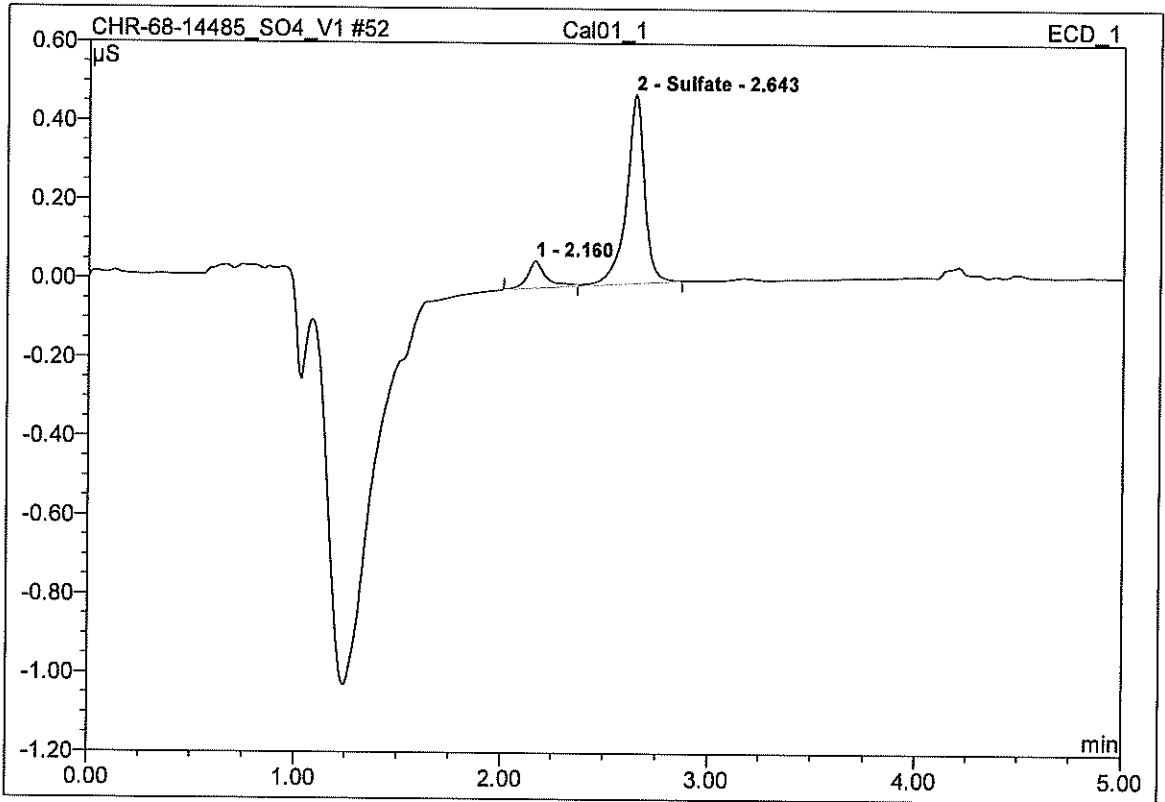
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

51 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	45	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:51	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



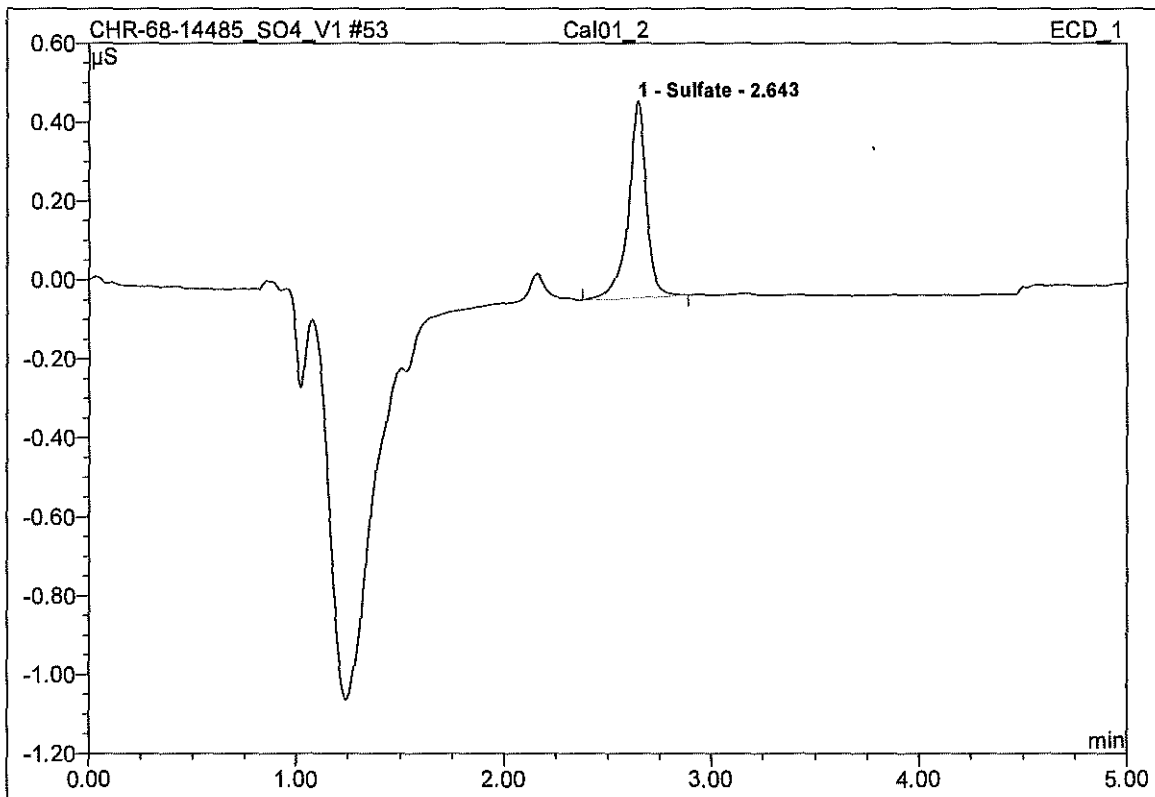
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

52 Cal01_1			
Clean Air			
Sample Name:	Cal01_1	Injection Volume:	1.0
Vial Number:	46	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 14:57	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



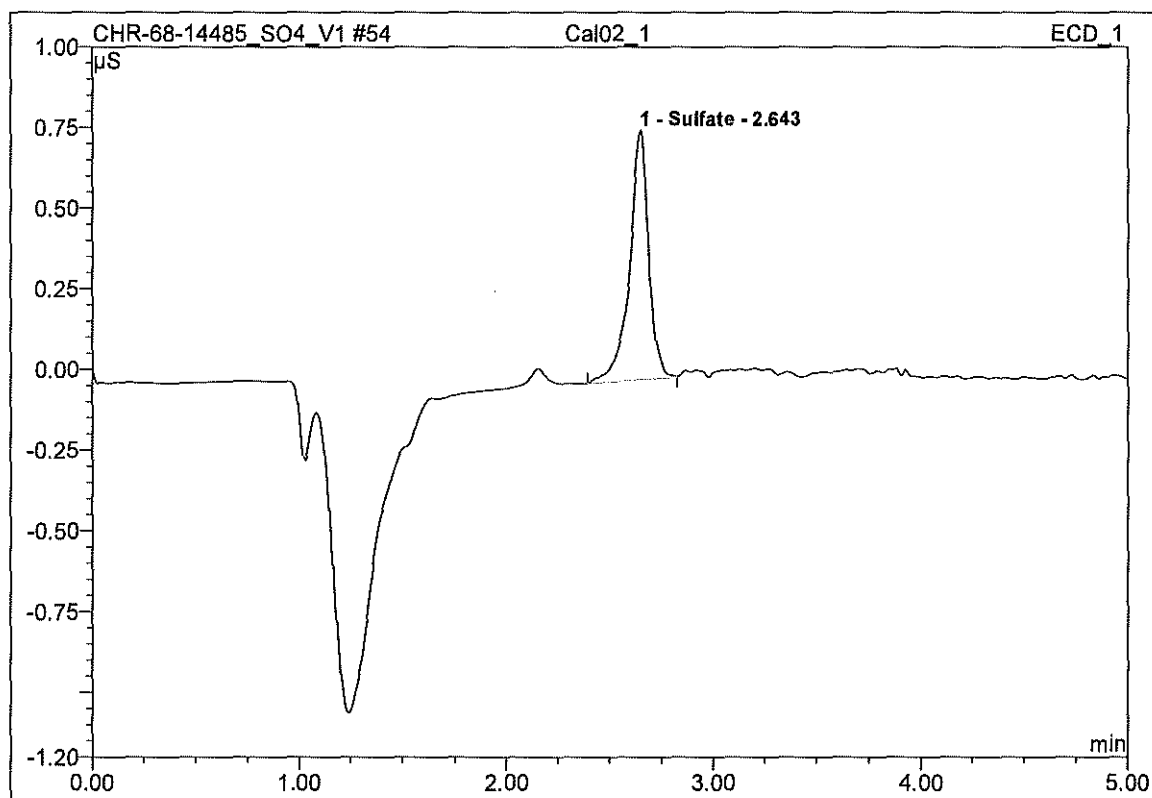
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.16	n.a.	0.067	0.007	11.83	n.a.	Ru
2	2.64	Sulfate	0.477	0.049	88.17	n.a.	BMB
Total:			0.544	0.056	100.00	0.000	

53 Cal01_2			
Clean Air			
Sample Name:	Cal01_2	Injection Volume:	1.0
Vial Number:	47	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:02	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



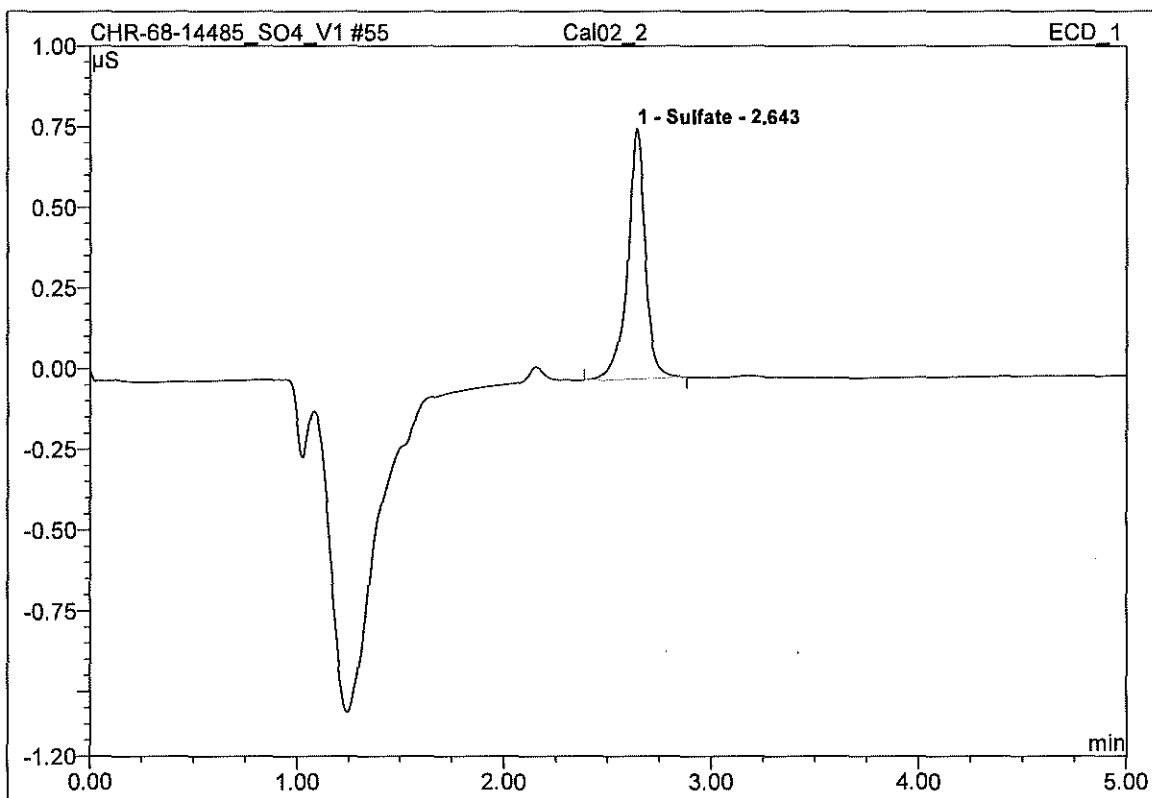
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	0.497	0.051	100.00	n.a.	BMB
Total:			0.497	0.051	100.00	0.000	

54 Cal02_1			
Clean Air			
Sample Name:	Cal02_1	Injection Volume:	1.0
Vial Number:	48	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:07	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



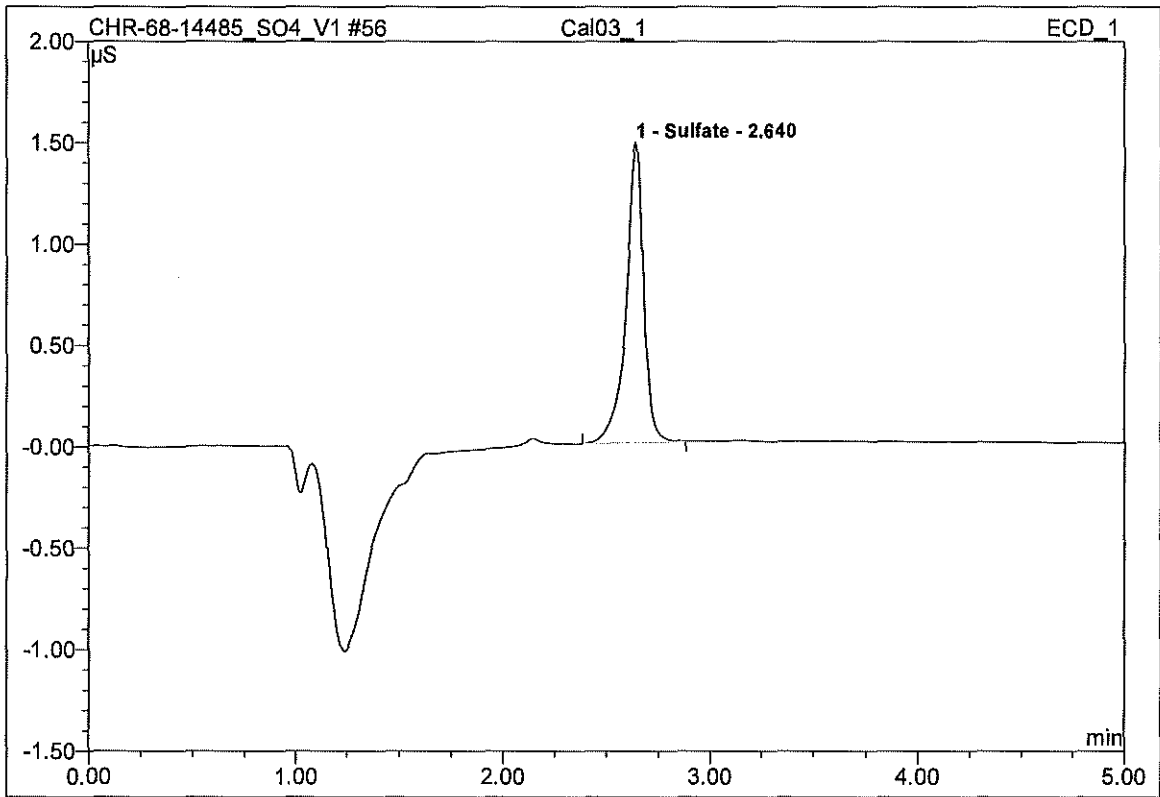
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	0.772	0.082	100.00	n.a.	BMB
Total:			0.772	0.082	100.00	0.000	

55 Cal02_2			
Clean Air			
Sample Name:	Cal02_2	Injection Volume:	1.0
Vial Number:	49	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:12	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



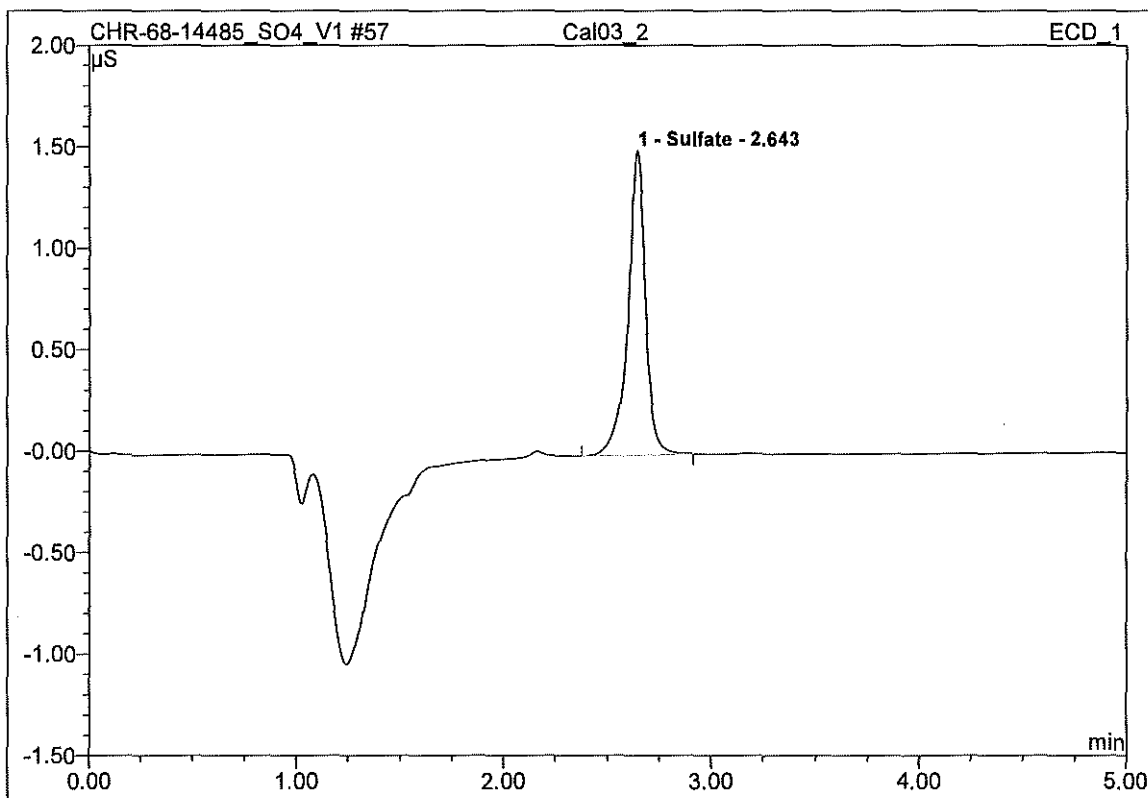
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	0.775	0.077	100.00	n.a.	BMB
Total:			0.775	0.077	100.00	0.000	

56 Cal03_1			
Clean Air			
Sample Name:	Cal03_1	Injection Volume:	1.0
Vial Number:	50	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:17	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



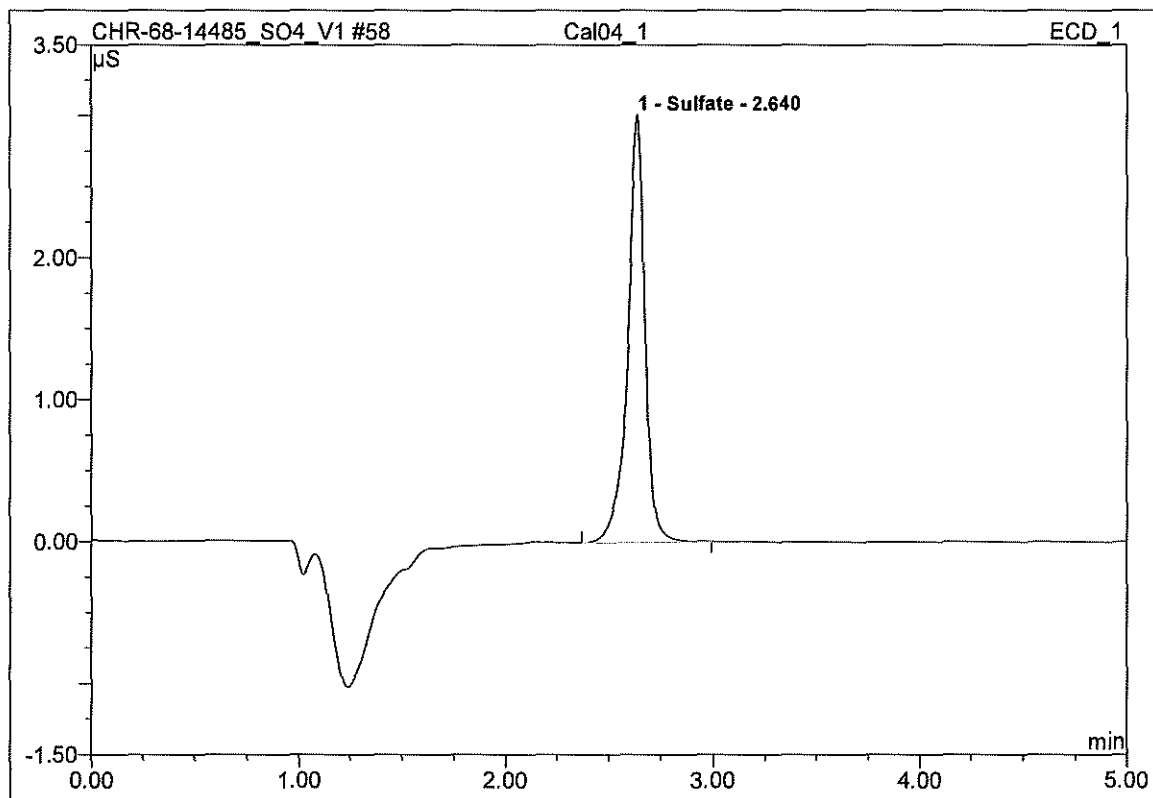
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	1.481	0.145	100.00	n.a.	BMB
Total:			1.481	0.145	100.00	0.000	

57 Cal03_2			
Clean Air			
Sample Name:	Cal03_2	Injection Volume:	1.0
Vial Number:	51	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:22	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



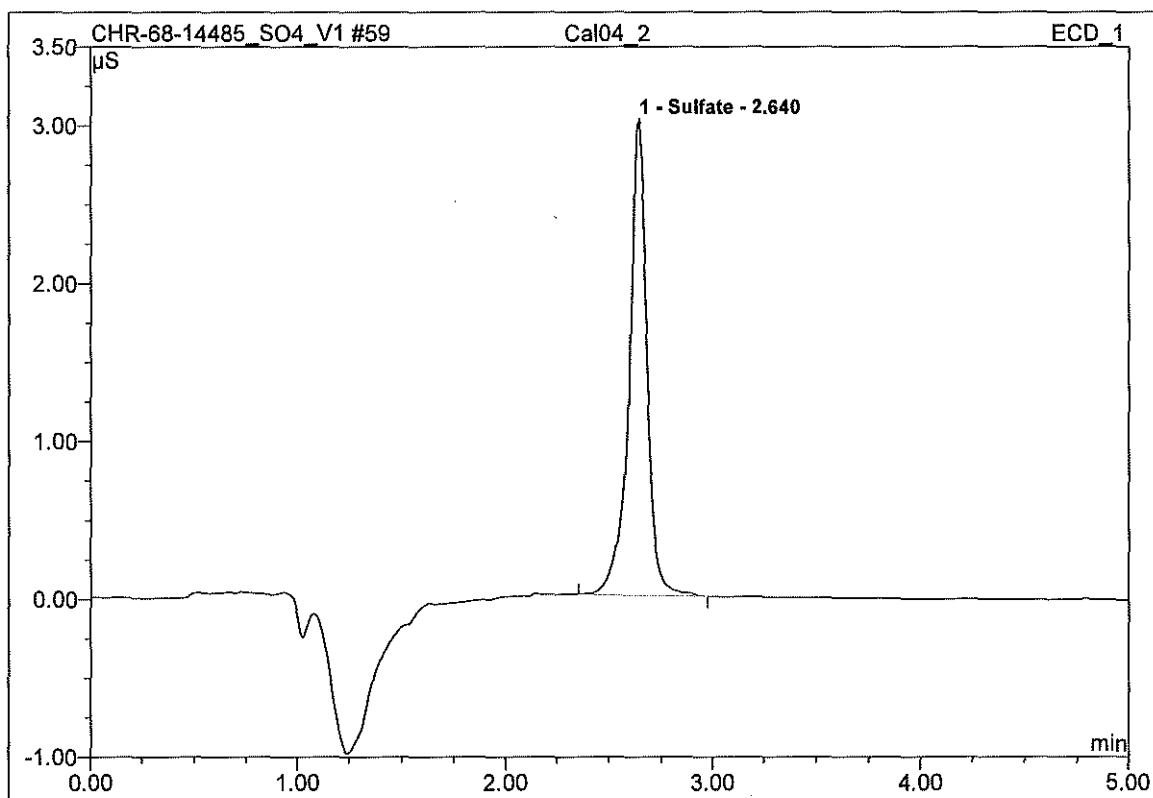
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	1.501	0.148	100.00	n.a.	BMB
Total:			1.501	0.148	100.00	0.000	

58 Cal04_1			
Clean Air			
Sample Name:	Cal04_1	Injection Volume:	1.0
Vial Number:	52	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:27	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



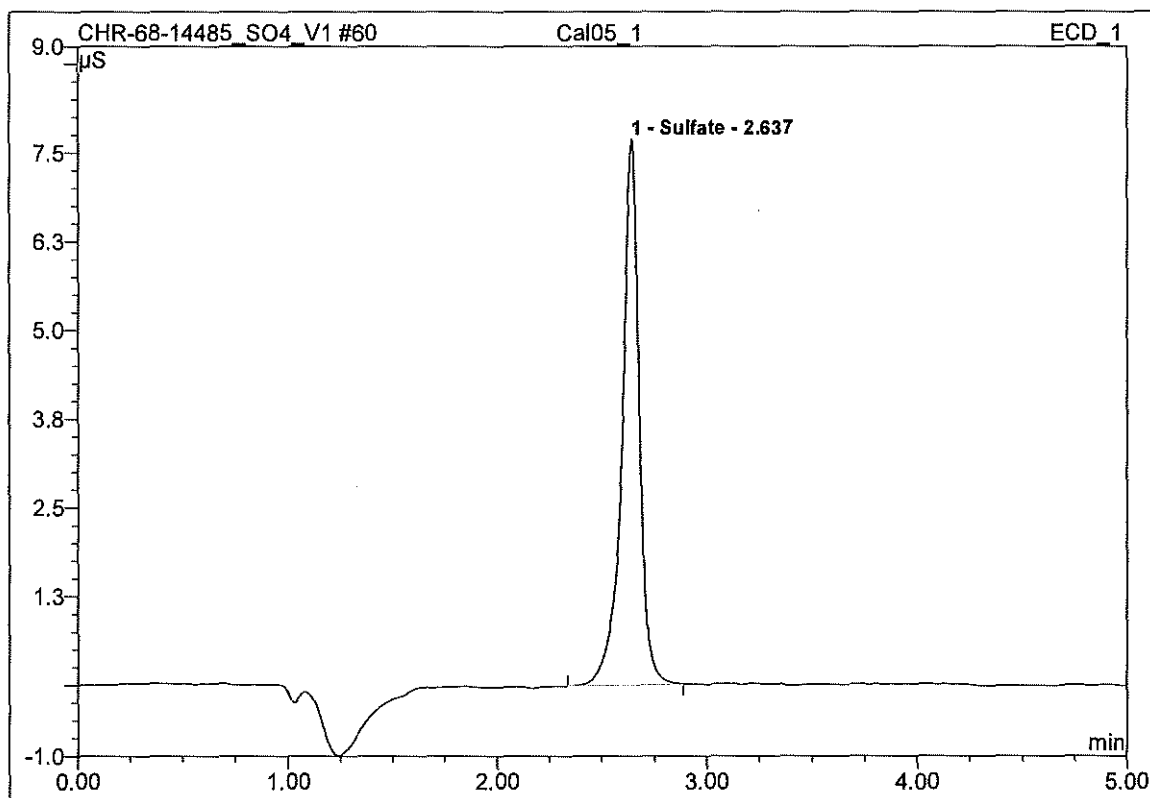
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	3.010	0.293	100.00	n.a.	BMB
Total:			3.010	0.293	100.00	0.000	

59 Cal04_2			
Clean Air			
Sample Name:	Cal04_2	Injection Volume:	1.0
Vial Number:	53	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:32	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



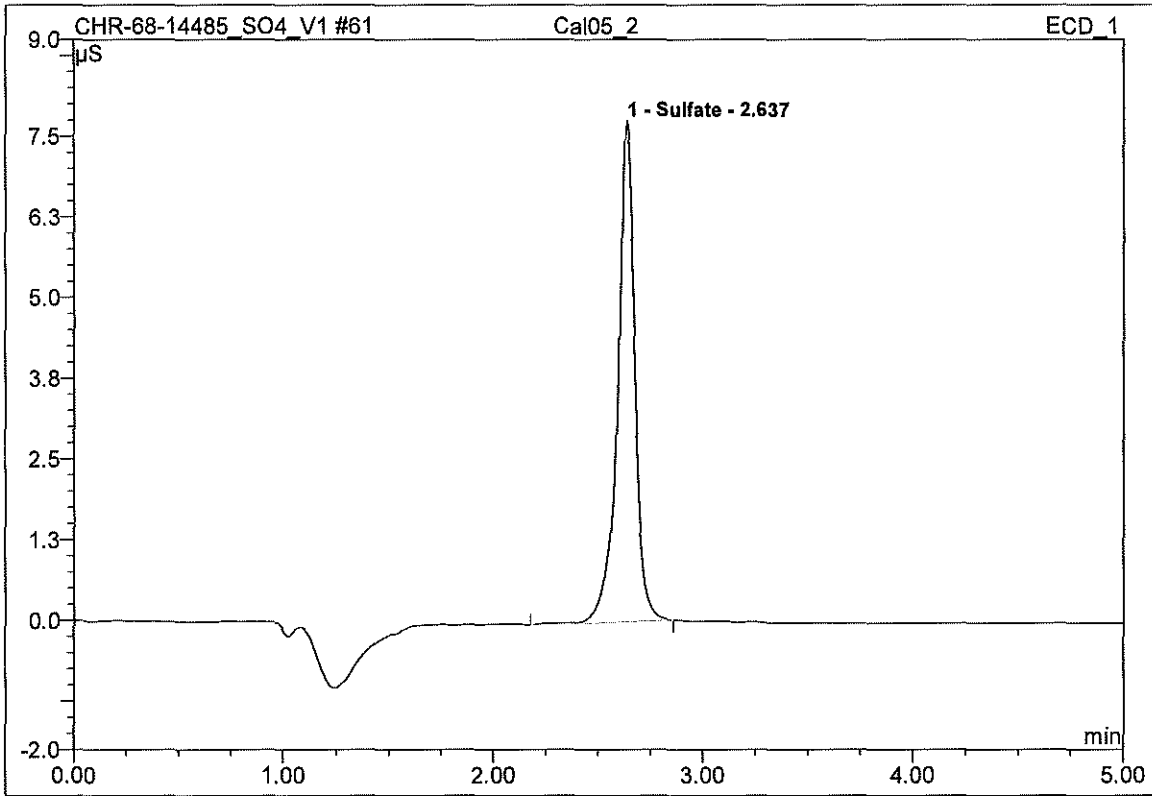
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	3.023	0.299	100.00	n.a.	BMB
Total:			3.023	0.299	100.00	0.000	

60 Cal05_1			
Clean Air			
Sample Name:	Cal05_1	Injection Volume:	1.0
Vial Number:	54	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:37	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



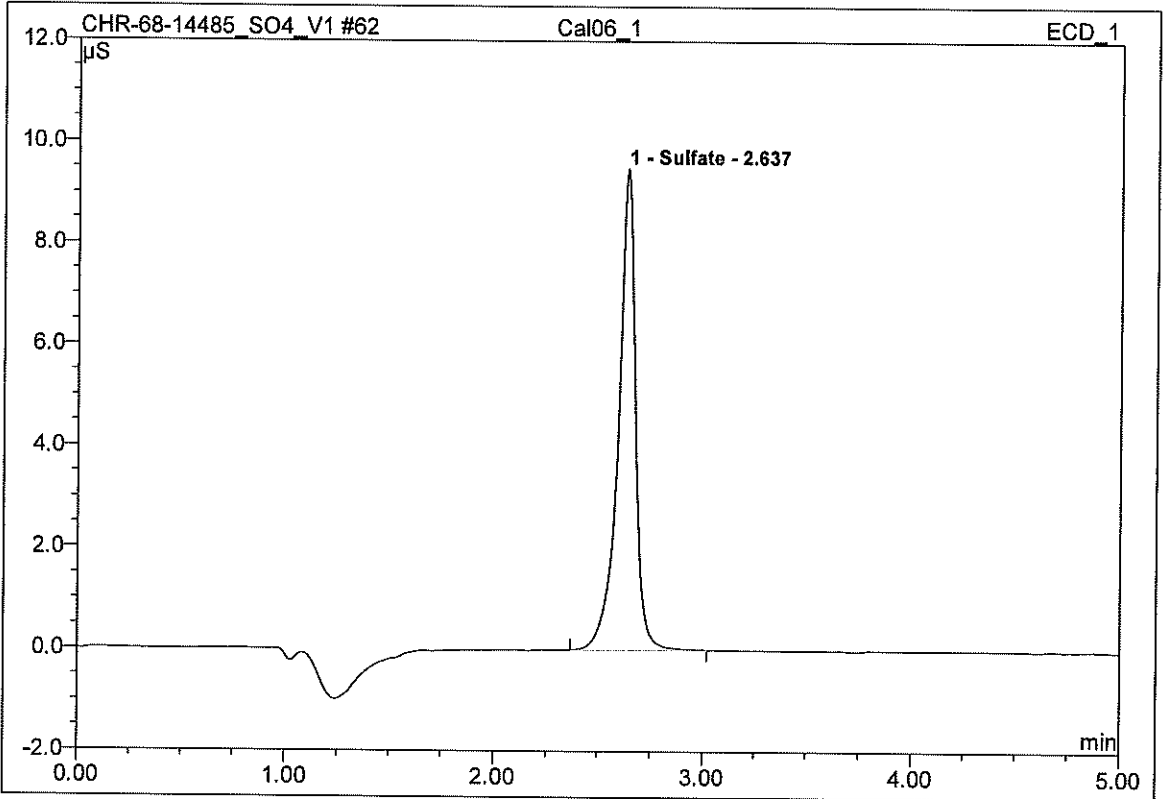
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	7.691	0.734	100.00	n.a.	BMB
Total:			7.691	0.734	100.00	0.000	

61 Cal05_2			
Clean Air			
Sample Name:	Cal05_2	Injection Volume:	1.0
Vial Number:	55	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:43	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



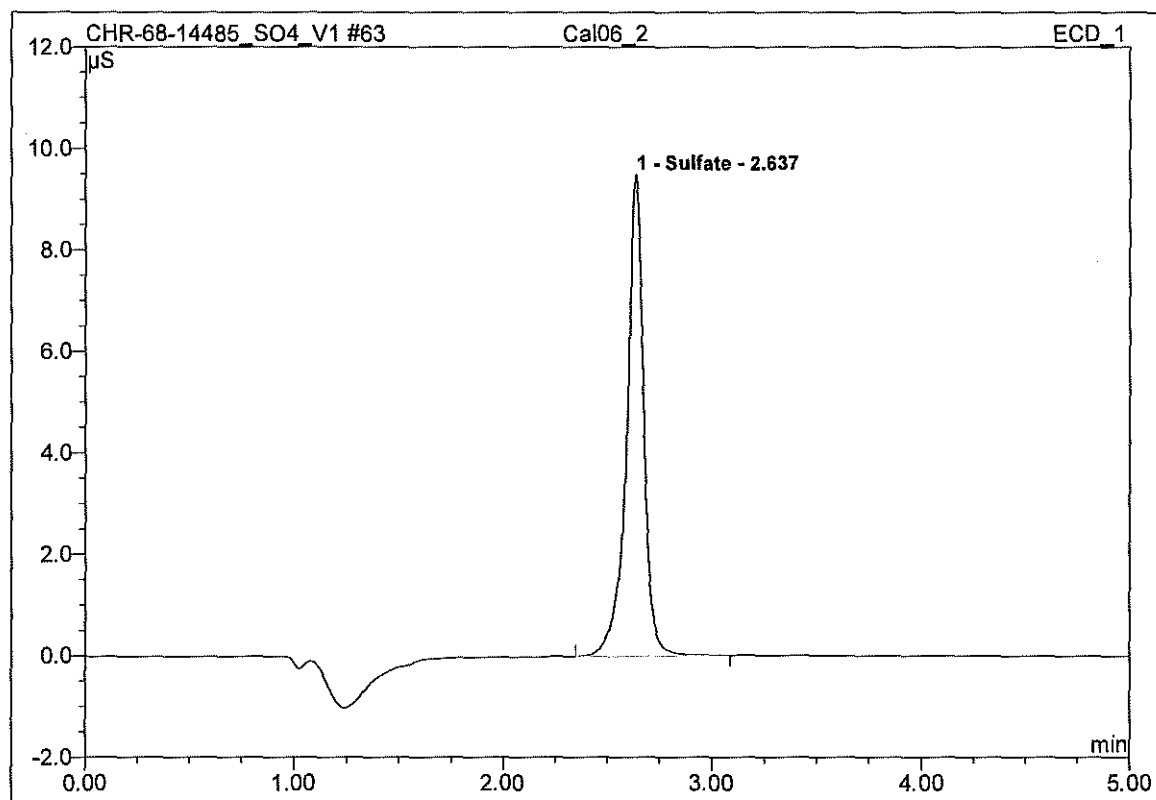
No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	7.753	0.739	100.00	n.a.	BMB
Total:			7.753	0.739	100.00	0.000	

62 . Cal06_1			
Clean Air			
Sample Name:	Cal06_1	Injection Volume:	1.0
Vial Number:	56	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:48	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



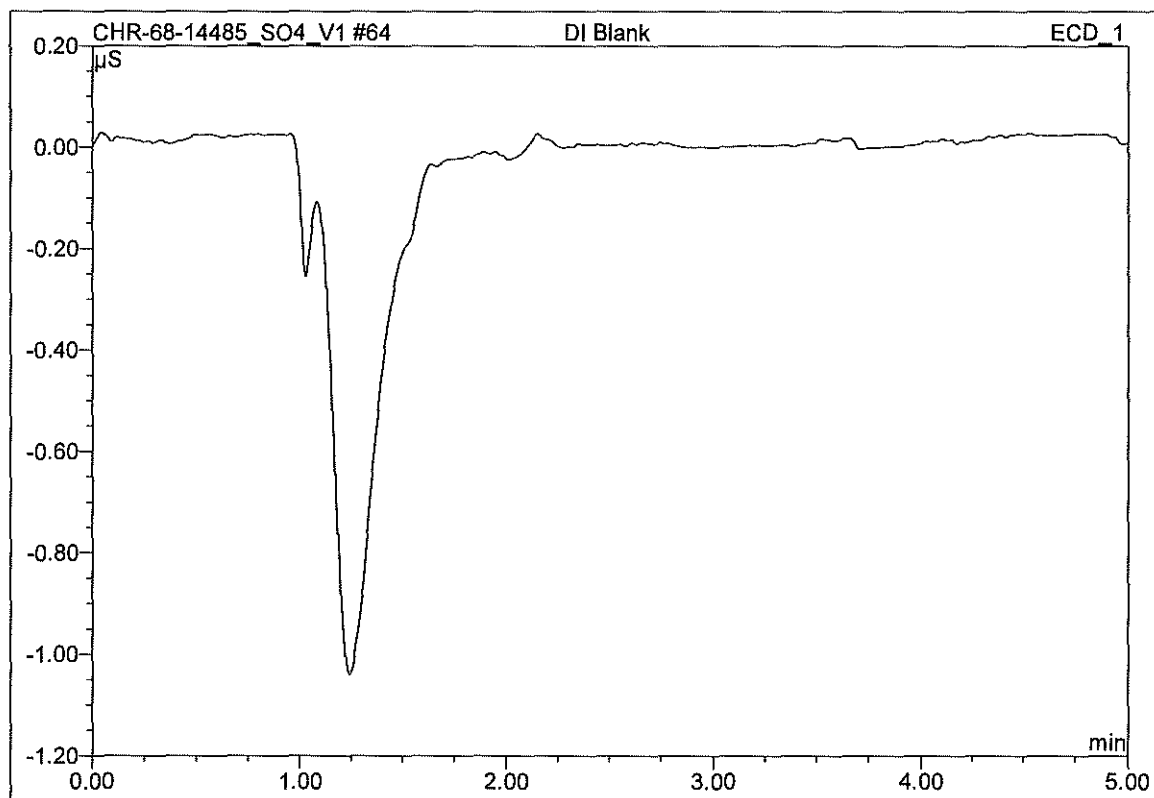
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	9.488	0.901	100.00	n.a.	BMB
Total:			9.488	0.901	100.00	0.000	

63 Cal06_2			
Clean Air			
Sample Name:	Cal06_2	Injection Volume:	1.0
Vial Number:	57	Channel:	ECD_1
Sample Type:	standard	Wavelength:	n.a.
Control Program:	AS40-5Inj2	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:53	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



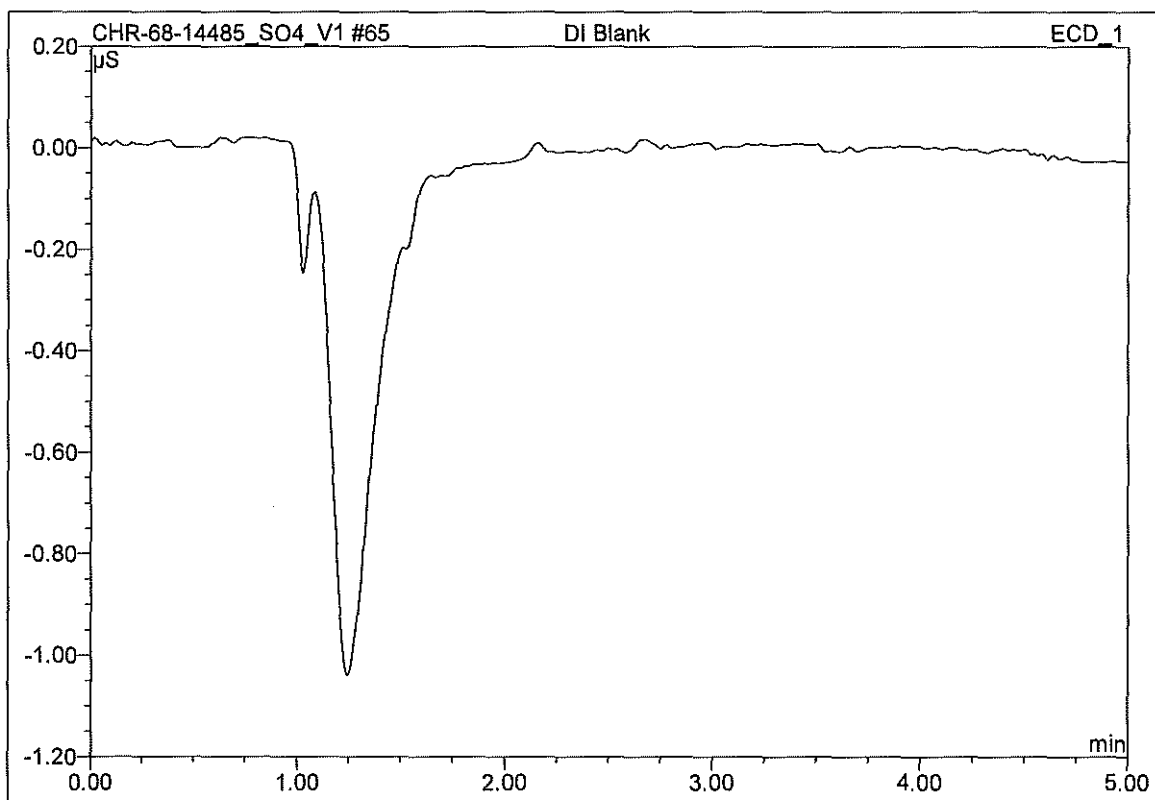
No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
1	2.64	Sulfate	9.491	0.905	100.00	n.a.	BMB
Total:			9.491	0.905	100.00	0.000	

64 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	58	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 15:58	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



No.	Ret.Time min	Peak Name	Height μS	Area μS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

65 DI Blank			
Clean Air			
Sample Name:	DI Blank	Injection Volume:	1.0
Vial Number:	59	Channel:	ECD_1
Sample Type:	blank	Wavelength:	n.a.
Control Program:	AS40-5Inj1	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 16:03	Sample Weight:	1.0000
Run Time (min):	5.00	Sample Amount:	1.0000



No.	Ret.Time min	Peak Name	Height µS	Area µS*min	Rel.Area %	Amount	Type
Total:			0.000	0.000	0.00	0.000	

66 END			
Clean Air			
Sample Name:	END	Injection Volume:	1.0
Vial Number:	60	Channel:	n.a.
Sample Type:	blank	Wavelength:	n.a.
Control Program:	End	Bandwidth:	n.a.
Quantif. Method:	default	Dilution Factor:	1.0000
Recording Time:	10/5/2021 16:08	Sample Weight:	1.0000
Run Time (min):	n.a.	Sample Amount:	1.0000

CHR-68-14485_SO4_V1 #66	END	ECD 1
Can't open raw data file "C:\Chromel\data\08011110_1\2_Data\14485\CHR-68-14485_SO4_V1.SEQ\ ECD_1.CH13657.acd". The system cannot find the file specified.		

n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	n.a.		n.a.	n.a.	n.a.	n.a.	
Total:			0.000	0.000	0.00	0.000	

APPENDIX J: AUDIT SAMPLE REPORT



**Josh Lord
Clean Air Engineering
110 Technology Drive
Pittsburgh, PA 15275
USA**

092321K



Final Report

Stationary Source Audit Program

Project # :092321K



A Waters Company

October 6, 2021

Josh Lord
Clean Air Engineering
110 Technology Drive
Pittsburgh, PA 15275

Enclosed is your final report for ERA's Stationary Source Audit Sample (SSAS) Program. Your final report includes an evaluation of all results submitted by your laboratory to ERA.

Data Evaluation Protocols: All analytes in ERA's SSAS Program have been evaluated comparing the reported result to the acceptance limits generated using the criteria contained in the TNI SSAS Table.

For any "Not Acceptable" results, please contact your state regulator for any corrective action requirements.

Thank you for your participation in ERA's SSAS Program. If you have any questions, please contact our Proficiency Testing Department at 1-800-372-0122.

Sincerely,

A handwritten signature in black ink, appearing to read "Matthew Seebeck", is written over a horizontal line.

Matthew Seebeck
Quality Officer

cc: Project File Number 092321K





A Waters Company

Recipient Type	Report Recipient	Contact	Project ID
Agency	MI DEQ - Detroit Field Office(SSAS) 3058 Grand Blvd. Cadillac Place Suite 3-200 Detroit, MI 48211 USA	Mark Dziadosz dziadoszm@michigan.gov Phone: 586-753-3745	
Facility	Guardian Industries 14600 Romine Rd Carleton, PA 48117 USA	Ben Kroeger benjamin.kroeger@guardian.com Phone: 734-654-4430	
Lab	Clean Air Engineering 110 Technology Drive Pittsburgh, PA 15275 USA	Josh Lord Lab Analyst jchilders@cleanair.com Phone: (412) 266-4098	
Tester	Clean Air Engineering 110 Technology Dr Pittsburgh, PA 15275 USA	Josh Lord Lab Analyst jchilders@cleanair.com Phone: (412) 266-4098	14485





A Waters Company

092321K Laboratory Exception Report

Josh Lord
Lab Analyst
Clean Air Engineering
110 Technology Drive
Pittsburgh, PA 15275
(412) 266-4098

EPA ID:
ERA Customer Number:

Not Reported
C487979

Not Acceptable Evaluations

There were no Not Acceptable evaluations for this study.



All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01

16341 Table Mountain Pkwy • Golden, CO 80403 • 800.372.0122 • 303.431.8454 • fax 303.421.0159 • www.eraqc.com

Project # : 092321K






Final Report Results For Laboratory Clean Air Engineering



All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01

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Project # : 092321K 



A Waters Company

SSAP Final Evaluation Report

Project Number: 092321K

ERA Customer Number: C487979

Laboratory Name: Clean Air Engineering

Inorganic Results

All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01

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Project # : 092321K





092321K Evaluation Final Complete Report

A Waters Company

Josh Lord
Lab Analyst
Clean Air Engineering
110 Technology Drive
Pittsburgh, PA 15275
(412) 266-4098

EPA ID:
ERA Customer Number:

Not Reported
C487979

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Analyst Name
<i>SSAP Sulfuric Acid/Sulfur Dioxide in Impinger Solution (cat# 1444, lot# 092321K) Study Dates: 09/23/2021 - 10/06/2021</i>									
4020	H2SO4	mg/dscm	55.169	55.2	49.7 - 60.7	Acceptable	EPA 8 (Titration) 2000	10/5/2021	

All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01

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Project # : 092321K

APPENDIX K: CLEANAIR RESUMES AND CERTIFICATIONS

Josh Childers, PE

PROFESSIONAL PROFILE

Mr. Childers has twelve years of experience as a Field Engineer, Field Test Leader and Project Manager for Clean Air Engineering in over 30 states and 13 countries. He has been involved with equipment servicing, calibration and design/fabrication. Field Test Leader experience has included field crew supervision and safety, project execution, data reduction, sample preparation and client coordination. He has been involved in all phases of project management including, but not limited to, proposal and protocol development, test schedule coordination, test plan creation and report submittal. Methodology experience includes USEPA Methods 1 through 29, as well as Methods 30B, 30B Modified (speciated mercury), 201A, 202, 320 and 321 including various CTM, OTM and ALT methods.

Additional experience includes generation of test protocols, coordination with Client and local regulatory agencies for protocol approval and project scheduling, and development of SOPs and Guidance Documents for FTIR and high pressure testing. This includes creation of reporting templates for data reduction and project discussion for EPA Method 320/ASTM D6348.

PROJECT EXPERIENCE

FTIR/CEMS Diagnostic & Engineering Studies

Xcel Energy; Hayden Generating Station; Unit 2 SCR Outlet; Hayden, Colorado.

Project Manager and Field Test Leader. The objective of this project was to perform diagnostic guarantee testing for ammonia slip and NOx distribution at a newly installed SCR Outlet. FTIR measurements were used with a specially designed and passivated sampling system to perform analyte traverses. Data was used to create plots for NH₃, NOx, SO₂, CO, H₂O, O₂ and CO₂. Other analytes were monitored but not required for the guarantee testing. Data was provided on-site to the client to validate performance criteria and forgo wet method testing as validation.

Mr. Childers has planned and executed real-time measurement projects utilizing an FTIR and CEMS (including mercury) on several different process types measuring a wide range of analytes. Field validation of the method setup (Method 301) and field calculations for minimum detection limits/uncertainties are performed on each project to ensure high quality data and low residuals across the IR spectrum. FTIR test data has been validated by concurrent wet method or thermal oxidation test data.

Additional studies include:

- Xcel Energy; Hayden Generating Station; Unit 1 SCR Outlet; Hayden, Colorado
- Cormetech Inc.; Suez Energy Generation NA; Ennis, Texas
- Chemours & DuPont, Washington Works; Washington, West Virginia
- Cone Midstream Partners LP; Compressor Stations; West Virginia & Pennsylvania
- AMEX Power and Process America; Bremono Bluff Generating Station; Bremono Bluff, Virginia
- Wärtsilä Finland Oy; Bermeo Test Facility; Bermeo, Spain
- Holcim (US) Inc, Kiln Stack; Hagerstown, Maryland
- General Electric Power Generation; Rhodes, Greece
- General Electric Power Generation, Ghorashal Power Plant; Ghorashal, Bangladesh
- Engen Petroleum LTD.; Engen Refinery; Wentworth, South Africa

High Pressure-High Temperature Refinery Testing

Shell; Deer Park Refinery; FCC Unit; Deer Park, Texas

Project Manager and Field Test Leader. The purpose of this test program was to perform isokinetic measurements at various points along the process including the TSS Inlet, Outlet and Underflow. This data was required to provide particulate concentration, mass loading, particle size distribution data and volumetric flow rate results in order to inspect efficiency of the process operations. Project objectives were completed, and results were sent to laboratories for further analysis.

Additional high pressure project examples include:

- Gestor Contratos TSA PCS; Refineria de Cartagena (Reficar); Cartagena, Colombia
- Technip; GALP Energia – Sines Refinery; Sines, Portugal
- R.A.M; Raffineria di Milazzo; Milazzo, Italy
- CEPESA; Refineria de Gibraltar-San Roque; San Roque, Spain
- INA; Rijeka Refinery; Zagreb, Croatia
- Reliant Industries; Jamnagar Refinery; Jamnagar, India.
- Preem Petroleum, Lysekil Refinery; Västra Götaland, Sweden
- CTCl Corporation, CPC Talin RFC: Kaohsiung, Taiwan
- SASOL Synfuels, SCC; Secunda, South Africa
- Envirox, NATREF FCCU: Sasolburg, South Africa

Compliance Projects

Covanta Energy; Essex County Resource Recovery Facility; Newark, New Jersey.

Project Manager and Field Test Leader. The purpose of this test program was to complete regulatory compliance testing at a municipal waste incinerator. Compliance testing was performed on multiple units and at inlet/stack locations. Measurements included HCl, Dioxin/Furans, Ammonia and Mercury/Metals. Testing was performed in the presence of New Jersey DEP.

Additional compliance project examples include:

- Arrow Material Services; Barge Loading Operations Flare; Belpre, Ohio
- CEMEX; Kiln Stacks; Odessa, Texas
- DTE Energy, EES Coke Battery – Zug Island; Underfire Combustion Stack; Detroit, Michigan
- DTE Energy, EES Coke Battery – Zug Island; PECS Stack; Detroit, Michigan
- Covanta Energy; Camden County Energy Recovery Center; Camden, New Jersey.
- First Energy Corporation, Bayshore Power Plant; Oregon, Ohio
- Holcim (US) Inc, Kiln Stack; Hagerstown, Maryland
- Eastern Kentucky Power Cooperative, Spurlock Generating Station; Maysville, Kentucky
- Proctor and Gamble Paper Products, Mehoopany, Pennsylvania
- Severstal Wheeling, Inc., Mountain State Carbon, LLC

CONFERENCES AND PRESENTATIONS

PIOGA Air Quality Compliance Training – May 2016

- Presenter of “A Field Guide to Subpart OOOO Testing”

PIOGA Air Quality Compliance Training – December 2016

- Presenter of “A Field Guide to Subpart OOOOa Testing”

Dry Hydrate Users Group – March 2017

- Presenter of “Review of Dry Sorbent Injection Performance Test Methodology and Capture Results at Coal-Fired Electric Generating Units”

Dry Hydrate Users Group & Stationary Source Sampling and Analysis for Air Pollutants – March 2018

- Presenter of “Review of Best Practices to Improve Particulate Matter Sampling”

Dry Hydrate Users Group – February 2019

- Presenter of “DSI Performance Test Methodology”

Stationary Source Sampling and Analysis for Air Pollutants – April 2019

- Presenter of “FTIR Best Practices”
- Chair of “Refining and Chemical Sectors” Session

Stationary Source Sampling and Analysis for Air Pollutants – April 2020

- Chair of “Emerging Compounds” Session

PROFESSIONAL CERTIFICATIONS AND LICENSES

Professional Engineer (PE)

- Commonwealth of Pennsylvania – License Number PE091554
- State of Washington – License Number 20110720

Qualified Source Testing Individual (QSTI) Test Exams (Certificate No. 2011-547):

- Group I (Manual Gas Volume and Flow Measurements and Isokinetic Particulate Sampling Methods)
- Group II (Manual Gaseous Pollutants Source Sampling Methods)
- Group III (Gaseous Pollutants Source Sampling Methods)
- Group IV ((Hazardous Metals Measurement Sampling Methods)

MKS FTIR Training Certificate (April 2019 and April 2016)

Project Management Institute (PMI) – Project Management Training (35-hour PDUs)

PROFESSIONAL AFFILIATIONS

Stack Testing Accreditation Council (STAC)

- Vice-Chairman

ASTM Workgroup – WK67126

- Committee Member/Contributor

EDUCATION

Bachelor of Science in Mechanical Engineering
Bachelor of Science in Aerospace Engineering
West Virginia University; Morgantown, West Virginia

SOURCE EVALUATION SOCIETY



Qualified Source Testing Individual

LET IT BE KNOWN THAT

JOSHUA A. CHILDERS

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 17TH DAY OF JANUARY 2019 AND EFFECTIVE UNTIL JANUARY 16TH, 2024

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

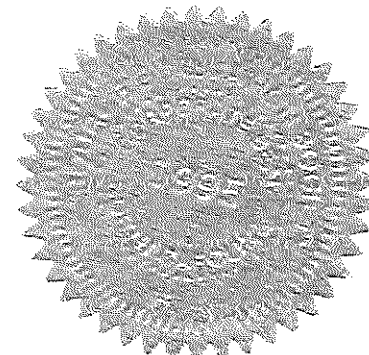
Tina Sanderson, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills, QSTI/QSTO Review Board

Bruce Randall, QSTI/QSTO Review Board

CERTIFICATE
NO.
2011-547



SOURCE EVALUATION SOCIETY



Qualified Source Testing Individual

LET IT BE KNOWN THAT

JOSHUA A. CHILDERS

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GASEOUS POLLUTANTS SOURCE SAMPLING METHODS

ISSUED THIS 1ST DAY OF NOVEMBER 2019 AND EFFECTIVE UNTIL OCTOBER 31ST, 2024

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

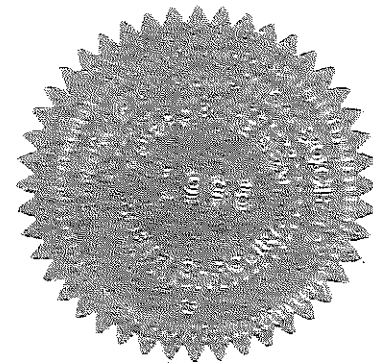
Tina Sanderson, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

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Bruce Randall QSTI/QSTO Review Board

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GASEOUS POLLUTANTS INSTRUMENTAL SAMPLING METHODS

ISSUED THIS 23RD DAY OF DECEMBER 2019 AND EFFECTIVE UNTIL DECEMBER 22ND, 2024

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

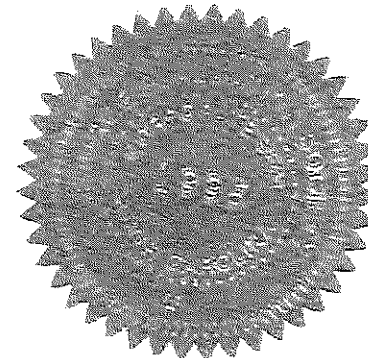
Tina Sanderson, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE
NO.
2011-547



SOURCE EVALUATION SOCIETY



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HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

HAZARDOUS METALS MEASUREMENT SAMPLING METHODS

ISSUED THIS 3RD DAY OF JULY 2020 AND EFFECTIVE UNTIL JULY 2ND, 2025

Peter R. Westlin, QSTI/QSTO Review Board

J. Wade Blce, QSTI/QSTO Review Board

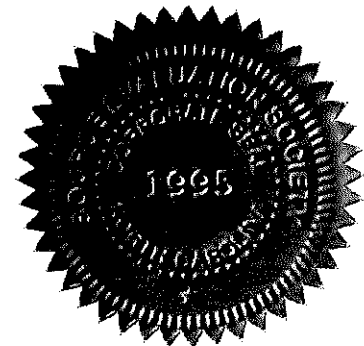
Peter S. Pakalnis, QSTI/QSTO Review Board

Karen D. Kajlya-Mills, QSTI/QSTO Review Board

Tina Sanderson, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE
NO.
2011-547



ERIC DOAK
Project Engineer / Project Manager

PROFESSIONAL PROFILE

Mr. Doak has over 22 years of experience in all aspects of environmental air testing involving compliance, diagnostic, guarantee, performance and experimental work. Responsibilities have included location leader, laboratory work/on-site analysis, job leading and report writing.

Mr. Doak has extensive experience in performing EPA Methods 1-4, 5, 5B, 5F,6, 6C, 7E, 8, 9, 10, 11, 12, 13B, 15A, 16A, 17, 18, 19, 20, 22, 23, 25, 25A, 26, 26 modified (ammonia), 26A, 29, 30B, 30B modified (speciated mercury), 101A, 104, 108, 201A, 202, 205, 301, 306, 316, 320; conditional test methods (CTM) 011, modified 013B/ASTM-CCM (Controlled Condensation Method), 027, ASTM_D6784 -02 (Ontario-Hydro Method), Solid Waste 846 methods 0010, 0011, 0061 and Performance Specifications (PS) 2, 3, 4, 4A, 8, 8A, 12B and 15.

Since 1994, he has been involved with projects at many different facilities including coal fired power plants, natural gas turbines, municipal waste incinerators, hazardous waste incinerators, cement kilns, steel mills, paper mills, oil refineries, chemical plants, biomass, Marcellus shale gas compressor stations and other specialty industries,

As a Project Engineer, Mr. Doak was the leader of many projects in the field working with clients and crew members to finish projects efficiently and safely as possible. Mr. Doak has been a Qualified Stack Testing Individual (QSTI) in Groups 1-4 for 10 years. He has also written site specific test plans, test protocols, cost estimates, proposals, test reports and performed on-site visits. In addition, Mr. Doak has also managed several smaller projects for the Eastern Region from writing the test plan to the final report.

As a lab technician, Mr. Doak has extensive laboratory experience, performing gravimetric analysis; sulfates and chlorides analysis by titration, ion specific electrode analysis for ammonia, as well as ion chromatography analysis for sulfate, chloride and ammonia. He also ran the Eastern Region laboratory from 1995 to 2001, where he was responsible for packing chemicals and glassware in addition to performing sample analysis and generating lab reports for a multitude of projects.

As a technician, Mr. Doak has performed instrument calibrations, equipment maintenance and repair and many continuous improvement projects. He has a wide array of experience with continuous emissions monitoring systems (CEMS), including the ECOM analyzer, Horiba -250 portable gas analyzer, FTIR MKS MG2000 analyzer and Clean Air's proprietary Multiple Access Sampling System (MASS) used for balancing a selective catalytic reduction (SCR) system. Along with the responsibilities mentioned above, Mr. Doak is the lead operator of Clean Air's acquired mercury IRM CEM. He has generated an operating manual and has provided training to individuals regarding its proper use.

Mr. Doak has also worked on many international projects, traveling to several countries including Philippines, Ghana, Trinidad, Hong Kong, Taiwan, Sweden and Canada.

PROJECT EXPERIENCE

Covanta Energy

Performed compliance testing on stack and inlet to SDA, visible emissions, field test leader, and manager of the field lab at over twenty municipal solid waste (MSW) incinerator facilities. A multitude of test methods were performed including EPA Methods 1-5, 6C, 7E, 9, 10, 12, 13B, 18, 22, 23/0010, 26, 29, 101A, 201A, 202 and SW-846 0061.

Bechtel Corporation, Mauban, Philippines

Performed compliance and guarantee testing on a pulverized coal-fired power plant. Responsibilities included air monitoring equipment and observation of opacity at various emissions sources.

China Light & Power (CLP), Tuen Mun Hong Kong

Performed guarantee testing on a coal-fired power plant. Performed Method 5B testing vertically with a 33 ft. probe with help from local plant workers.

Indiantown Cogeneration L.P., Indiantown, Florida

Performed visible emissions at various emissions sources, on-site ammonia slip results across SCR beds, three relative accuracy test audits (RATA) and coordinating PM on the stack. Also led a crew in performing the five-year compliance testing for the site.

Wheeling-Pittsburgh Steel Corporation, Steubenville, Ohio

Led a crew of seven and coordinated testing with 3 shift supervisors sequentially for PM testing at three different locations during the steel making process.

Babcock Borsig Power, Kentucky

Conducted testing program on ECOM-S+ analyzer at the inlet and outlet of an SCR bed to determine the effectiveness of the catalyst beds.

Mitsubishi Power, Florida Power and Light

Conducted CEMS and particulate testing used to tune three gas fired combustion turbines with a HRSG (Heat Recovery Steam Generator) and provided analysis and results for guarantee testing.

Columbia Gas, West Virginia

Conducted compliance testing on 4-stroke lean-burn compressor engines using CEMS and an FTIR.

PROFESSIONAL CERTIFICATIONS

Qualified Source Testing Individual (QSTI) Test Exams (Certificate No.2007-062):

- Group I (Manual Gas Volume and Flow Measurements and Isokinetic Particulate Sampling Methods)
- Group II (Manual Gaseous Pollutants Source Sampling Methods)
- Group III (Gaseous Pollutants Source Sampling Methods)
- Group IV ((Hazardous Metals Measurement Sampling Methods)

EDUCATION

Community College of Allegheny County
AS, Chemistry, 1989

Pennsylvania State University
Bachelor of Science in Chemical Engineering, 1992

SOURCE EVALUATION SOCIETY



Qualified Source Testing Individual

LET IT BE KNOWN THAT

ERIC C. DOAK

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 20TH DAY OF JANUARY 2017 AND EFFECTIVE UNTIL JANUARY 19TH, 2022

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakainis, QSTI/QSTO Review Board

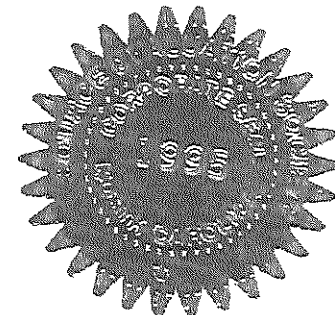
Theresa Lowe, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE
NO.
2007-062



SOURCE EVALUATION SOCIETY



Qualified Source Testing Individual

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ERIC C. DOAK

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED
EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES
ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GASEOUS POLLUTANTS SOURCE SAMPLING METHODS

ISSUED THIS 20TH DAY OF JANUARY 2017 AND EFFECTIVE UNTIL JANUARY 19TH, 2022

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

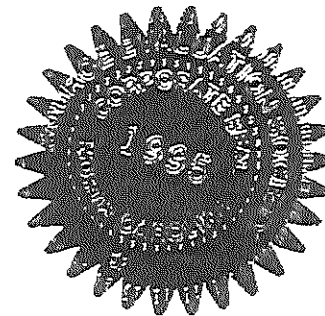
Theresa Lowe, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE
NO.
2007-062



SOURCE EVALUATION SOCIETY



Qualified Source Testing Individual

LET IT BE KNOWN THAT

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HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

GASEOUS POLLUTANTS INSTRUMENTAL SAMPLING METHODS

ISSUED THIS 28TH DAY OF OCTOBER 2016 AND EFFECTIVE UNTIL OCTOBER 27TH, 2021

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

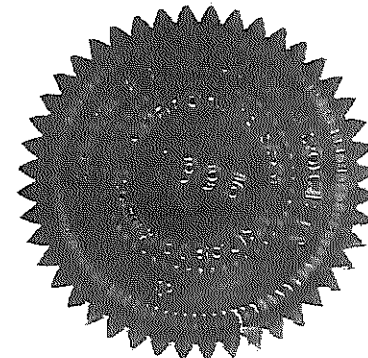
Theresa Lowe, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajlya-Mills, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE
NO.
2007-062



SOURCE EVALUATION SOCIETY



Qualified Source Testing Individual

LET IT BE KNOWN THAT

ERIC C. DOAK

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

HAZARDOUS METALS MEASUREMENT SAMPLING METHODS

ISSUED THIS 5TH DAY OF FEBRUARY 2021 AND EFFECTIVE UNTIL FEBRUARY 4TH, 2026

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Tina Sanderson, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE
NO.
2007-062





Jennifer L. Wright <jlwright@cleanair.com>

RE: SES Exam Results - Anthony Pallone

Robert Doran <rdoran@cleanair.com>
To: Anthony Pallone <ajpallone@cleanair.com>
Cc: Jennifer Wright <jlwright@cleanair.com>

Mon, Feb 10, 2020 at 1:10 PM

You did it! Congratulations!

- Rob

From: Anthony Pallone <ajpallone@cleanair.com>
Sent: Monday, February 10, 2020 1:09 PM
To: Robert Doran <rdoran@cleanair.com>
Subject: Fwd: SES Exam Results - Anthony Pallone

AJ Pallones Exam Results

Anthony Pallone
CleanAir Engineering, Inc.
110 Technology Drive | Pittsburgh, PA 15275
M: +1-724-681-8240 | cleanair.com

Begin forwarded message:

From: Theresa Lowe <tf_lowe@yahoo.com>
Date: February 7, 2020 at 6:32:51 PM EST
To: "ajpallone@cleanair.com" <ajpallone@cleanair.com>
Subject: **SES Exam Results - Anthony Pallone**
Reply-To: Theresa Lowe <tf_lowe@yahoo.com>

THIS EMAIL IS THE OFFICIAL NOTIFICATION OF YOUR SES QUALIFIED SOURCE TESTING INDIVIDUAL OR OBSERVER (QSTI/QSTO) EXAM(S) RESULTS (Please Print Out for Your Records)

To:	Anthony Pallone
Employed by:	Clean Air Engineering
Phone:	724-227-0275
Email:	ajpallone@cleanair.com

The Source Evaluation Society, through its contract with Eastern Technical Associates, has received the score of the exam(s) you completed on the date(s) as listed below. You are required to receive a score of 40 to pass an exam. As noted below, a "P" indicates you passed the exam, a "DNP" indicates that you did not pass the exam.

Group #	Exam	Date of Exam	Exam #	Score	Status
1	EPA Manual Gas Volume and Flow Measurements and Isokinetic Particulate Sampling Methods	1/10/20	15012	40	P

1A	Stack Gas Flow Rate Measurements Sampling Methods				
2	EPA Manual Gaseous Pollutants Source Sampling Methods				
3	EPA Gaseous Pollutants Instrumental Methods				
4	EPA Hazardous Metals Measurement Methods				
5	Part 75 CEMS RATA Testing				

NOTE: (1) The ECMPA AETB reporting requirements include a provision for an email address to be noted for the exam provider. Your exam provider is the Source Evaluation Society. Please use the following email address: qstiprogram@gmail.com. (2) Your exam score(s), per ASTM D7036-04, will be applicable for five years. You will need to re-take your exam(s) before expiration in order to maintain a current status. You are responsible for keeping track of scheduling for your re-test.

If you passed one or more exams, you are eligible to apply for your SES QSTI/QSTO qualification approval(s). To complete the qualification process, you will need to do the following: For New Applications / Additional Group Certificates / Renewals: Please check the SES Website (www.sesnews.org) under the link for the "SES QSTI/QSTO Program" for directions on how to apply for your certificate or contact Theresa Lowe at qstiprogram@gmail.com.

Please contact Theresa Lowe of SES (qstiprogram@gmail.com) with any questions about the exams. If you are interested in rescheduling the exam(s), please contact Kristy Radford or Janie Rose-Lofty of ETA (kristy@smokeschool.com; Janie@smokeschool.com)

All information regarding the QSTI/QSTO application process may be sent by email (which is the preferred and faster method) to qstiprogram@gmail.com, or mail your application to:
SES g P. O. Box 12124 g Research Triangle Park, NC g 27709-2124

Please let me know if you have any questions or if I can be of any assistance.

Theresa Lowe
SES QSTI/QSTO Review Committee Administrator



Jennifer L. Wright <jlwright@cleanair.com>

Fwd: SES Exam Results - Joshua Lord

1 message

Josh Lord <jlord@cleanair.com>
To: Robert Doran <rdoran@cleanair.com>, "Jennifer L. Wright" <jlwright@cleanair.com>

Mon, Nov 18, 2019 at 2:49 PM

Here are the results from the group 1 test!

----- Forwarded message -----
From: **Theresa Lowe** <tf_lowe@yahoo.com>
Date: Wed, Nov 13, 2019 at 8:33 PM
Subject: SES Exam Results - Joshua Lord
To: jlord@cleanair.com <jlord@cleanair.com>

THIS EMAIL IS THE OFFICIAL NOTIFICATION OF YOUR SES QUALIFIED SOURCE TESTING INDIVIDUAL OR OBSERVER (QSTI/QSTO) EXAM(S) RESULTS (Please Print Out for Your Records)

To:	Joshua Lord
Employed by:	Clean Air Engineering, Inc.
Phone:	724-227-0274
Email:	jlord@cleanair.com

The Source Evaluation Society, through its contract with Eastern Technical Associates, has received the score of the exam(s) you completed on the date(s) as listed below. You are required to receive a score of 40 to pass an exam. As noted below, a "P" indicates you passed the exam, a "DNP" indicates that you did not pass the exam.

Group #	Exam	Date of Exam	Exam #	Score	Status
1	EPA Manual Gas Volume and Flow Measurements and Isokinetic Particulate Sampling Methods	11/1/19	14981	40	P
1A	Stack Gas Flow Rate Measurements Sampling Methods				
2	EPA Manual Gaseous Pollutants Source Sampling Methods				
3	EPA Gaseous Pollutants Instrumental Methods				
4	EPA Hazardous Metals Measurement Methods				
5	Part 75 CEMS RATA Testing				

NOTE: (1) The ECMPs AETB reporting requirements include a provision for an email address to be noted for the exam provider. Your exam provider is the Source Evaluation Society. Please use the following email address: qstiprogram@gmail.com. (2) Your exam score(s), per ASTM D7036-04, will be applicable for five years. You will need to re-take your exam(s) before expiration in order to maintain a current status. You are responsible for keeping track of scheduling for your re-test.

If you passed one or more exams, you are eligible to apply for your SES QSTI/QSTO qualification approval(s). To complete the qualification process, you will need to do the following: For New Applications / Additional Group Certificates / Renewals: Please check the SES Website (www.sesnews.org) under the link for the "SES QSTI/QSTO Program" for directions on how to apply for your certificate or contact Theresa Lowe at qstiprogram@gmail.com.

Please contact Theresa Lowe of SES (qstiprogram@gmail.com) with any questions about the exams. If you are interested in rescheduling the exam(s), please contact Kristy Radford or Janie Rose-Lofty of ETA (kristy@smokeschool.com; Janie@smokeschool.com)

All information regarding the QSTI/QSTO application process may be sent by email (*which is the preferred and faster method*) to qstiprogram@gmail.com, or mail your application to:
SES g P. O. Box 12124 g Research Triangle Park, NC g 27709-2124

Please let me know if you have any questions or if I can be of any assistance.

Theresa Lowe
SES QSTI/QSTO Review Committee Administrator

--
Josh Lord Field Engineer/ Team Safety Leader

CleanAir Engineering, Inc.

110 Technology Drive | Pittsburgh, PA 15275

O: +1-724-227-0274 | C: +1-412-266-4098 | cleanair.com

This message contains information that may be confidential or privileged and is intended for the addressee. Any disclosure, dissemination, distribution or copying of this communication by persons other than the addressee is strictly prohibited. If you have received this message in error, please advise the sender by reply e-mail and delete all copies of this message and its attachments.



SOURCE
EVALUATION
SOCIETY

Name: Joshua M Lord
SES ID: DO NOT DISPLAY - 1470947
Test Name: GROUP 2
Test Date: 7/1/2021

On behalf of the Source Evaluation Society, we are pleased to inform you that you achieved a passing score on the Group 2 - EPA Manual Gaseous Pollutants Source Sampling Methods examination. The tables below show your overall score and performance in each content area of the exam.

Overall Test Results:

	Results
Your Score	45
Passing Score	40
Possible Score	50

Results By Domain:

Your performance in each content area or domain is based on small subsets of test questions and should be considered a rough estimate of your knowledge within each area.

Domain	Percent Correct
Fundamentals, test planning, test site preparation	75%
Method applicability and specifications, pollutants measured, interferences	87%
Sampling equipment preparation, calibration, operating procedures	92%
Isokinetic and proportional sampling, gas flow and emissions calculations	100%

* Percent Correct is the number of items answered correctly in a domain divided by the total number of scored items within that domain.

You are now eligible to apply for the SES QSTI/QSTO qualification approval(s). Please check the SES Website (www.sesnews.org) under the link for the "SES QSTI/QSTO Program" for directions on how to apply for your certificate or contact the SES QSTI Administrator at qstiprogram@gmail.com.

NOTE: (1) The ECMPS AETB reporting requirements include a provision for an email address to be noted for the exam provider. Your exam provider is the Source Evaluation Society. Please use the following email address: qstiprogram@gmail.com. (2) Your exam score(s), per ASTM D7036-04, will be applicable for five years. You will need to retake your exam(s) before expiration in order to maintain a current status. You are responsible for keeping track of scheduling for your retest.

Please contact the SES QSTI Administrator at qstiprogram@gmail.com with any questions about the exams. All information regarding the QSTI/QSTO application process may be sent by email (which is the preferred and faster method) to the SES QSTI Administrator at qstiprogram@gmail.com, or mail your application to:

Source Evaluation Society
P. O. Box 12124
Research Triangle Park, NC 27709-2124



SOURCE
EVALUATION
SOCIETY

Name: Joshua M Lord
SES ID: DO NOT DISPLAY - 1470947
Test Name: GROUP 3
Test Date: 1/22/2021

On behalf of the Source Evaluation Society, we are pleased to inform you that you achieved a passing score on the Group 3 - EPA Gaseous Pollutants Instrumental Methods and CEMS RATAs examination. The tables below show your overall score and performance in each content area of the exam.

Overall Test Results:

	Results
Your Score	40
Passing Score	40
Possible Score	50

Results By Domain:

Your performance in each content area or domain is based on small subsets of test questions and should be considered a rough estimate of your knowledge within each area.

Domain	Percent Correct
Fundamentals, test planning, test site preparation	75%
Method applicability and specifications, pollutants measured, interferences	75%
Sampling equipment and CEMS preparation, calibration, operating procedures	83%
Gas flow, emissions, and RATA calculations	83%

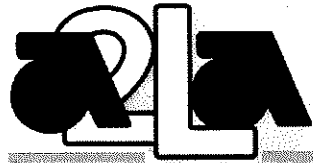
* Percent Correct is the number of items answered correctly in a domain divided by the total number of scored items within that domain.

You are now eligible to apply for the SES QSTI/QSTO qualification approval(s). Please check the SES Website (www.sesnews.org) under the link for the "SES QSTI/QSTO Program" for directions on how to apply for your certificate or contact the SES QSTI Administrator at qstiprogram@gmail.com.

NOTE: (1) The ECMPs AETB reporting requirements include a provision for an email address to be noted for the exam provider. Your exam provider is the Source Evaluation Society. Please use the following email address: qstiprogram@gmail.com. (2) Your exam score(s), per ASTM D7036-04, will be applicable for five years. You will need to retake your exam(s) before expiration in order to maintain a current status. You are responsible for keeping track of scheduling for your retest.

Please contact the SES QSTI Administrator at qstiprogram@gmail.com with any questions about the exams. All information regarding the QSTI/QSTO application process may be sent by email (which is the preferred and faster method) to the SES QSTI Administrator at qstiprogram@gmail.com, or mail your application to:

Source Evaluation Society
P. O. Box 12124
Research Triangle Park, NC 27709-2124



American Association for Laboratory Accreditation

Accredited Air Emission Testing Body

A2LA has accredited

CLEAN AIR ENGINEERING

In recognition of the successful completion of the joint A2LA and Stack Testing Accreditation Council (STAC) evaluation process, this laboratory is accredited to perform testing activities in compliance with ASTM D7036:2004 - Standard Practice for Competence of Air Emission Testing Bodies.



Presented this 5th day of January 2021,

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4342.02
Valid to October 31, 2022

This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

CLEAN AIR ENGINEERING
500 West Wood Street
Palatine, IL 60067
Mr. Scott Brown Phone: 847-654-4544
sbrown@cleanair.com

ENVIRONMENTAL^{1,2}

Valid To: October 31, 2022

Certificate Number: 4342.01

In recognition of the successful completion of the A2LA evaluation process (including an evaluation of the laboratory's compliance with ISO/IEC 17025:2005 and the NELAC Institute Field Sampling and Measurement Organization Volume 1 (TNI FSMO V1 2007, Rev 2.0), accreditation is granted to this organization to perform recognized methods using the following sampling and measurement technologies:

FSMO Type: Commercial

Mobile Units: Mobile Trailer Units

Sampling:

<u>Matrix</u>	<u>Technology(ies)</u>	<u>Methods</u>
Air	Absorption in Impinger Solution	EPA Methods 6, 6B, 7C, 7D, 8, 12, 13A, 13B, 14, 14A, 15, 15A, 16, 16A, 23, 26, 26A, 29, 101, 101A, 102, 104, 106, 202, 306, 316; Conditional Test Methods 013, 027; SW-846 Methods 0011, 0023A, 0030, 0031, 0050, 0051, 0060, 0061; CARB Methods 425, 426, 428, 429, 430, 431; ASTM D6735-01, D6831-02; NCASI Method 8A, ISS/FP-A105.01; Other Test Method (OTM) 029
Air	Absorption in Sorbent Trap	EPA 30B, PS12A, PS12B
Air	Absorption in Sorbent Trap and Impinger Solution	NCASI Methods: CI/SG/Pulp-94.02; SI/CG/Pulp 94.03
Air	Filter	EPA Methods 5, 5A, 5B, 5D, 5E, 5F, 5H, 5I, 12, 13B, 14, 14A, 17, 23, 29, PS11, 101, 101A, 102, 104, 106, 201, 201A, 306, 316; Conditional Test Methods 013; SW-846 Methods, 0010, 0011, 0023A, 0060, 0061; CARB Methods 425, 426, 428, 429, 430, 501; ASTM D6784-02, D6831-02; Other Test Method (OTM) 029
Air	Tedlar Bags or Stainless Canisters	EPA 18, 25, 10B, 106

Measurement:

<u>Matrix</u>	<u>Test</u>	<u>Technology(ies)</u>	<u>Methods</u>
Air	Air Flow	Pitot tube	EPA 1, 1A, 2,2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, PS6, Part 75 CEMS
Air	Continuous Emissions	Electromagnetic, Infrared, Ultraviolet, Non-Dispersive Infrared, Fluorescence, FTIR, Chemiluminescence	EPA 3A, 6C, 7E, 10, 10A, 10B, 20, 30A, PS2, PS3, PS4, PS4A, PS7, PS16, PS18, 205, Part 75 CEMS; Conditional Test Method 0030
Air	Continuous Emissions (FTIR)	FTIR	EPA 318, 320, 321, PS15; ASTM D6348-03
Air	Continuous Emissions (VOCs)	Flame Ionization Detection	EPA 25A, 25B, 25C, 25D, 25E, 204, B, 204C, 204D, PS8
Air	Continuous Emissions in conjunction with an Absorbing Solution	Infrared, Ultraviolet, Non-Dispersive Infrared, Fluorescence	EPA 16C, PS5
Air	Correction Factor	Calculation	EPA 3B
Air	Moisture Content	N/A	EPA 4, 6A, 320; Psychrometric Moisture; Part 75 CEMS
Air	Molecular Weight	N/A	EPA 3
Air	Verification of Temporary or Permanent Enclosure	N/A	EPA 204, 204B
Air	Visual and Fugitive Emissions	N/A	EPA 9, 22, PS 1

Field Analysis/Testing:

<u>Matrix</u>	<u>Technology</u>	<u>Analyte(s)</u>
Air	Gas Chromatography	TRS, Gaseous Organic Compounds, Performance Spec. 9, EPA 18, 106
Air	Ion Chromatography	HCl, Cl ₂ , HF, F ₂ , HBr, Br ₂ , SO ₄ , NH ₃ , NO ₂ , NO ₃ , PO ₄ , Li, Ma, K, Mg, Ca
Air	Ion Specific Electrode	NH ₃
Air	Ohio Lumex (Thermal Atomic Absorption)	Hg

¹All sampling and analysis is performed in the field.

Location 2:
110 Technology Drive
Pittsburgh, PA 15275-1004

Location 3:
13720 24th Washington Street East
Units 102 and 109. Building E
Sumner, WA 98390



² Mobile Lab Units:

Mobile Lab VINs:

1WC200G2811097523

1WC200G2811097148

1WC200G2841107312

1WC200G2641107311

1WC200G2441109073

1WC200J2381120774

1WC200G2611097147

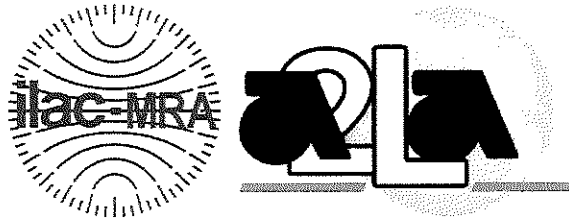
1wc200j2791124568

1WC200G291114451

5NHUAMV249V327844

1WC200J20C1192704





Accredited Laboratory

A2LA has accredited

CLEAN AIR ENGINEERING

Palatine, IL

for technical competence in the field of

Environmental Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of R219 - *Specific Requirements - TNI Field Sampling and Measurement Organization Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 5th day of January 2021,

A handwritten signature in black ink, appearing to be 'A. ...', written over a horizontal line.

Vice President, Accreditation Services

For the Accreditation Council

Certificate Number 4342.01

Valid to October 31, 2022

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

